Office of
Fissile Materials Disposition

United States Department of Energy

Surplus Plutonium Disposition Draft Environmental Impact Statement

Volume I - Part A

July 1998

For Further Information Contact:
U.S. Department of Energy
Office of Fissile Materials Disposition, P.O. Box 23786, Washington, DC 20026-3786

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Office of Fissile Materials Disposition
United States Department of Energy
P. O. Box 23786
Washington, DC 20026-3786

Attention: Surplus Plutonium Disposition
Draft Environmental Impact Statement

Printed with soy ink on recycled paper.

Department of Energy
Washington, DC 20585

Dear Interested Party:

The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) is enclosed for your information and review.

This draft SPD EIS identifies reasonable alternatives and potential environmental impacts for the proposed siting, construction, and operation of three facilities for plutonium disposition. The first is a facility to disassemble and convert pits (a nuclear weapons component) into plutonium oxide suitable for disposition. This pit disassembly and conversion facility will be located at either DOE's Hanford Site, Idaho National Engineering and Environmental Laboratory (INEEL), Pantex Plant, or Savannah River Site (SRS) with SRS and Pantex designated as preferred sites. The second is a facility to immobilize surplus plutonium for disposal in a geologic repository. This second facility will be located at either Hanford or SRS, and includes a collocated capability to convert non-pit plutonium materials into a form suitable for immobilization. SRS has been designated as the preferred site. The third is a facility to fabricate plutonium oxide into mixed oxide (MOX) fuel. This MOX fuel fabrication facility would be located at either Hanford, INEEL, Pantex or SRS and the MOX fuel would be used in existing commercial light water reactors in the United States. SRS has been designated as the preferred site for the MOX fuel fabrication facility. The EIS also discusses decommissioning and decontamination of the three facilities. The SPD EIS analyzes these alternatives and the No Action Alternative, in which no disposition would occur.

The public comment period for this draft EIS will begin on July 17, 1998 and will close on September 16, 1998. As part of the review process and to receive comments on the draft EIS, the Department will hold five public meetings from August 4, 1998 to August 20, 1998. You are invited to participate in any of these meetings. Specific meeting dates, times, locations, preregistration, and other information may be obtained by calling 1-800-820-5134. You should also call this number with any questions regarding the draft EIS or to learn about the program's website: *www.doe.md.com*.

In addition, you may submit written comments to: Department of Energy, Office of Fissile Materials Disposition, P.O. Box 23786, Washington, D.C. 20026-3786. Comments may also be submitted orally (to a recording machine) or by fax by calling 1-800-820-5156. Thank you for your interest in the fissile materials disposition program.

Sincerely,

Howard R. Canter

Howard R. Canter
Acting Director
Office of Fissile Materials Disposition

Enclosure

Cover Sheet

Responsible Agency: United States Department of Energy (DOE)

Title: *Surplus Plutonium Disposition Draft Environmental Impact Statement* (SPD EIS) (DOE/EIS-0283-D)

Locations of Candidate Sites: California, Idaho, New Mexico, South Carolina, Texas, and Washington

Contacts:

For further information on the SPD EIS contact:

Mr. G. Bert Stevenson, NEPA Compliance Officer
Office of Fissile Materials Disposition
U.S. Department of Energy
P.O. Box 23786
Washington, DC 20026-3786
Voice: (202) 586–5368

For further information on the DOE National Environmental Policy Act (NEPA) process contact:

Ms. Carol Borgstrom, Director
Office of NEPA Policy and Assistance
Office of Environment, Safety and Health
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585
Voice: (202) 586–4600 or (800) 472–2756

Abstract: On May 22, 1997, DOE published a Notice of Intent (NOI) in the Federal Register (62 Federal Register 28009) announcing its decision to prepare an environmental impact statement (EIS) that would tier from the analysis and decisions reached in connection with the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS (Storage and Disposition PEIS)*. DOE's disposition strategy allows for both the immobilization of surplus plutonium and its use as mixed oxide (MOX) fuel in existing domestic, commercial reactors. The disposition of surplus plutonium would also involve disposal of the immobilized plutonium and MOX fuel (as spent nuclear fuel) in a geologic repository.

The *Surplus Plutonium Disposition Environmental Impact Statement* analyzes alternatives that would use the immobilization approach (for some of the surplus plutonium) and the MOX fuel approach (for some of the surplus plutonium); alternatives that would immobilize all of the surplus plutonium; and the No Action Alternative. The alternatives include three disposition facilities that would be designed so that they could collectively accomplish disposition of up to 50 metric tons (55 tons) of surplus plutonium over their operating lives: 1. The pit disassembly and conversion facility would disassemble pits (a weapons component) and convert the recovered plutonium, as well as plutonium metal from other sources, into plutonium dioxide suitable for disposition. 2. The immobilization facility would include a collocated capability for converting nonpit plutonium materials into plutonium dioxide suitable for immobilization and would be located at either Hanford or SRS. DOE has identified SRS as the preferred site for an immobilization facility. 3. The MOX fuel fabrication facility would fabricate plutonium dioxide into MOX fuel.

Public Involvement: Comments on the SPD Draft EIS may be submitted: by mail to DOE, Office of Fissile Materials Disposition, c/o SPD EIS, P.O. Box 23786, Washington, DC 20026–3786; by calling DOE at 1–800–820–5156; or by sending a facsimile (fax) message to DOE at 1–800–820–5156. To ensure consideration in the SPD Final EIS, these comments should be submitted within 60 days after the U.S. Environmental Protection Agency Notice of Availability is published in the Federal Register. Comments received after the end of the comment period will be considered to the extent possible. Public meetings will be held on the dates and times specified in a DOE Federal Register notice and announced in local media. Comments on the SPD Draft EIS can also be submitted at these meetings. Preregistration for the public meetings is available by calling 1–800–820–5134 or by fax at 1–800–820–5156. Additional information can be obtained by calling the contacts listed above, or by visiting the Office of Fissile Materials Disposition web site at http://www.doe-md.com.

DOE/EIS-0283-D

Surplus Plutonium Disposition Draft Environmental Impact Statement

Volume I - Part A

United States Department of Energy
Office of Fissile Materials Disposition

July 1998

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List of Acronyms

AEA	Atomic Energy Act of 1954
AECL	Atomic Energy of Canada Limited
AIRFA	American Indian Religious Freedom Act
ALARA	as low as is reasonably achievable
ANL–W	Argonne National Laboratory–West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARF	airborne release fraction
BEA	Bureau of Economic Analysis
BEIR–V	Report V of the Committee on the Biological Effects of Ionizing Radiations
BIO	Basis for Interim Operation
BLM	Bureau of Land Management
BWR	boiling water reactor
CAA	Clean Air Act
CANDU	Canadian Deuterium Uranium (reactors)
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CPP	Chemical Processing Plant
CWA	Clean Water Act of 1972, 1987
D&D	decontamination and decommissioning
DBA	design-basis accident
DNFSB	Defense Nuclear Facilities Safety Board
DOC	U.S. Department of Commerce
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DR	damage ratio
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor (I or II)
EIS	environmental impact statement

EPA	U.S. Environmental Protection Agency
ES&H	environment, safety, and health
ETB	Engineering Test Bay
FAA	U.S. Federal Aviation Administration
FDP	fluorinel dissolution process
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFF	Uranium Fuel Fabrication Facility
FFTF	Fast Flux Test Facility
FI	field investigation
FM	Farm-to-Market (road)
FMF	Fuel Manufacturing Facility
FMEA	failure modes and effects analysis
FMEF	Fuels and Materials Examination Facility
FONSI	finding of no significant impact
FPF	Fuel Processing Facility
FPPA	Farmland Protection Policy Act
GDP	gaseous diffusion plant
GE	General Electric Company
GENII	Generation II, Hanford Environmental Radiation Dosimetry Software System
GPS	global positioning satellite
HE	high explosive
HEPA	high-efficiency particulate air (filter)
HEU	highly enriched uranium
HFEF	Hot Fuel Examination Facility
HIGHWAY	(computer code: distances and populations along U.S. highways)
HLW	high-level waste
HLWVF	high-level-waste vitrification facility
HWTPF	Hazardous Waste Treatment and Processing Facility
HYDOX	hydride oxidation
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission on Radiological Protection
ID DHW	Idaho Department of Health and Welfare
INEEL	Idaho National Engineering and Environmental Laboratory
INRAD	Intrinsic Radiation

INTEC	Idaho Nuclear Technology and Engineering Center
ISC3	Industrial Source Complex Model, Version 3
ISCST3	Industrial Source Complex Model, Short-Term, Version 3
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LDR	Land Disposal Restrictions
LEU	low-enriched uranium
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LPF	leak path factor
LWR	light-water reactor
M&H	Mason & Hanger Corporation
MACCS2	Melcor Accident Consequence Code System (computer code)
MAR	material at risk
MEI	maximally exposed individual
MMI	Modified Mercalli Intensity
MOX	mixed oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NCRP	National Council on Radiation Protection and Measurements
NDA	nondestructive analysis
NEPA	National Environmental Policy Act of 1969
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPH	natural phenomena hazard
NPS	U.S. National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRU	National Research Universal
NTS	Nevada Test Site
NWCF	New Waste Calcining Facility
NWS	National Weather Service

ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
ORNL	Oak Ridge National Laboratory
PBF	Power Burst Facility
PEIS	programmatic environmental impact statement
PFP	Plutonium Finishing Plant
PIE	postirradiation examination
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 microns
PNNL	Pacific Northwest National Laboratory
PRA	probabilistic risk assessment
PSD	prevention of significant deterioration
PUREX	Plutonium-Uranium Extraction (Facility)
PWR	pressurized water reactor
R&D	research and development
RADTRAN4	(computer code: risks and consequences of radiological materials transport)
RAMOD	Radioactive Materials Research, Operations, and Demonstration
RCRA	Resource Conservation and Recovery Act, as amended
REA	regional economic area
RF	respirable fraction
RfC	reference concentration
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System II (computer code)
RISKIND	(computer code: risks and consequences of radiological materials transport)
ROD	Record of Decision
ROI	region of influence
RMF	Radiation Measurements Facility
RWMC	Radioactive Waste Management Complex
S/A	Similarity of Appearance (provision of Endangered Species Act)
SAR	safety analysis report
SARA	Superfund Amendments and Reauthorization Act of 1986
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric & Gas Company
SCSHPO	South Carolina State Historic Preservation Officer
SDWA	Safe Drinking Water Act, as amended
SHPO	State Historic Preservation Officer

SMC	Specific Manufacturing Complex
SNF	spent nuclear fuel
SNM	special nuclear material
SPD	surplus plutonium disposition
SPD EIS	*Surplus Plutonium Disposition Environmental Impact Statement*
SPERT	Special Power Excursion Reactor Test
SRS	Savannah River Site
SST	safe, secure trailer
SWMU	solid waste management unit
SWP 1	Service Waste Percolation Pond 1
TA	Technical Area
TCE	trichloroethylene
TNRCC	Texas Natural Resource Conservation Commission
TPBAR-LTA	tritium-producing burnable absorber rod lead test assembly
TRU	transuranic
TRUPACT	TRU waste package transporter
TSCA	Toxic Substances Control Act
TSP	total suspended particulates
TWRS	tank waste remediation system
TWRS EIS	*Tank Waste Remediation System Final Environmental Impact Statement*
UC	Regents of the University of California
USACE	U.S. Army Corps of Engineers
USEC	United States Enrichment Corporation
USFWS	U.S. Fish and Wildlife Service
UV	ultraviolet
VOC	volatile organic compounds
VORTAC	Very High Frequency Omnidirection Radio Tactical Air Navigation Device
VRM	Visual Resource Management
WAG 3	Waste Area Grouping 3
WERF	Waste Experimental Reduction Facility
WIPP	Waste Isolation Pilot Plant
WM PEIS	*Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WNP–2	Washington Nuclear Plant–2

WPPSS	Washington Public Power Supply System
WROC	Waste Reduction Operations Complex
WSRC	Westinghouse Savannah River Company
ZPPR	Zero Power Physics Reactor

Chemicals and Units of Measure

μCi	microcurie
μg	microgram
μm	micrometer (micron)
46°26'07"	46 degrees, 26 minutes, 7 seconds
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
dB	decibel
dBA	decibel, A-weighted
ft	foot
ft^2	square foot
ft^3	cubic foot
g	gram
g	gravitational acceleration
gal	gallon
ha	hectare
hr	hour (in compound units)
in	inch
kg	kilogram
km	kilometer
km^2	square kilometers
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mg	milligram
mi	mile
min	minute
mph	miles per hour

mrem	millirem
MVA	megavolt-ampere
MW	megawatt
MWe	megawatt electric
MWh	megawatt-hour
N_2	nitrogen
nCi	nanocurie
NO_2	nitrogen dioxide
pCi	picocurie
person-rem	person-rem
$PM_{2.5}$	particulate matter less than or equal to 2.5 μm in diameter
PM_{10}	particulate matter less than or equal to 10 μm in diameter
rad	radiation absorbed dose
rem	roentgen equivalent man
s	second
SO_2	sulfur dioxide
t	metric ton
ton	short ton
UF_6	uranium hexafluoride
UO_2	uranium dioxide
yd	yard
yd^3	cubic yard
yr	year (in compound units)
°C	degrees Celsius (Centigrade)
°F	degrees Fahrenheit

Metric Conversion Chart

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

Metric Prefixes

Prefix	Symbol	Multiplication Factor
exa-	E	1 000 000 000 000 000 000 = 10^{18}
peta-	P	1 000 000 000 000 000 = 10^{15}
tera-	T	1 000 000 000 000 = 10^{12}
giga-	G	1 000 000 000 = 10^{9}
mega-	M	1 000 000 = 10^{6}
kilo-	k	1 000 = 10^{3}
hecto-	h	100 = 10^{2}
deka-	da	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001= 10^{12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001= 10^{-18}

Next Section

Chapter 1
Background, Purpose of, and Need for the Proposed Action

1.1 BACKGROUND

In December 1996, the U.S. Department of Energy (DOE) published the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (*Storage and Disposition PEIS*) (DOE 1996a). This programmatic environmental impact statement (PEIS) analyzes the potential environmental consequences of alternative strategies for the long-term storage of weapons-usable plutonium and highly enriched uranium (HEU) and the disposition of weapons-usable plutonium that has been or may be declared surplus to national security needs.[1] The Record of Decision (ROD) for the *Storage and Disposition PEIS*, issued on January 14, 1997 (DOE 1997a), outlines DOE's decision to pursue a hybrid approach to plutonium disposition that would make surplus weapons-usable plutonium inaccessible and unattractive for weapons use. DOE's disposition strategy, consistent with the preferred alternative analyzed in the *Storage and Disposition PEIS*, allows for both the immobilization of some (and potentially all) of the surplus plutonium and use of some of the surplus plutonium as mixed oxide (MOX) fuel in existing domestic, commercial reactors. The disposition of surplus plutonium would also involve disposal of both the immobilized plutonium and the MOX fuel (as spent fuel) in a geologic repository.

On May 22, 1997, DOE published a Notice of Intent (NOI) in the Federal Register (FR) (DOE 1997b) announcing its decision to prepare an environmental impact statement (EIS) that would tier from the analysis and decisions reached in connection with the *Storage and Disposition PEIS*. This EIS, the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), addresses the extent to which each of the two plutonium disposition approaches (immobilization and MOX) would be implemented and analyzes candidate sites for plutonium disposition facilities,[2] as well as alternative technologies for immobilization.

This SPD EIS analyzes a nominal 50 metric tons (t) (55 tons) of surplus weapons-usable plutonium, which is primarily in the form of pits, metal, and oxides.[3] In addition to 38.2 t (42 tons) of weapons-grade plutonium already declared by the President as excess to national security needs, the material analyzed includes weapons-grade plutonium that may be declared surplus in the future, as well as weapons-usable, reactor-grade plutonium that is surplus to the programmatic and national defense needs of DOE.

As depicted in Figure 1–1, there are six locations of surplus plutonium within the DOE complex: the Hanford Site (Hanford) near Richland, Washington; Idaho National Engineering and Environmental Laboratory (INEEL) near Idaho Falls, Idaho; Los Alamos National Laboratory (LANL) near Los Alamos, New Mexico; the Pantex Plant (Pantex) near Amarillo, Texas; the Rocky Flats Environmental Technology Site (RFETS) near Golden, Colorado; and the Savannah River Site (SRS) near Aiken, South Carolina.

Under the hybrid alternatives, about 34 percent of the surplus plutonium analyzed in this SPD EIS is not suitable for fabrication into MOX fuel due to the technology, complexity, timing, and cost that would be involved in purifying the material. The *Storage and Disposition PEIS* ROD determined that DOE would

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[1] DOE addresses the disposition of surplus HEU in a separate environmental impact statement, the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE 1996b) issued in June 1996, with the ROD (DOE 1996c) issued in July 1996.

[2] This SPD EIS also analyzes a No Action Alternative, i.e., the possibility of disposition not occurring and instead continued storage of surplus plutonium in accordance with the *Storage and Disposition PEIS* ROD.

[3] Some materials are already in a final disposition form (i.e., irradiated fuel) and will not require further action before disposal. These materials, therefore, are not included in the 50 t (55 tons) analyzed in this SPD EIS.

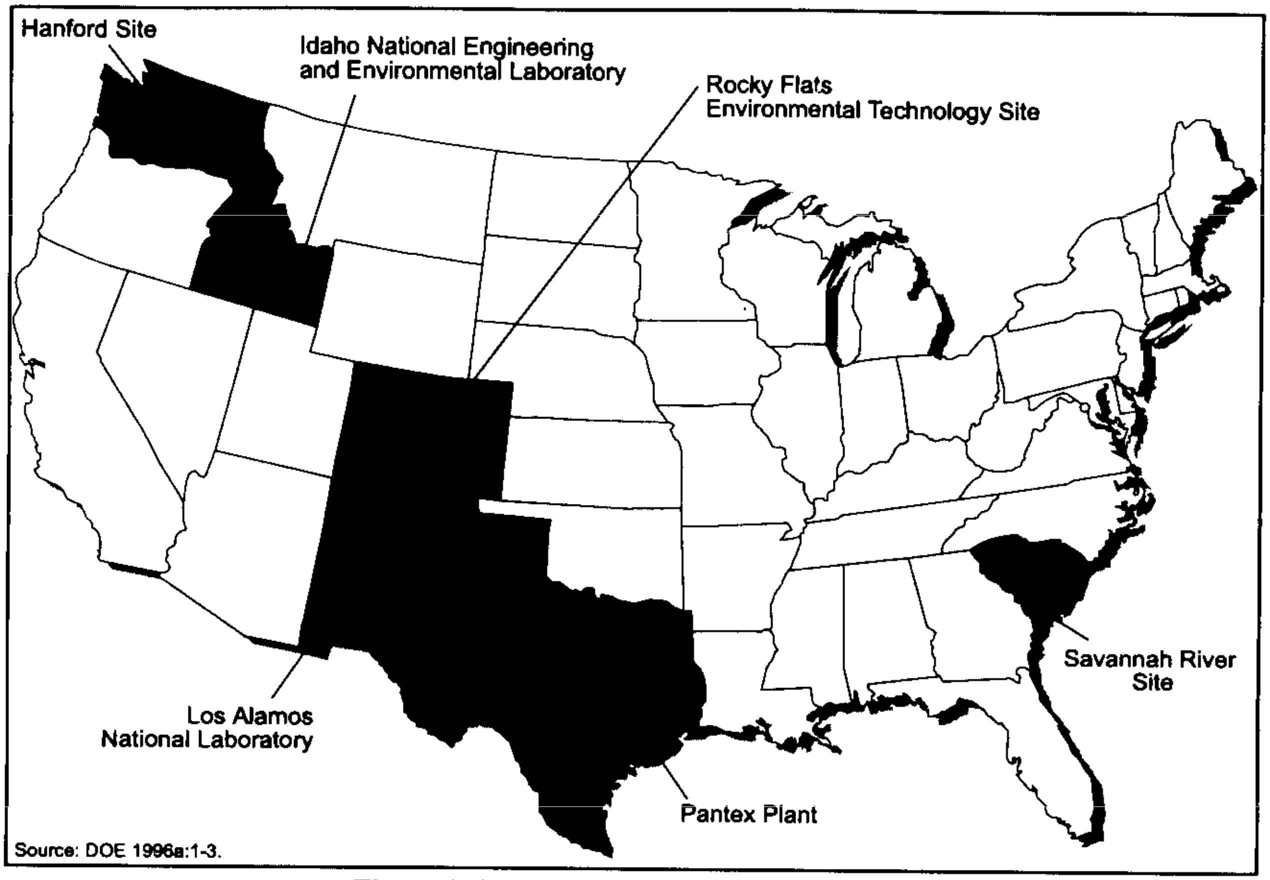

Figure 1–1. Locations of Surplus Plutonium

immobilize at least 8 t (9 tons) of the current surplus plutonium. Since issuance of the ROD, further consideration has indicated that 17 t (19 tons) of the surplus plutonium is not suitable for use in MOX fuel and should be immobilized. Therefore, fabricating all 50 t (55 tons) of surplus plutonium into MOX fuel is not a reasonable alternative and is not analyzed. This SPD EIS does, however, analyze the immobilization of all the surplus plutonium. (See Section 2.3.2.2 for a discussion on the amounts of materials subject to disposition.) Given the variability in purity of the surplus plutonium to be dispositioned, some of the plutonium currently considered for MOX fabrication may also need to be immobilized. The incremental impacts that would be associated with a small shift in materials throughput are discussed in Section 4.30.

As part of its plutonium disposition strategy, DOE reserves the option to use some of the surplus plutonium as MOX fuel in Canadian Deuterium Uranium (CANDU) reactors. This option would only be undertaken in the event that a multilateral agreement were negotiated among Russia, Canada, and the United States. Because this option is under consideration, DOE, in cooperation with Canada and Russia, may participate in a proposed test and demonstration program using U.S. MOX fuel in a Canadian test reactor.[4]

[4] A separate environmental review, the *Parallex Project Fuel Manufacture and Shipment Environmental Assessment* (DOE 1997c) (preapproval draft issued August 1997), analyzes the fabrication and proposed shipment of MOX fuel rods for research and development activities involving the use of limited amounts of U.S. MOX fuel in a Canadian test reactor.

1.2 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The purpose of and need for the proposed action is to reduce the threat of nuclear weapons proliferation worldwide by conducting disposition of surplus plutonium in the United States in an environmentally safe and timely manner. Comprehensive disposition actions are needed to ensure that surplus plutonium is converted to proliferation-resistant forms. In September 1993, President Clinton issued the *Nonproliferation and Export Control Policy* (White House 1993) in response to the growing threat of nuclear proliferation. Further, in January 1994, President Clinton and Russia's President Yeltsin issued a *Joint Statement by the President of the Russian Federation and the President of the United States of America on Non-proliferation of Weapons of Mass Destruction and the Means of Their Delivery* (White House 1994). In accordance with these policies, the focus of the U.S. nonproliferation efforts includes ensuring the safe, secure, long-term storage and disposition of surplus weapons-usable fissile plutonium. The disposition activities proposed in this SPD EIS will enhance U.S. credibility and flexibility in negotiations on bilateral and multilateral reductions of surplus weapons-usable fissile materials inventories. Actions undertaken by the United States would generally be coordinated with efforts to address surplus plutonium stocks in the Russian Federation. For example, the construction of new facilities for disposition of U.S. plutonium will likely depend on progress in Russia. However, the United States will retain the option to begin certain disposition activities, when appropriate, in order to encourage the Russians and set an international example.

This SPD EIS addresses both the immobilization and MOX fuel approaches to surplus plutonium disposition, which include siting, construction, operation, and ultimate decontamination and decommissioning (D&D) of three types of facilities at one or two of four DOE candidate sites:

- A facility for disassembling pits (a weapons component) and converting the recovered plutonium, as well as plutonium metal from other sources, into plutonium dioxide suitable for disposition. This facility, the pit disassembly and conversion facility, is referred to in this document as the *pit conversion facility*. Candidate sites for this facility are Hanford, INEEL, Pantex, and SRS.

- A facility for immobilizing surplus plutonium for eventual disposal in a geologic repository pursuant to the Nuclear Waste Policy Act, the plutonium conversion and immobilization facility, is referred to as the *immobilization facility*. This facility would include a collocated capability for converting nonpit plutonium materials into plutonium dioxide suitable for immobilization. The immobilization facility would be located at either Hanford or SRS. DOE identified SRS as the preferred site for an immobilization facility in the *Storage and Disposition PEIS* ROD. Technologies for immobilization are also discussed in this SPD EIS.

- A facility for fabricating plutonium dioxide into MOX fuel, the MOX fuel fabrication facility, is referred to as the *MOX facility*. Candidate sites for this facility are Hanford, INEEL, Pantex, and SRS. Also included in this SPD EIS is a separate analysis of MOX lead assembly[5] activities at five DOE candidate sites: Argonne National Laboratory–West (ANL–W) at INEEL; Hanford; Lawrence Livermore National Laboratory (LLNL) in Livermore, California; LANL; and SRS. DOE would fabricate a limited number of MOX fuel assemblies, referred to as lead assemblies, for testing in reactors before commencing fuel irradiation under the proposed MOX fuel program.

This SPD EIS also analyzes a No Action Alternative, as required by the National Environmental Policy Act (NEPA). In the No Action Alternative, surplus weapons-usable plutonium in storage at various DOE sites would remain at those locations. The vast majority of pits and plutonium metal would continue to be stored

[5] A MOX lead assembly is a prototype reactor fuel assembly that contains MOX fuel.

at Pantex, and the remaining plutonium in various forms would continue to be stored at Hanford, INEEL, LANL, RFETS, and SRS.

1.3 DECISIONS TO BE MADE

DOE will base the following decisions on the analytical results of this SPD EIS and other cost, schedule, and nonproliferation considerations:

- Whether to construct and operate a pit conversion facility, and if so, where.
- Whether to construct and operate an immobilization facility, and if so, where (including selection of a technology for immobilization and the amount of plutonium to be immobilized).
- Whether to construct and operate a MOX facility, and if so, where (including separate selection of a site for fabrication of lead assemblies and the amount of plutonium to be fabricated into MOX fuel).

1.4 ISSUES IDENTIFIED DURING THE SCOPING PERIOD

In mid-1997, DOE conducted a public scoping process to solicit comments on its NOI concerning the disposition of surplus plutonium. Written comments were requested from the public via U.S. mail, fax, and Web site, and oral comments were collected via telephone and at four public scoping meetings. During June and July 1997, about 580 people attended the scoping meetings held near the candidate sites for disposition facilities. The specific locations of the meetings were Idaho Falls, Idaho (near INEEL); Amarillo, Texas (near Pantex); North Augusta, South Carolina (near SRS); and Richland, Washington (near Hanford). These meetings were designed to provide a forum in which participants could discuss issues directly with DOE program officials, and DOE could solicit relevant input from affected or interested local and regional stakeholders. The meetings were conducted in a workshop format, providing stakeholders with numerous opportunities to learn about the issues and express their comments and concerns. Each workshop consisted of a short plenary session, followed by discussion groups and summarizing remarks. The comments provided at the scoping meetings were documented and used in the development of this SPD EIS.

A database was created to track written and oral comments received during the scoping process. More than 1,400 individual documents, culminating in 2,000 comments, were received and recorded in the database. An analysis was conducted of the comments received during the scoping process. They were initially grouped in the following seven areas: *proposed action, alternatives, facilities/technologies, impact, costs, public involvement*, and *other*. Comments were further categorized into four major groups according to their relationship to the scope of this SPD EIS: *already intended for inclusion in this SPD EIS, needs to be addressed in this SPD EIS, needs to be or is already addressed elsewhere*, and *other*. The following summary describes some of the major issues identified during the scoping process.

Issues Already Intended for Inclusion in This SPD EIS. Many comments received during the scoping process concern issues that were already intended to be included in this SPD EIS. For example, many commentors expressed concern over the potential environmental impacts of the various technologies at the candidate sites and requested that an in-depth analysis be conducted to determine the potential impacts. A concern was also expressed that making can-in-canister the preferred immobilization technology without an evaluation of alternative technologies circumvents the NEPA process. Other commentors recommended that this SPD EIS include a detailed accounting of the wastes that will be generated and the location of their ultimate disposal. A number of commentors were concerned that existing legal agreements with State governments and other agencies (e.g., triparty agreements) would be overlooked and possibly ignored. Other commentors addressed the quantity of plutonium to be immobilized or fabricated into MOX fuel. DOE is addressing all of these issues in this SPD EIS.

Additional Issues That Need to Be Addressed in This SPD EIS. A few commentors suggested that additional issues be considered in this SPD EIS. These issues include the relationship of plutonium disposition and tritium production, and use of the Fast Flux Test Facility (FFTF) at Hanford solely for surplus plutonium disposition. Appendix D was added to this SPD EIS to address FFTF issues. Some commentors suggested that Pantex be considered as a candidate site for the pit conversion facility under all situations, including the 50-t (55-ton) immobilization option, because most of the surplus pits are currently located there. In response to these comments, DOE added three new alternatives for the option of immobilizing all 50 t (55 tons) of surplus plutonium. Initially, the alternatives included siting both the pit conversion and immobilization facilities at only one site (i.e., Hanford or SRS). The three new alternatives include Pantex as a candidate site for the pit conversion facility.

Issues That Need to Be or Are Already Addressed Elsewhere. Many comments received during the scoping process concern issues that are not within the scope of this SPD EIS but are being or will be addressed elsewhere. For example, a question was raised as to the role of the U.S. Nuclear Regulatory Commission (NRC) licensing requirements in regard to plutonium disposition facilities. Suggestions were made to include NRC processes in the SPD EIS. The NRC will be a "commenting" agency on the SPD EIS. DOE will provide copies of the draft and final SPD EIS to NRC for review and comment. In addition, an NRC license would be sought for the MOX facility. Domestic, commercial reactors operate under NRC licenses, and their proposed use of MOX fuel would be subject to review by NRC.

Some questions and concerns were also raised about MOX fuel fabrication and reactor irradiation services procurement, a process outside of the scope of this SPD EIS but related to the overall plutonium disposition program (see Section 2.1.3 for further discussion of the procurement process). Many commentors suggested that DOE, in either this SPD EIS or other program studies, analyze the total cost of each alternative, including facility construction and modification, operations, and D&D, as well as all related site infrastructure costs. DOE has prepared a separate cost study (DOE 1998a) that will be considered, along with this SPD EIS analysis, in the decisionmaking process. Some commentors suggested that the potential impacts of the disposal of spent nuclear fuel generated by MOX fuel use be included in this SPD EIS. This issue has already been addressed in the *Storage and Disposition PEIS* and disposal of spent nuclear fuel will be addressed in the *Environmental Impact Statement for Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE, in preparation).[6]

Other. Many of the comments received were expressions of opinion or comments not directly related to issues addressed in this SPD EIS. For example, opposition was expressed by both U.S. and Canadian citizens to using CANDU reactors. Similarly, a number of commentors expressed their support for or opposition to immobilization and MOX technologies. Others expressed support for specific facilities or questioned the viability of site-specific facilities for pit conversion, immobilization, or MOX fuel fabrication. A number of commentors expressed their concern over the market viability of alternative reactor fuels, even though MOX fuel would not be sold on the open market. Some commentors expressed their support for a hybrid disposition approach using both immobilization and MOX fuel fabrication.

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[6] For purposes of this SPD EIS, a geologic repository candidate site at Yucca Mountain, Nevada, was assumed to be the final disposal site for all immobilized plutonium and spent fuel. Currently, Yucca Mountain is the only site being characterized as a geologic repository. DOE is preparing a separate EIS, *Environmental Impact Statement for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* to analyze the site-specific environmental impacts from construction, operation, and eventual closure of a potential geologic repository at Yucca Mountain.

1.5 SCOPE OF THIS SPD EIS

Site-specific issues associated with siting, construction, and operation of the three disposition facilities are analyzed in this SPD EIS. The three facilities would be designed so that they could collectively accomplish disposition of up to 50 t (55 tons) of surplus plutonium over their operating lives, as shown in Figure 1–2. When the missions of the plutonium disposition facilities are completed, deactivation and stabilization would be performed to reduce the risk of radiological exposure; reduce the need for and costs associated with long-term maintenance; and prepare the building for potential future use. (See Section 4.31 for a discussion on deactivation and stabilization.) At the end of the useful life of the facilities, DOE would evaluate options for D&D or reuse of the facilities. D&D of these facilities would not occur for many years. When DOE is ready for D&D of these facilities, an appropriate NEPA review will be conducted. This SPD EIS also analyzes transportation of the following: plutonium from storage locations to the pit conversion facility or the immobilization facility, depending on the material and the alternative; plutonium dioxide from the pit conversion facility to the MOX or immobilization facility; depleted uranium hexafluoride from a representative DOE site to a representative commercial conversion facility; uranium feed supply (uranium dioxide) from a representative commercial conversion facility to the MOX fabrication and/or immobilization facilities; MOX fuel to a commercial reactor; and immobilized plutonium to a geologic repository. In addition to the various disposition alternatives, a No Action Alternative is also analyzed. In this alternative, disposition would not occur, and surplus plutonium would remain in long-term storage in accordance with the storage approach identified in the *Storage and Disposition PEIS* ROD. For all alternatives analyzed in this SPD EIS, it is assumed that storage actions described in the *Storage and Disposition PEIS* ROD have been accomplished.[7]

Because this SPD EIS tiers from the analyses and decisions reached in association with the *Storage and Disposition PEIS*, analyses relevant to disposition options or candidate sites are incorporated by reference and summarized; they are not repeated here. A generic analysis of potential impacts at domestic, commercial reactors, from the *Storage and Disposition PEIS*, is summarized in Section 4.28 and included as part of the presentation of integrated MOX impacts in Section 2.18.3. Furthermore, as explained in Section 2.1.3, DOE will prepare and consider an environmental critique (a synopsis of which will be included in the SPD Final EIS) concerning, among other things, the environmental impacts of potentially using MOX fuel at the specific commercial reactors identified in response to DOE's *Request for Proposals for MOX Fuel Fabrication and Reactor Irradiation Services*. In addition, environmental impact analysis relating to specific reactors will be included in the SPD Final EIS.

The MOX fuel fabrication and ceramic immobilization processes require the use of uranium dioxide as a feed material, which can be obtained from either natural or depleted uranium. Because DOE has a large inventory of depleted uranium hexafluoride (the equivalent of 385,000 t [424,385 tons] of depleted uranium dioxide), this SPD EIS analyzes the use of a small amount of that inventory (about 145 t [160 tons] per year) to produce uranium dioxide (White 1997:1).[8] Depleted uranium hexafluoride is currently stored at three DOE sites: the East Tennessee Technology Park in Oak Ridge, Tennessee; the Paducah Gaseous Diffusion Plant near Paducah, Kentucky; and the Portsmouth Gaseous Diffusion Plant (Portsmouth) near Piketon, Ohio. For purposes of analysis in this SPD EIS, Portsmouth is used as a representative site for a source of depleted

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[7] Recent studies have indicated that cost savings could be realized from the transfer of nonpit materials from RFETS and Hanford to SRS earlier than specified in the *Storage and Disposition PEIS* ROD. A supplement analysis is being prepared to determine if a supplemental PEIS would be needed.

[8] The contractor chosen by DOE to conduct MOX fuel fabrication will have the option of acquiring uranium dioxide from another source.

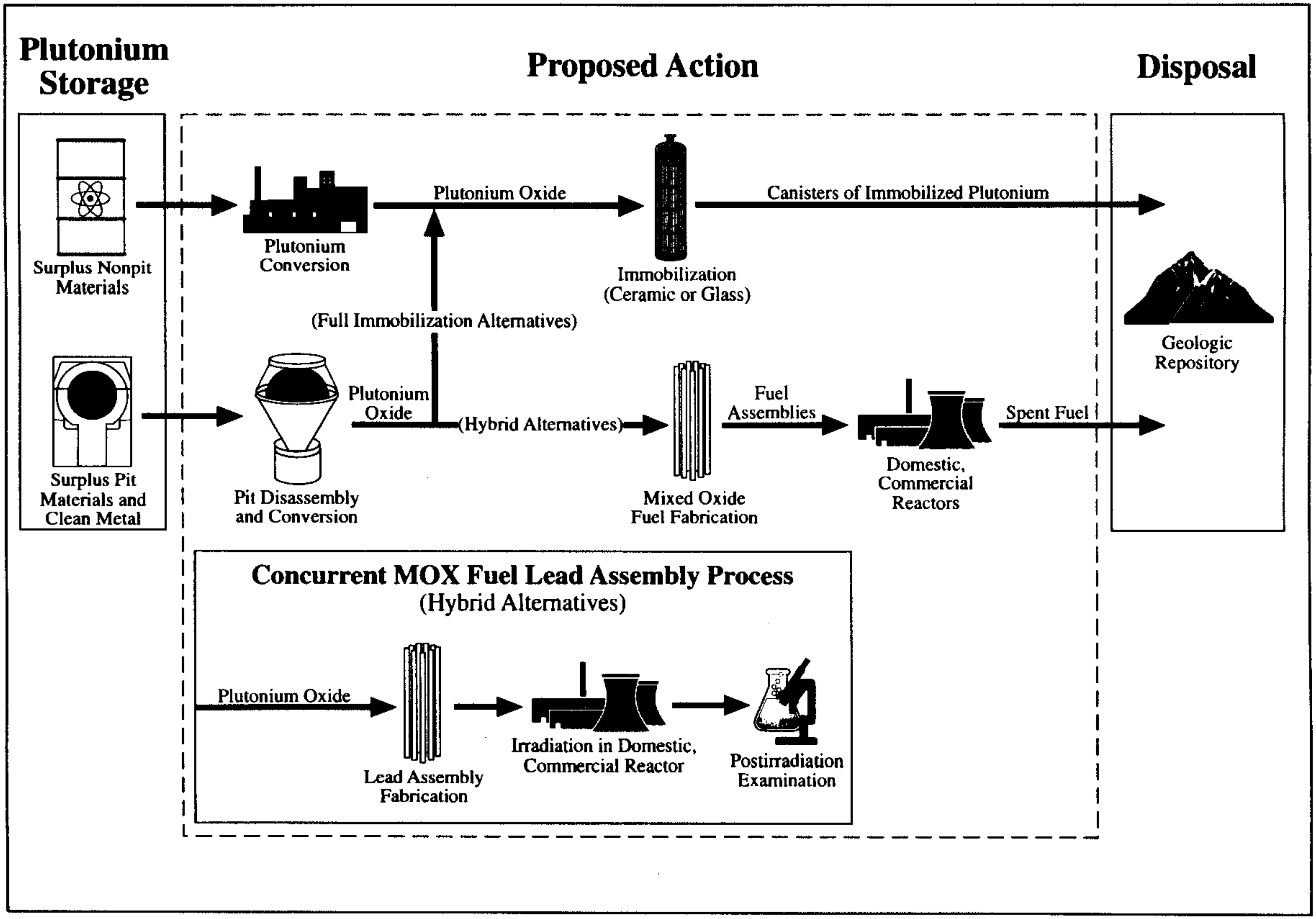

Figure 1–2. Proposed Plutonium Disposition Processes

uranium hexafluoride.[9] Included for evaluation in this SPD EIS are the activities necessary to package the depleted uranium hexafluoride for shipment to a representative commercial conversion facility (for purposes of analysis, this SPD EIS uses the General Electric Company's Nuclear Energy Production Facility in Wilmington, North Carolina) for conversion to uranium dioxide,[10] to transport the depleted uranium hexafluoride from Portsmouth to Wilmington, and to transport the uranium dioxide from Wilmington to the candidate MOX fuel fabrication and immobilization sites (i.e., Hanford, INEEL, Pantex, and SRS).

As part of the assessment of the MOX alternatives, this SPD EIS analyzes the fabrication of up to 10 lead assemblies that may be needed to support the MOX fuel program. Existing U.S. DOE facilities at five candidate sites are analyzed, as is the transportation of feed materials to the lead assembly fabrication sites and the fabricated lead assemblies to a domestic, commercial reactor for test irradiation. Postirradiation examination (PIE) may be required to support NRC licensing activities related to the use of MOX fuel in domestic, commercial reactors. This SPD EIS discusses PIE at two potential sites, ANL–W and Oak Ridge National Laboratory in Oak Ridge, Tennessee. These two sites are currently the only sites that possess the capability to conduct PIE activities without major modifications to facility and processing capabilities; only minor modifications for receipt of materials would be required. Other potential facilities, either within the DOE complex or in the commercial sector, would require significant modifications to meet expected requirements of PIE.

DOE's NOI announcing the preparation of this SPD EIS includes a table outlining 12 disposition alternatives. Each alternative identifies the facilities, new or existing, at each candidate site that would be analyzed in this SPD EIS. For clarity, variations of each alternative are presented in this SPD EIS as separate, discrete alternatives, thus increasing the number of alternatives. For example, alternatives that include locating the immobilization facility in a new structure at SRS are identified in this SPD EIS as separate from those locating it in the existing Building 221–F at the site. Since the publication of the NOI, DOE has further increased the number of alternatives for SPD EIS analysis: it has included a new MOX facility at Hanford, in addition to the alternative involving modifying the Fuels and Materials Examination Facility. For the option of immobilizing all 50 t (55 tons) of surplus plutonium, DOE has also included Pantex as a candidate site for pit disassembly and conversion activities, adding another three alternatives. Previously, only SRS and Hanford were considered as sites for pit disassembly and conversion activities for the 50-t (55-ton) case. There are now 23 alternatives presented as 11 sets of alternatives, plus the No Action Alternative. For a more detailed discussion of alternative development, see Section 2.3.

As indicated in the ROD for the *Storage and Disposition PEIS*, this SPD EIS analysis provides, in part, the basis for determining a specific immobilization technology. This SPD EIS analyzes in detail the proposed can-in-canister approach and compares the results with the impacts predicted in the *Storage and Disposition PEIS* for the homogenous immobilization approach in new ceramic immobilization and vitrification facilities. In addition, for the can-in-canister approach, this SPD EIS separately analyzes the effects of immobilizing plutonium into either a titanate-based ceramic material or a lanthanide borosilicate glass.

To further define the potential processes to be used for the disposition of surplus plutonium, several research and development (R&D) activities are ongoing. A discussion of these R&D activities is provided in the *Pit*

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9 Portsmouth Gaseous Diffusion Plant is used as a representative site because it is the only one of the three DOE sites that is currently capable of transferring the depleted uranium hexafluoride from the 12.7-t (14-ton) tails cylinders in which it is currently stored to the 2.28-t (2.5-ton) feed cylinders that are compatible with the processing equipment at a commercial facility (White 1997:5).

10 Possible sites for this conversion facility include nuclear fuel fabrication facilities in Missouri, North Carolina, South Carolina, Washington, or a uranium conversion facility in Illinois. For purposes of analysis in this SPD EIS, the commercial nuclear fuel fabrication facility in Wilmington, North Carolina, is used as a representative site.

Disassembly and Conversion Demonstration Environmental Assessment and Research and Development Activities (DOE 1998b) (preapproval draft issued in May 1998). Several of these R&D activities are likely to continue after the ROD for this SPD EIS is issued.

1.6 PREFERRED ALTERNATIVES

DOE's preferred alternative for the disposition of surplus weapons-usable plutonium is to disposition up to 50 t[11] (55 tons) of plutonium using a hybrid approach that uses both the ceramic can-in-canister immobilization approach and the MOX/reactor approach. Approximately 17 t (19 tons) would be immobilized in a ceramic form, placed in cans, and embedded in large canisters containing high-level vitrified waste for ultimate disposal in a geologic repository pursuant to the Nuclear Waste Policy Act. Approximately 33 t (36 tons) would be used to fabricate MOX fuel, which would be irradiated in existing, domestic, commercial reactors. The resulting spent fuel would be placed in a geologic repository pursuant to the Nuclear Waste Policy Act.

Pursuing the hybrid approach provides the best opportunity for U.S. leadership in working with Russia to implement similar options for reducing Russia's excess plutonium in parallel. Pursuing the hybrid approach also sends the strongest possible signal to the world of U.S. determination to reduce stockpiles of surplus weapons-usable plutonium, as quickly as possible, in an irreversible manner. The construction of new facilities for the disposition of surplus U.S. plutonium would not take place unless there is significant progress on plans for plutonium disposition in Russia.

DOE's preference for siting plutonium disposition facilities is as follows:

- **Immobilization at SRS (new construction and Defense Waste Processing Facility [DWPF]).** Construct and operate a new immobilization facility at SRS using the ceramic can-in-canister technology. This technology would immobilize plutonium in a ceramic form, seal it in cans, and place the cans in canisters filled with borosilicate glass containing intensely radioactive high-level waste (HLW) at the existing DWPF. This preferred can-in-canister approach at SRS complements existing missions, takes advantage of existing infrastructure and staff expertise, and enables DOE to use an existing facility (DWPF). SRS was previously designated the preferred site for immobilization in the NOI issued in May 1997. The ceramic can-in-canister approach would involve slightly lower environmental impacts than the homogenous approach. The ceramic can-in-canister approach would involve better performance in a geologic repository and provide greater proliferation resistance than the glass can-in-canister approach.

- **MOX Fuel Fabrication at SRS (new construction).** Construct and operate a new MOX facility at SRS and produce MOX fuel containing surplus weapons-usable plutonium for irradiation in existing, domestic, commercial reactors.[12] SRS is preferred for the MOX facility because this activity complements existing missions and takes advantage of existing infrastructure and staff expertise. Pantex does not offer a comparable infrastructure, including waste treatment. DOE has determined that Hanford's cleanup mission is critical, therefore DOE prefers that the cleanup mission remain the site's top priority and similarly, that INEEL should focus on cleanup and nuclear technology.

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[11] Some materials are already in a final disposition form (i.e., irradiated fuel) and will not require further action before disposal.

[12] Specific reactor sites have not been identified. The SPD Final EIS will include environmental impact analyses related to the specific reactors identified in response to DOE's *Request for Proposals for MOX Fuel Fabrication and Reactor Irradiation Services* (see Section 2.1.3).

- **Pit Disassembly and Conversion at SRS or Pantex.** Construct and operate a new pit conversion facility at SRS or Pantex for the purpose of disassembling nuclear weapons pits and converting the plutonium metal to a declassified oxide form suitable for international inspection and disposition using either immobilization or MOX/reactor approaches.

  The modest differences between SRS and Pantex do not justify selecting one of the two sites at this time. Both Pantex and SRS have complementary activities already located, or scheduled to be located, at these sites. Either of the other candidate sites, Hanford and INEEL, would require additional and otherwise unnecessary transportation. (Because the surplus pits are stored at Pantex and because SRS is the preferred location for the MOX facility, selection of either Hanford or INEEL for pit conversion would require shipments between Pantex and the selected pit conversion site, then subsequent shipments to SRS.) Moreover, a pit disassembly and conversion facility at either Hanford or INEEL would divert resources and management attention from the primary missions of those sites. Following consideration of public comments on the SPD Draft EIS, DOE will announce its preference for the location of this facility in the SPD Final EIS, scheduled for release in late 1998 or early 1999.

These preferred alternatives correspond to Alternatives 3A and 5A as presented in Table 2–1 and as described in this SPD EIS.

DOE does not, at this time, have a preference for the location where lead assemblies for MOX fuel qualification would be fabricated nor where postirradiation examination of these assemblies, if required, would be conducted. DOE would continue ongoing R&D efforts concerning disposition of surplus weapons-usable plutonium as discussed in the *Storage and Disposition PEIS*, this SPD EIS, and the *Pit Disassembly and Conversion Demonstration Environmental Assessment and Research and Development Activities*.

1.7 RELATIONSHIP TO OTHER ACTIONS AND PROGRAMS

The proposed plutonium disposition actions would be coordinated with other ongoing DOE programs. For example, waste generated by the construction and operation of the proposed facilities would be managed in accordance with decisions made pursuant to the RODs issued for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*. Similarly, material treatment or stabilization activities at DOE sites could yield weapons-usable fissile materials that would be dispositioned according to decisions made based on the analysis in this SPD EIS. Also, unrelated actions proposed for the sites under consideration in this SPD EIS could have impacts at these sites. These impacts are considered in the cumulative impact assessment in Section 4.32. Provided in the following sections are brief summaries of the documents issued for such actions or programs.

1.7.1 Materials and Disposition Options

The *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE/EIS-0229, December 1996) analyzes the environmental impacts of alternatives considered for the long-term storage of weapons-usable fissile materials (HEU and plutonium) and for the disposition of weapons-usable plutonium that has been declared surplus to national security needs. The ROD (January 1997) encompasses two categories of plutonium decisions: (1) the sites and facilities for the storage of nonsurplus plutonium and the storage of surplus plutonium pending disposition, and (2) the programmatic strategy for disposition of surplus plutonium. This ROD does not include the final selection of sites for plutonium disposition facilities or the extent to which the two plutonium disposition approaches (immobilization and MOX) will be ultimately implemented. (Those decisions will be based in part on the analysis in this tiered SPD EIS.) However, DOE does announce in the ROD that the list of candidate sites for plutonium disposition has been narrowed. It also announces the decision to store surplus and nonsurplus HEU in upgraded facilities at the Oak Ridge Reservation. Recent DOE studies have indicated that significant cost savings could be realized from the transfer of nonpit materials from RFETS and Hanford earlier than indicated in the *Storage and Disposition PEIS* ROD. A supplement analysis[13] is being prepared to determine if a supplemental PEIS would be needed.

The *Pit Disassembly and Conversion Demonstration Environmental Assessment and Research and Development Activities* (DOE/EA-1207, May 8, preapproval draft) analyzes a proposed demonstration project at LANL to determine the feasibility of an integrated pit disassembly and conversion system as part of the surplus plutonium disposition strategy. This demonstration would involve the disassembly of up to 250 pits and conversion of the recovered plutonium to plutonium metal ingots and plutonium oxide. If approved, the demonstration would start sometime during the summer of 1998 and last up to 4 years. The results of the demonstration would help "fine-tune" the operational parameters of the pit conversion facility. The environmental assessment also describes ongoing R&D activities related to the disposition of surplus plutonium.

The *Parallex Project Fuel Manufacture and Shipment Environmental Assessment* (DOE/EA-1216, August 18, 1997, preapproval draft) tiers from the *Storage and Disposition PEIS* and analyzes the fabrication and transport of a limited amount of U.S. MOX fuel to a Canadian reactor for test irradiation; Russian MOX fuel would also be irradiated as part of the experiment. The possibility of using Russian and U.S. MOX fuel in Canadian reactors was retained as an option in the event that an agreement to that end could be reached among Russia, Canada, and the United States. The MOX fuel fabricated at LANL would be transported in U.S. Department of Transportation–approved containers by commercial carriers to a Canadian port of entry. At the Canadian border, Atomic Energy of Canada Limited (AECL) would take possession of the fuel and complete its shipment to the National Research Universal (NRU) test reactor at Chalk River Laboratories in Chalk River, Ontario. The AECL would be responsible for conducting all subsequent fuel performance tests in the NRU reactor. All spent fuel resulting from the tests would be disposed of in Canada under the Canadian spent fuel program.

The *Draft Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (DOE/EIS-0227D, November 1997) evaluates the potential environmental impacts associated with reasonable management alternatives for certain plutonium residues and all scrub alloy currently stored at RFETS near Golden, Colorado. DOE previously decided to stabilize, if necessary, and repackage the plutonium residues for safe interim storage at RFETS, as discussed in the *Solid Residue Treatment, Repackaging, and Storage Environmental Assessment* (DOE/EA-1120, April 1996); *Finding of No Significant Impact* (April 1996). The management alternatives analyzed in the EIS are no action (which includes the application of variances to safeguards termination limits), processing without plutonium separation, and processing with plutonium separation. If the ROD for the EIS selects plutonium separation for a residue(s) category or scrub alloy, the plutonium separated at RFETS, LANL, or SRS would be either immobilized or used as MOX fuel in accordance with the disposition alternatives discussed in this SPD EIS.

The *Draft Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DOE/EIS-0269, December 1997) evaluates the environmental impacts of six alternative strategies for the long-term management of DOE-owned depleted uranium hexafluoride currently stored at the East Tennessee Technology Park in Oak Ridge, Tennessee; the Paducah Gaseous Diffusion Plant in Paducah, Kentucky; and the Portsmouth Gaseous Diffusion Plant near Piketon, Ohio. These alternatives involve cylinder technology and design; conversion of depleted uranium

[13] When it is unclear whether a supplement to an EIS is needed, DOE is required to prepare a supplement analysis to assist in making that determination.

hexafluoride to another chemical form; and materials use, storage, disposal, and transportation. This SPD EIS analyzes the conversion of depleted uranium hexafluoride, from a representative site (Portsmouth), to uranium dioxide, which would be used as feedstock for MOX fuel fabrication and immobilization.

The *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (DOE/EIS-0161, October 1995; ROD, December 1995) evaluates alternatives for new tritium production and the recycling of tritium recovered from weapons retired from service. One of the alternatives discussed involves the use of MOX fuel in a multipurpose reactor, using MOX fuel to produce tritium, as well as restart of FFTF. In the Tritium ROD, this option was deferred for future consideration. The implications of an FFTF restart, if proposed by DOE in the future, are discussed in Appendix D of this SPD EIS.

1.7.2 Waste Management

The *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (WM PEIS) (DOE/EIS-0200-F, May 1997; Transuranic [TRU] Waste ROD, January 1998) examines the potential environmental and cost impacts of strategic alternatives for managing five types of radioactive and hazardous wastes that have resulted, and will continue to result, from nuclear defense and research activities at a variety of sites around the United States. The WM PEIS provides information on the impacts of various siting configurations that DOE will use to decide at which sites to locate additional treatment, storage, and disposal capacity for each waste configuration. Any waste resulting from actions taken in this SPD EIS would be treated, stored, and disposed of in accordance with the RODs and other decisions resulting from the WM PEIS. To date, one ROD (January 1998) for the treatment and storage of TRU waste has been issued. This ROD determined that those DOE sites that currently have or will generate TRU waste will prepare it for storage and store it on the site, the only exception being that Sandia National Laboratory will transfer its TRU waste to LANL.

The *Waste Isolation Pilot Plant Final Environmental Impact Statement* (DOE/EIS-0026, October 1980; ROD, January 1981) and associated supplements (DOE/EIS-0026-S-2, January 1990 [ROD, June 1990]; and DOE/EIS-0026-S-2, September 1997 [ROD, January 1998]) analyze the development, operation, and transportation activities associated with the Waste Isolation Pilot Plant (WIPP), a mined repository for TRU waste near Carlsbad, New Mexico. TRU waste produced as a result of surplus plutonium disposition activities would ultimately be disposed of at WIPP, when it meets all disposition criteria.

The *Environmental Impact Statement for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* (DOE/EIS-0250, in preparation) analyzes the construction, operation, and eventual closure of a geologic repository at Yucca Mountain to dispose of commercial and DOE spent nuclear fuel, high-level radioactive waste, and materials that NRC determines by rule require the same degree of isolation. National transportation, waste packaging, and Nevada transportation are evaluated as part of the analysis. Three implementing design alternatives based on thermal load—low, intermediate, and high—are examined. Waste produced from these SPD EIS plutonium immobilization and MOX alternatives are included in the analysis. This SPD EIS does not analyze Yucca Mountain as a potential geologic repository site.

The Accelerating Cleanup, Paths to Closure Draft (DOE/EM-0342, February 1998) is DOE's blueprint for waste cleanup. It provides DOE's detailed projections on the scope, schedules, and costs for the cleanup of contaminated soil, groundwater, and facilities; treatment, storage, and disposal of waste; and effective management of nuclear materials and spent nuclear fuel. Included in the report are site waste and material disposition flow charts that describe each waste stream, the steps for processing or managing the wastes, and the permanent waste disposal sites that have been designated. This document is not a plan or a decisionmaking document; it describes the status and direction of DOE's draft cleanup strategy. Appropriate NEPA reviews will be conducted before any decisions are made. This SPD EIS reflects the proposals in *Paths to Closure* to the extent possible. Subsequent versions of *Paths to Closure* will reflect implications of the waste management and environmental restoration implications of the decisions made as a result of this SPD EIS.

1.7.3 SPD EIS Candidate Sites

The *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (TWRS EIS) (DOE/EIS-0189, August 1996; ROD, February 1997) satisfies the DOE commitment made in the *Disposal of Hanford Defense High-Level, Transuranic and Tank Waste Final Environmental Impact Statement* (DOE/EIS-0113, December 1987; RODs, March and April 1988) to prepare a supplemental NEPA analysis. The TWRS EIS was prepared in response to several important changes subsequent to the ROD, including a revised strategy for managing and disposing of tank waste and encapsulated cesium and strontium. The TWRS EIS evaluates, as a part of the proposed action: continued operation and management of the tank farms; waste transfer system upgrades; and retrieval and treatment of the tank waste, which would include the construction and operation of a facility to vitrify HLW and vitrify or similarly immobilize the low-activity waste. DOE decided to implement the preferred alternative for retrieval, treatment, and disposal of tank waste and to defer a decision on the disposition of cesium and strontium capsules. The HLW vitrification facility is a candidate facility for immobilization activities considered in this SPD EIS.

The *Plutonium Finishing Plant Stabilization Final Environmental Impact Statement* (DOE/EIS-0244, May 1996; ROD, July 1996) analyzes the potential environmental impacts of alternative approaches to: (1) stabilization of residual plutonium-bearing materials at the Hanford Plutonium Finishing Plant (PFP) to a form suitable for long-term storage; (2) removal of readily retrievable plutonium-bearing materials left behind in process equipment, process areas, and air quality and liquid waste management systems as a result of historic uses; and (3) interim storage of stabilized fissile material in existing PFP vaults pending decisions on ultimate storage and disposition of the material. DOE decided to remove readily retrievable plutonium-bearing materials in holdup at PFP. Following their stabilization, plutonium-bearing materials will be in a form suitable for interim storage in existing vaults at PFP. These materials are included in the plutonium inventory addressed in this SPD EIS. Other plutonium-bearing material having low plutonium content (less than 50 percent by weight) and meeting criteria established by DOE may be treated at PFP using a cementation process.

The *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan,* (DOE/EIS-0222, draft issued August 1996) analyzes the consequences (primarily from remediation activities) of the actions determined necessary to achieve desired future land-use objectives. It does not provide site-specific analyses of remediation technologies and activities that are required by the Comprehensive Environmental Response, Compensation and Liability Act and Resource Conservation and Recovery Act. Hanford is a candidate site for surplus plutonium disposition activities.

The *Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement* (Final, June 1994, National Park Service) evaluates protecting the Hanford Reach of the Columbia River in terms of its designation as a Wild and Scenic River, provisions for recreation access, and visitor interpretation and education. Hanford is a candidate site for surplus plutonium disposition activities.

The *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203, April 1995; ROD, May 1995) is a complex-wide evaluation of alternatives for managing, through the year 2035, existing and reasonably foreseeable amounts of spent nuclear fuel within the DOE inventory. The EIS contains an analysis of the transportation of spent nuclear fuel, as well as sitewide alternatives for environmental restoration and waste management programs at the Idaho National Engineering

Laboratory (INEL, now INEEL). The ROD designated Hanford, INEEL, and SRS for regional spent fuel storage and management, and made decisions for environmental restoration and waste management at INEEL. In March 1996, DOE issued an amendment to the May 1995 ROD to include a decision to regionalize the management of DOE-owned spent nuclear fuel by fuel type, including spent fuel currently stored at Hanford, INEEL, and SRS. All three sites are candidate sites for plutonium disposition activities.

The *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (DOE/EIS-0218, February 1996; ROD, July 1996) evaluates the adoption of a joint DOE/Department of State policy to manage spent nuclear fuel from foreign research reactors, including HEU fuels provided by the United States to other countries for research reactors. Management alternatives include a number of implementation options for port selection, transportation, and storage at DOE sites. The ROD selected a management policy that provided for the return to the United States of spent fuels from various research reactors, using two designated U.S. ports, and the storage at INEEL and SRS for the foreseeable future. INEEL and SRS are candidate sites for plutonium disposition activities.

The *Site-Wide Environmental Impact Statement on the Continued Operation of the Los Alamos National Laboratory* (DOE/EIS-0238, May 1998) evaluates ongoing and reasonably foreseeable new operations and facilities at LANL in support of DOE missions. This sitewide EIS updates the LANL sitewide EIS issued in 1979. LANL is the site for the pit disassembly and conversion demonstration and a candidate site for the lead assembly fabrication activity considered in this SPD EIS. Currently, small-scale R&D activities related to pit disassembly and conversion and MOX fuel fabrication are being conducted at LANL.

The *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE/EIS-0225, November 1996; ROD, January 1997) evaluates all current and proposed facilities and activities at Pantex, including weapons dismantlement and storage of the resulting nuclear materials and classified weapons components in the near term (over a 5- to 10-year period). This sitewide EIS addresses alternative interim storage sites for Pantex plutonium pits, some of which will ultimately be disposed of as determined in this SPD EIS. Pantex is one of the candidate sites for pit disassembly and conversion and MOX fuel fabrication activities considered in this SPD EIS.

The *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE/EIS-0236, November 1996; ROD, December 1996) evaluates the potential environmental impacts resulting from activities associated with nuclear weapons research, design, development, and testing, as well as the assessment and certification of their safety and reliability. The stewardship portion of the document analyzes the development of three new facilities to provide enhanced experimental capabilities. The stockpile management portion of this EIS concerns producing, maintaining, monitoring, refurbishing, and dismantling the nuclear weapons stockpile at eight sites, including Pantex and SRS, both candidate sites for plutonium disposition activities. A decision was made in the ROD to downsize a number of facilities for stockpile dismantlement, and to build experimental facilities at LLNL.

The *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (DOE/EIS-0220, October 1995) analyzes the potential environmental impacts of the management of certain nuclear materials at SRS pending decisions on their future use or ultimate disposition. The EIS includes an analysis of the construction of the SRS Actinide Packaging and Storage Facility, which is identified in this SPD EIS as a possible materials storage facility. Five RODs have been issued since the Final EIS was published. On December 12, 1995, DOE issued a ROD and Notice of Preferred Alternatives (60 Federal Register 65300) on the interim management of several categories of nuclear materials at SRS. DOE decided to stabilize plutonium and uranium stored in vaults using a combination of management methods. On February 8, 1996, DOE issued a supplemental ROD (61 Federal Register 6633) on the stabilization of two of the remaining categories of nuclear materials (Mark-16 and Mark-22 fuels and other aluminum-clad targets) analyzed in the Final EIS.

After considering a DOE staff study and recommendation on canyon facility utilization, DOE issued a second supplemental ROD on September 6, 1996 (61 Federal Register 48474) for stabilization of the neptunium 237 solutions, obsolete neptunium targets, and plutonium 239 solutions. On April 2, 1997, DOE issued a third supplemental ROD (62 Federal Register 17790) on stabilization in the F-Canyon and FB-Line facilities of the remaining Taiwan Research Reactor spent nuclear fuel. In October 1997, DOE issued a fourth supplemental ROD to add an additional method, processing and storage for vitrification in DWPF, to those being used in the management of plutonium and uranium stored in vaults; and to amend its September 6, 1996, ROD to provide for use of the H-Canyon facilities to stabilize, to oxide forms, the plutonium 239 and neptunium 237 solutions stored in H-Canyon and obsolete neptunium 237 targets stored in K-Reactor.

The *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE/EIS-0217, Final, July 1995; ROD, September 1995) analyzes future SRS waste management needs for all waste types over the next 30 years, including the treatment, storage, and disposal of high-level, low-level, mixed, hazardous, and TRU wastes generated from environmental restoration, facility operations, and the decontamination and decommissioning of buildings. In the ROD, DOE selected phased approaches to waste treatment, storage, and disposal facilities identified in the Final EIS. SRS is a candidate site for plutonium disposition activities.

The *Disposition of Surplus Highly Enriched Uranium (HEU) Final Environmental Impact Statement* (DOE/EIS-0240, June 1996; ROD, July 1996) addresses the disposition of a nominal 200 t (220 tons) of HEU declared surplus to the national security needs of the United States. Alternatives include several approaches to blending down the highly enriched material to make it nonweapons usable and suitable for fabrication into fuel for commercial nuclear reactors. The ROD calls for blending, over time, as much material as possible (up to 85 percent) for commercial use, and blending the remainder for disposal as low-level waste. Blending sites include SRS, one of the candidate sites for surplus plutonium disposition activities.

The *F-Canyon Plutonium Solutions at Savannah River Site Final Environmental Impact Statement* (DOE/EIS-0219, December 1994; ROD, February 1995) evaluates alternatives to stabilize plutonium solutions currently stored in F-Canyon at SRS before their disposition as determined in this SPD EIS. The alternatives examined are taking no action, processing the solutions to plutonium metal, processing the solutions to plutonium dioxide, and transferring the solutions to the HLW tanks for vitrification in DWPF. DOE has processed the plutonium solutions to a metal form using the F-Canyon and FB-Line facilities at SRS. Building 221–F at F-Canyon is analyzed in this SPD EIS as a potential immobilization facility.

The *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE/EIS-0082-S, November 1994; ROD, April 1995) assesses the environmental impacts of the construction and operation of DWPF at SRS as modified from the original design addressed in a 1982 EIS. DWPF includes the HLW pretreatment process, the vitrification facility, facilities for the manufacture and disposal of saltstone (low-level waste resulting from the pretreatment of HLW), radioactive glass waste storage facilities, and associated support facilities. Some of the immobilization alternatives being analyzed in this SPD EIS require DWPF to provide the surrounding radiation barrier for the immobilized plutonium.

Environmental Impact Statement for Accelerator Production of Tritium at the Savannah River Site (DOE/EIS-0270D, draft issued December 1997) evaluates the siting, construction, and operation of a linear accelerator at SRS that would produce tritium, a gaseous radioactive isotope of hydrogen considered essential to the operation of U.S. thermonuclear weapons. SRS is a candidate site for plutonium disposition activities.

The *Construction and Operation of a Tritium Extraction Facility at the Savannah River Site Environmental Impact Statement* (DOE/EIS-0271D, draft, March 1998) evaluates the construction and operation of a facility for the extraction of tritium to support the DOE tritium production capability. SRS is a candidate site for plutonium disposition activities.

The *Final Environmental Impact Statement for Shutdown of the River Water System at Savannah River Site* (DOE/EIS-268, May 1997; ROD, January 1998) evaluates the shutdown of the River Water System used to pump large quantities of water from the Savannah River for cooling purposes within SRS. Alternatives for placing all or part of the system in standby mode are also considered. The ROD selected the No Action Alternative, that is, continuing the maintenance and operation of the Savannah River Water System for the foreseeable future. SRS is a candidate site for plutonium disposition activities.

The *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y–12 Plant, Oak Ridge, Tennessee* (DOE/EA-0929, September 1994; FONSI, September 1995) analyzes the continued receipt, prestorage processing, and interim storage of enriched uranium in quantities that would exceed the historic maximum storage level. On the basis of this EA, DOE determined that the Y–12 Plant would store no more than 500 t (551 tons) of HEU and no more than 6 t (6.6 tons) of low-enriched uranium. HEU recovered from the pit conversion facility will be shipped to Y–12 for interim storage pending disposition. This SPD EIS analyzes the transportation of HEU from the candidate pit conversion facility sites to Y–12.

1.7.4 Cooperating Agencies

In May 1997, DOE notified several agencies, including NRC and the Environmental Protection Agency (EPA), that this SPD EIS was being prepared. On November 10, 1997, NRC informed DOE that it would be a "commenting" rather than "cooperating" agency.[14] In keeping with this decision, DOE will provide copies of the draft and final SPD EIS to NRC for comment. No agencies other than EPA have decided to be a cooperating agency for this SPD EIS.

1.8 ORGANIZATION OF THE SPD EIS

This SPD EIS consists of three volumes. Volume I contains the main text of the EIS. Volume II contains technical appendixes that provide supporting details for the analyses in Volume I, as well as additional project information. Volume III, to be included with the SPD Final EIS, will contain the comments received on the Draft EIS during the public review period, along with the DOE responses to these comments. An EIS Summary is also available as a separate publication.

Volume I consists of Chapters 1 through 9. Chapter 2 describes the surplus plutonium disposition alternatives, how the alternatives were developed, and the proposed types of disposition facilities. It also provides a comparison of the alternatives. Chapter 3 describes the potentially affected environments at the candidate sites. Chapter 4 provides summary descriptions of the potential impacts of the proposed action and alternatives on 13 resource areas. This chapter also describes cumulative impacts, irreversible and irretrievable commitments of resources, unavoidable adverse impacts, and the relationship between short-term uses of the environment and long-term productivity. Chapter 5 provides a description of the environmental and health and safety compliance requirements governing implementation of the alternatives and includes the status of required consultations with Federal, State, and local agencies. References are included at the end of each chapter.

[14] A cooperating agency participates in the NEPA process at the request of the lead agency developing an EIS. The cooperating agency is involved in the scoping process and may develop information and prepare environmental analyses in its area of special expertise and make available staff support to the lead agency (40 CFR 1501.6, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*). The lead agency may also request other agencies to comment on a draft EIS (40 CFR 1503.1).

Chapters 6, 7, 8, and 9 are the glossary of terms, the list of SPD EIS preparers, the SPD EIS distribution list, and the index, respectively.

Volumes II and III provide information that supports Volume I. Volume II consists of 14 appendixes and includes background documents, process descriptions, facility data, descriptions of methods used to estimate environmental impacts of the alternatives, and the detailed impact analysis. Volume III will include the comments received on the SPD Draft EIS, the responses to the comments, and a brief summary of changes made to the SPD Draft EIS in response to the comments.

1.9 REFERENCES

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement,* DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement,* DOE/EIS-0240, Office of Fissile Materials Disposition, Washington, DC, June.

DOE (U.S. Department of Energy), 1996c, *Record of Decision for the Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement,* 61 FR 40619, Office of the Federal Register, Washington, DC, August 5.

DOE (U.S. Department of Energy), 1997a, *Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement,* 62 FR 3014, Office of the Federal Register, Washington, DC, January 14.

DOE (U.S. Department of Energy), 1997b, *Surplus Plutonium Disposition Environmental Impact Statement,* Notice of Intent, 62 FR 28009, Office of the Federal Register, Washington, DC, May 22.

DOE (U.S. Department of Energy), 1997c, *Parallex Project Fuel Manufacture and Shipment Environmental Assessment* (preapproval draft), DOE/EA-1216, Office of Fissile Materials Disposition, Washington, DC, August 18.

DOE (U.S. Department of Energy), 1998a, *Site Selection Cost Analysis for Surplus Weapons-Usable Plutonium Disposition,* Office of Fissile Materials Disposition, Washington, DC, June.

DOE (U.S. Department of Energy), 1998b, *Pit Disassembly and Conversion Demonstration Environmental Assessment and Research and Development Activities* (preapproval draft), DOE/EA-1207, Office of Fissile Materials Disposition, Washington, DC, May 8.

DOE (U.S. Department of Energy), in preparation, *Environmental Impact Statement for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* DOE/EIS-0250, Office of Civilian Radioactive Waste Management, Washington, DC.

White, V.S., 1997, *Initial Data Report in Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for the UO_2 Supply,* ORNL/TM-13466, Lockheed Martin Energy Research Corporation, Oak Ridge, TN, August.

White House, 1993, *Nonproliferation and Export Control Policy,* Office of the Press Secretary, Washington, DC, September 27.

White House, 1994, *Joint Statement by the President of the Russian Federation and the President of the United States of America on Non-proliferation of Weapons of Mass Destruction and the Means of Their Delivery,* Office of the Press Secretary, Washington, DC, January 14.

Next Section

Chapter 2
Alternatives for Disposition of Surplus Weapons-Usable Plutonium

2.1 ALTERNATIVES ANALYZED IN THIS SPD EIS

This *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) analyzes the potential environmental impacts associated with implementing disassembly of pits (a component of nuclear weapons) and conversion of the recovered plutonium and clean plutonium metal at four candidate sites; conversion and immobilization of plutonium from nonpit sources at two candidate sites; and mixed oxide (MOX) fuel fabrication activities at four candidate sites. This SPD EIS also evaluates immobilizing plutonium in ceramic or glass forms, and compares the can-in-canister approach with the homogenous ceramic immobilization and vitrification approaches that were evaluated in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition PEIS)* (DOE 1996a). As part of the MOX option, this SPD EIS also evaluates the potential impacts of fabricating MOX fuel lead assemblies (for test irradiation in domestic, commercial nuclear power reactors) at five candidate U.S. Department of Energy (DOE) sites and addresses the generic impacts of irradiating MOX fuel in domestic, commercial reactors. Figure 2–1 is a map of the United States that identifies the proposed locations for the surplus plutonium disposition facilities.[1]

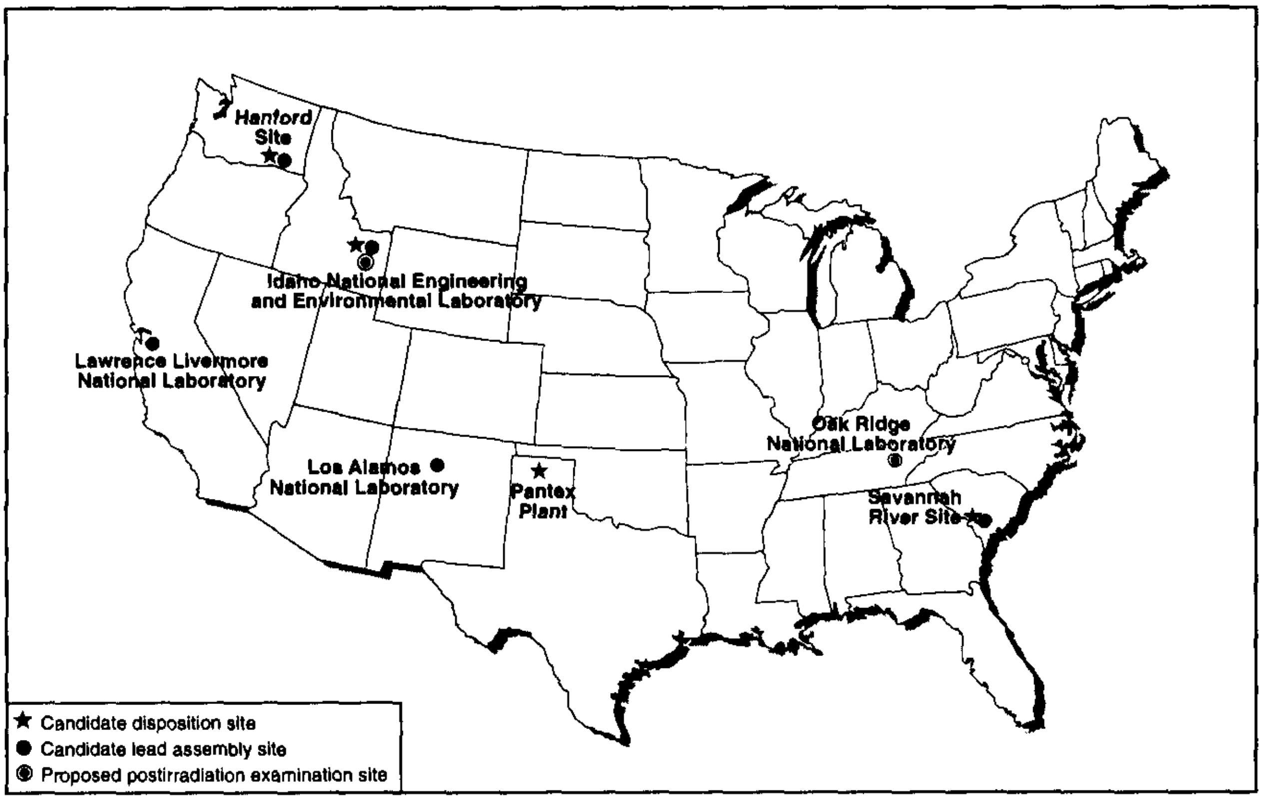


Figure 2–1. Proposed Locations of Surplus Plutonium Disposition Facilities

[1] *Specific reactor sites are not included because they have not been identified. The SPD Final EIS will include environmental impact analyses related to the specific reactors identified in response to DOE's Request for Proposals for MOX Fuel Fabrication and Reactor Irradiation Services.*

2.1.1 Surplus Plutonium Disposition Facility Alternatives

The alternatives analyzed in this SPD EIS are based on decisions announced in the Record of Decision (ROD) for the *Storage and Disposition PEIS*, as summarized in Chapter 1. Those decisions include:

- Combining the plutonium conversion and immobilization functions into a single facility,
- Pursuing the siting of a pit disassembly and conversion facility (pit conversion facility), a plutonium conversion and immobilization facility (immobilization facility), and a MOX fuel fabrication facility (MOX facility), and
- Reducing the number of possible disposition sites to be considered from six to four.

Twenty-three surplus plutonium disposition alternatives and the No Action Alternative, are shown in Table 2–1 and described in detail in Sections 2.5 through 2.16 of this chapter. The 23 action alternatives are organized into 11 sets of alternatives, reflecting various combinations of facilities and candidate sites, as well as the use of new or existing buildings. For example, Alternative 6, which would locate the pit conversion and MOX facilities at Hanford, and the immobilization facility at SRS, has four variations, denoted as 6A, 6B, 6C, and 6D. The variations occur because the immobilization facility could be located in new construction or in Building 221–F at the Savannah River Site (SRS), and the MOX facility could be in new construction or in the Fuel and Materials Examination Facility (FMEF) at the Hanford Site (Hanford).

Each of the 23 alternatives includes a pit conversion facility, but additional facilities in each alternative vary depending on the amount of plutonium to be immobilized. Alternatives 2 through 10 involve the hybrid approach of immobilizing 17 t (19 tons) of surplus plutonium and using 33 t (36 tons) for MOX fuel, and therefore, require all three facilities. Alternatives 11 and 12 involve immobilizing all 50 t (55 tons), and therefore, only include an immobilization facility and a pit conversion facility.

Alternative 1, the No Action Alternative, does not involve disposition of surplus weapons-usable plutonium, but instead addresses storing the plutonium in accordance with the *Storage and Disposition PEIS* ROD (DOE 1997a). Figures 2–2, 2–3, 2–4, and 2–5 are regional maps of the four candidate disposition sites: Hanford, Idaho National Engineering and Environmental Laboratory (INEEL), the Pantex Plant (Pantex), and SRS.

2.1.2 Immobilization Technology Alternatives

The *Storage and Disposition PEIS* discusses several immobilization technologies, including the homogenous ceramic and vitrification alternatives that were evaluated in detail, as well as the variants to those alternatives, which included the ceramic and glass can-in-canister approaches and another homogenous approach using an adjunct melter (discussed further in Appendix C of this SPD EIS). The ROD for the *Storage and Disposition PEIS* states that DOE would make a determination on the specific technology on the basis of "the follow-on EIS." This SPD EIS is that follow-on EIS, and identifies the ceramic can-in-canister approach as the preferred immobilization technology.

In order to bound the estimate of potential environmental impacts associated with ceramic and glass immobilization technologies, the *Storage and Disposition PEIS* analyzes the construction and operation of vitrification and ceramic immobilization facilities that used a homogenous approach. These facilities are based on generic designs that do not involve the use of existing facilities or specific site locations. These generic designs allow for surplus plutonium to be immobilized in a homogenous form, either within a ceramic matrix and formed into disks, or vitrified as borosilicate glass logs.

Table 2–1. Surplus Plutonium Disposition Facility Alternatives Evaluated in This SPD EIS

Alternative	Pit Disassembly and Conversion	Plutonium Conversion and Immobilization	MOX Fuel Fabrication	Disposition Amounts (Plutonium)
1	No Action			
2	Hanford (FMEF)	Hanford (FMEF and HLWVF)	Hanford (New)	17 t Immobilization/ 33 t MOX
3A	SRS (New)	SRS (New and DWPF)	SRS (New)	17 t Immobilization/ 33 t MOX
3B	SRS (New)	SRS (Bldg. 221–F and DWPF)	SRS (New)	17 t Immobilization/ 33 t MOX
4A	Pantex (New)	Hanford (FMEF and HLWVF)	Hanford (New)	17 t Immobilization/ 33 t MOX
4B	Pantex (New)	Hanford (FMEF and HLWVF)	Hanford (FMEF)	17 t Immobilization/ 33 t MOX
5A	Pantex (New)	SRS (New and DWPF)	SRS (New)	17 t Immobilization/ 33 t MOX
5B	Pantex (New)	SRS (Bldg. 221–F and DWPF)	SRS (New)	17 t Immobilization/ 33 t MOX
6A	Hanford (FMEF)	SRS (New and DWPF)	Hanford (New)	17 t Immobilization/ 33 t MOX
6B	Hanford (FMEF)	SRS (New and DWPF)	Hanford (FMEF)	17 t Immobilization/ 33 t MOX
6C	Hanford (FMEF)	SRS (Bldg. 221–F and DWPF)	Hanford (New)	17 t Immobilization/ 33 t MOX
6D	Hanford (FMEF)	SRS (Bldg. 221–F and DWPF)	Hanford (FMEF)	17 t Immobilization/ 33 t MOX
7A	INEEL (FPF)	SRS (New and DWPF)	INEEL (New)	17 t Immobilization/ 33 t MOX
7B	INEEL (FPF)	SRS (Bldg. 221–F and DWPF)	INEEL (New)	17 t Immobilization/ 33 t MOX
8	INEEL (FPF)	Hanford (FMEF and HLWVF)	INEEL (New)	17 t Immobilization/ 33 t MOX
9A	Pantex (New)	SRS (New and DWPF)	Pantex (New)	17 t Immobilization/ 33 t MOX
9B	Pantex (New)	SRS (Bldg. 221–F and DWPF)	Pantex (New)	17 t Immobilization/ 33 t MOX
10	Pantex (New)	Hanford (FMEF and HLWVF)	Pantex (New)	17 t Immobilization/ 33 t MOX
11A	Hanford (FMEF)	Hanford (FMEF and HLWVF)	NA	50 t Immobilization/ 0 t MOX
11B	Pantex (New)	Hanford (FMEF and HLWVF)	NA	50 t Immobilization/ 0 t MOX
12A	SRS (New)	SRS (New and DWPF)	NA	50 t Immobilization/ 0 t MOX
12B	SRS (New)	SRS (Bldg. 221–F and DWPF)	NA	50 t Immobilization/ 0 t MOX
12C	Pantex (New)	SRS (New and DWPF)	NA	50 t Immobilization/ 0 t MOX
12D	Pantex (New)	SRS (Bldg. 221–F and DWPF)	NA	50 t Immobilization/ 0 t MOX

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility (planned); NA, not applicable.

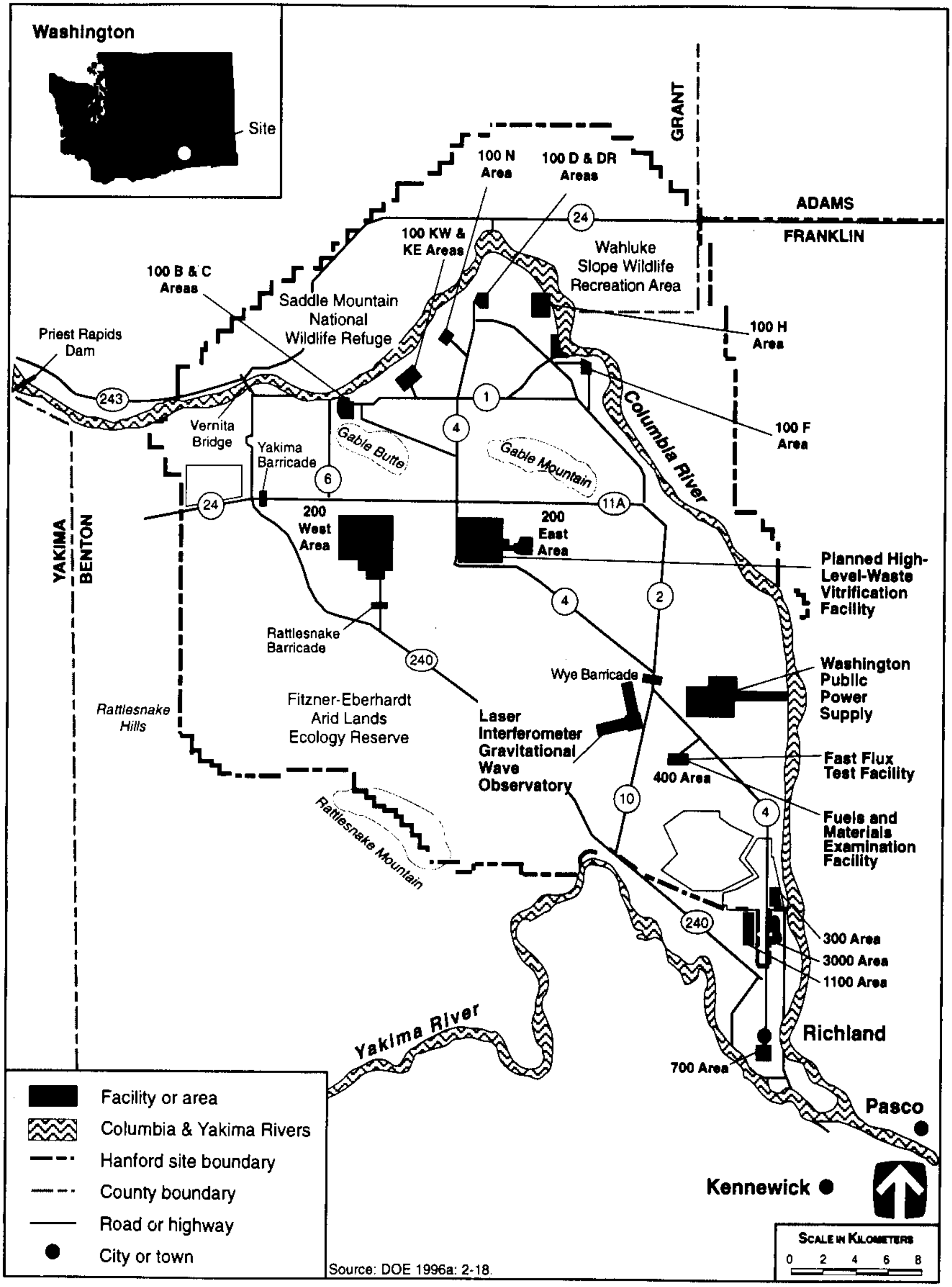


Figure 2–2. Hanford, Washington

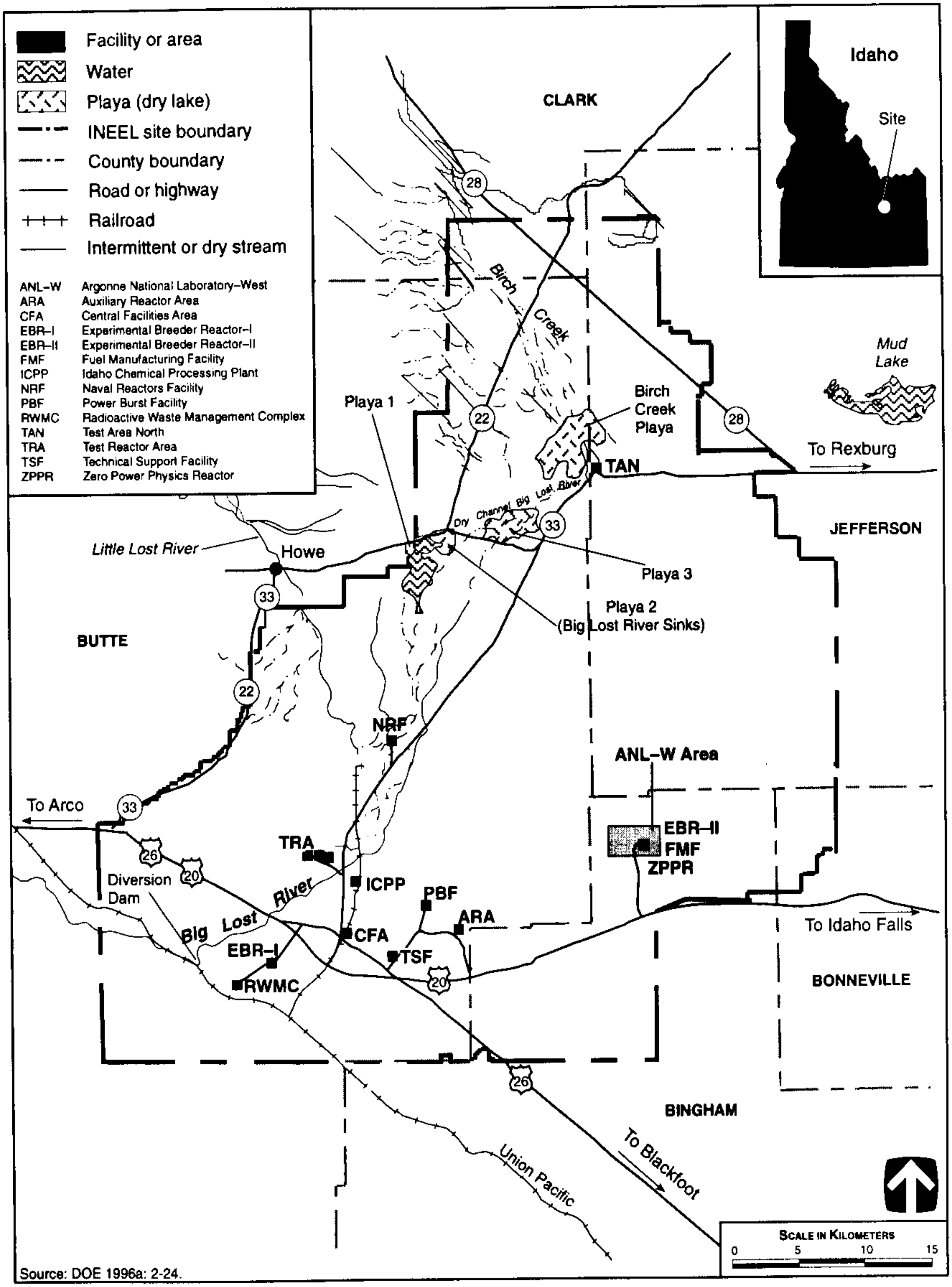


Figure 2–3. INEEL, Idaho

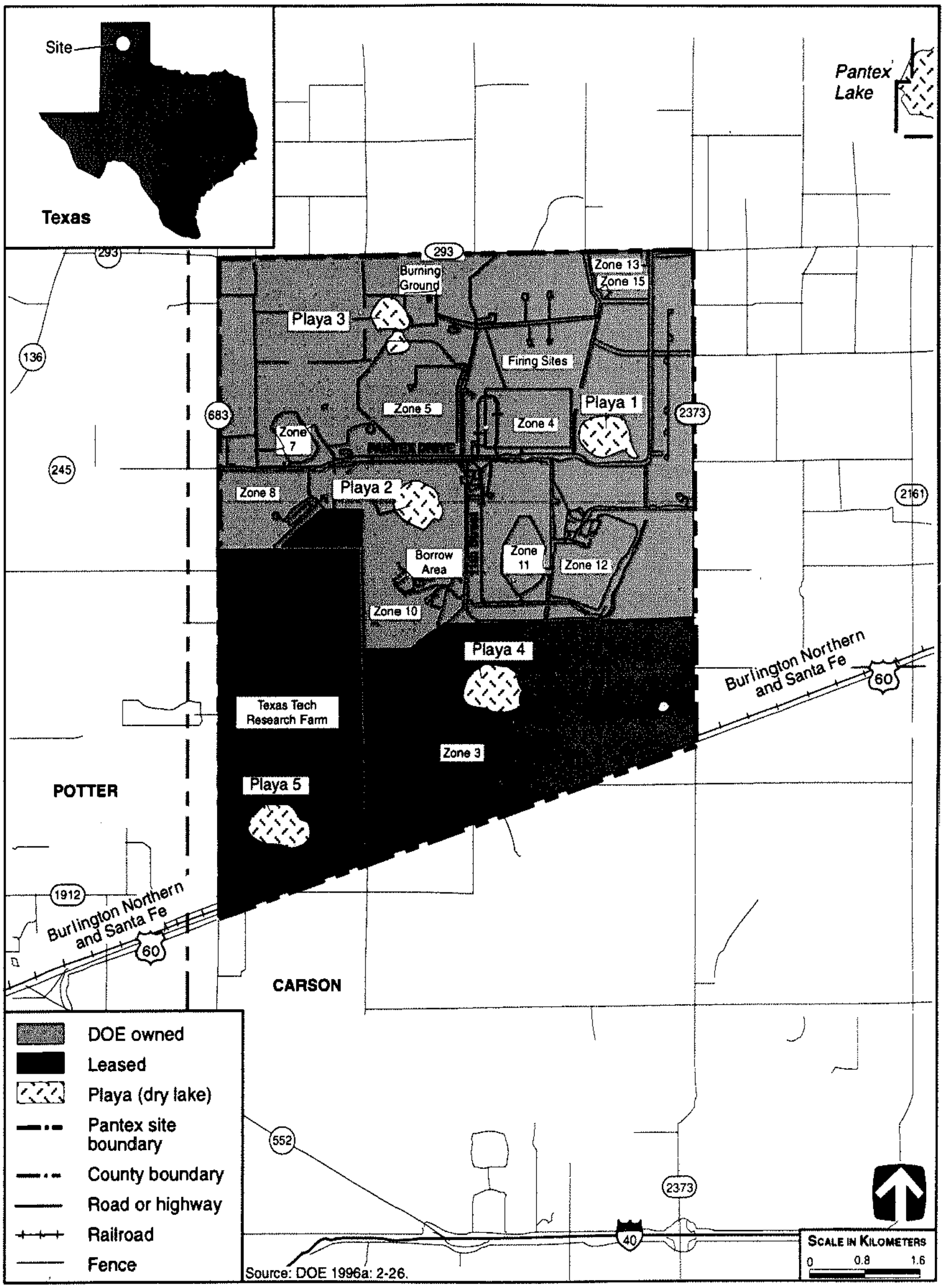
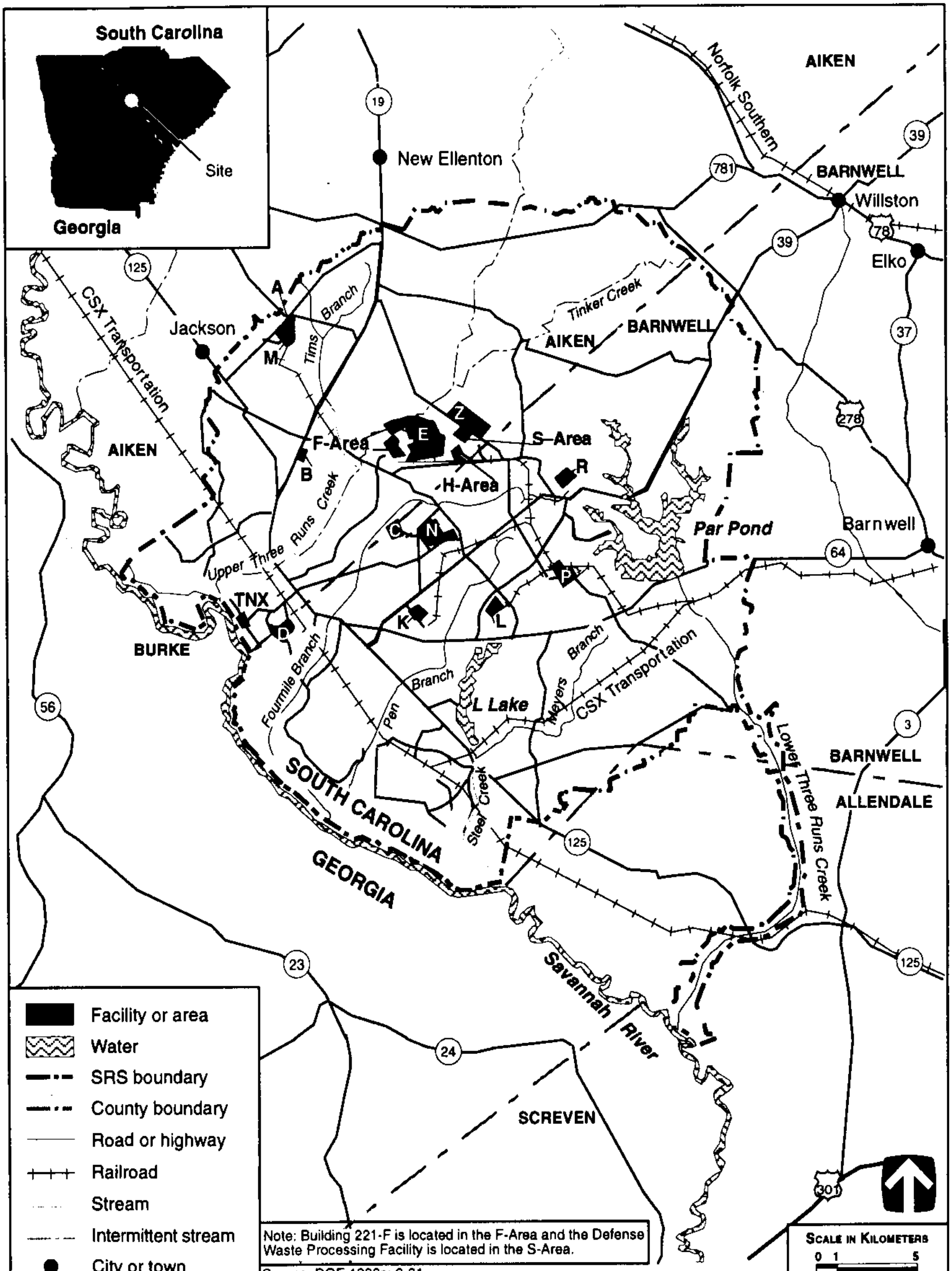


Figure 2–4. Pantex, Texas



Note: Building 221-F is located in the F-Area and the Defense Waste Processing Facility is located in the S-Area.

Source: DOE 1996a: 2-31.

Figure 2–5. SRS, South Carolina

In order to support a decision on the immobilization technology and form, this SPD EIS evaluates the potential environmental impacts of the ceramic and glass can-in-canister technologies, and compares those impacts with the impacts of the homogenous facilities evaluated in the *Storage and Disposition PEIS.* This comparison is presented in Section 4.29.

2.1.3 MOX Fuel Fabrication Alternatives

Alternatives that involve the manufacture of MOX fuel include the use of the fuel in existing domestic commercial nuclear power reactors. The environmental impacts of using MOX fuel in these reactors are evaluated in the *Storage and Disposition PEIS.* That analysis is incorporated by reference in this SPD EIS. Those impacts are summarized in Section 4.28 and included in the discussion of the integrated impacts of the MOX fuel alternatives presented in Section 2.18.3.

DOE has begun the procurement process for a potential a contract for MOX fuel fabrication and irradiation services. A final Request for Proposals (RFP) was released in May 1998.[2] Proposals are due in August 1998 and a contract award is scheduled for November 1998. The services requested by this procurement process include design, licensing, construction, operation, and eventual deactivation of the MOX facility as well as irradiation of the MOX fuel in three to eight domestic, commercial reactors. The RFP scope of work defines limited activities that may be performed prior to issuance of the SPD EIS ROD. These activities include non-site-specific work primarily associated with the development of the initial conceptual design for the fuel fabrication facility; and plans (paper studies) for outreach, long lead-team procurements, regulatory management, facility quality assurance, safeguards, security, fuel qualifications, and deactivation. There would be no construction, fabrication, or irradiation of MOX fuel until the SPD EIS ROD is issued. Such site-specific activities would depend on decisions in the ROD, and according to the RFP, DOE's exercise of contract options to allow such activities would be contingent on the ROD.

> **"216 Process"**
>
> DOE's NEPA Implementing Regulations (10 CFR 1021) include special provisions to enable a source selection official to consider, as part of the procurement decision, the environmental impacts of the offerors proposals. As provided in 10 CFR 1021.216, DOE may require that offerors submit environmental data and analyses as a discrete part of the offeror's proposal. DOE will then:
>
> - independently evaluate and verify the submitted information;
> - prepare an environmental critique (subject to confidentiality requirements of the procurement process) for offers in the competitive range, addressing environmental issues pertinent to a decision on the proposals; and
> - prepare a publicly available environmental synopsis, based on the environmental critique, to document consideration given to environmental factors in the selection process.
>
> After a selection has been made, the environmental synopsis shall be filed with EPA, made publicly available, and incorporated in an EIS prepared for the action.

Furthermore, in compliance with its National Environmental Policy Act (NEPA) regulations at 10 CFR 1021.216, DOE has requested that each offeror provide, as part of its proposal, environmental information specific to its proposed MOX facility design and the domestic, commercial reactors it proposes to use for irradiation of the fuel. That information will be analyzed by DOE to identify potential environmental impacts of the proposals and documented in an Environmental Critique, prepared pursuant to 10 CFR 1021.216(g), that will be considered by the selection official as part of his or her

[2] The RFP may be obtained from the Office of Fissile Materials Disposition website at www.doe-md.com under "HEU/Pu disposition."

decision. The Environmental Critique may contain proprietary information that will, therefore, not be made available to the public. However, an Environmental Synopsis of the Environmental Critique will be filed with the U.S. Environmental Protection Agency (EPA) and will be made available to the public as provided in 10 CFR 1021.216(h). The synopsis of the Environmental Critique will also be incorporated as an appendix in the SPD Final EIS.

The environmental information provided with the proposals and analyzed in the Environmental Critique will also be compared to the environmental impacts estimated in this SPD Draft EIS for construction and operation of the MOX facility. The SPD Final EIS will also include environmental impact analysis related to the specific reactors identified in response to the RFP.

Under the hybrid alternatives, DOE would produce up to 10 MOX fuel assemblies for testing in domestic, commercial reactors before commencement of full-scale MOX fuel irradiation. These lead assemblies would be available for irradiation to support U.S. Nuclear Regulatory Commission (NRC) licensing and fuel qualification efforts. Potential impacts of MOX fuel lead assembly fabrication are analyzed for three of the candidate sites for MOX fuel fabrication (Hanford, Argonne National Laboratory–West [ANL–W] at INEEL, and SRS), and two additional sites, Los Alamos National Laboratory (LANL) in New Mexico, and Lawrence Livermore National Laboratory (LLNL) in California. Pantex was not considered for lead assembly fabrication because it does not currently have any facilities capable of MOX fuel fabrication. Postirradiation examination of the lead assemblies, if required to support NRC licensing activities, would be conducted. Two potential sites are discussed in this SPD EIS: ANL–W and Oak Ridge National Laboratory (ORNL). These two sites are currently the only sites that have the capability to conduct postirradiation examination activities without major modifications to facility and processing capabilities; only minor modifications for receipt of materials would be required. Other potential facilities, either within the DOE complex or in the commercial sector, would require significant modifications to meet expected requirements.

2.2 MATERIALS ANALYZED IN THIS SPD EIS

There are eight general categories used to describe the 50 t (55 tons) of surplus plutonium, which represent the physical and chemical nature of the plutonium. Two of the categories—clean metal (including pits) and clean oxide—would either be fabricated into MOX fuel if the hybrid approach is selected, or immobilized. The remaining six categories of material—impure metals, plutonium alloys, impure oxides, uranium/plutonium oxides, alloy reactor fuel, and oxide reactor fuel—would be immobilized.

DESCRIPTION OF SURPLUS PLUTONIUM BY DISPOSITION FEED CATEGORIES

PLUTONIUM FEED FOR IMMOBILIZATION OR MOX FUEL FABRICATION:

Clean Metal. Pure plutonium metal generally with less than 100 parts per million (ppm) of any given chemical impurity. The metal may have some oxidation or casting residues on the surface. The only major chemical impurities are gallium and radioactive decay products such as americium, neptunium, or uranium. Examples of pure metal items include unalloyed "buttons" of plutonium metal, billets, ingots, castings or rough machined items, finished machined weapon components, and other miscellaneous small metal pieces and parts.

Clean Oxide. Plutonium oxides with less than 3 percent by weight of impurities.

FEED FOR IMMOBILIZATION:

Impure Metal. Items with impurities that are more than 100 ppm, but less than 50 percent by weight.

Plutonium Alloys. Plutonium-containing alloys with impurities that are less than 50 percent by weight. Examples of plutonium alloy items include alloyed plutonium "buttons," casting products, machined product items, and ingots.

Impure Oxide. Plutonium oxides with 3 to 50 percent by weight of impurities. Examples in this category include plutonium oxides containing uranium oxides and plutonium oxides containing neptunium, thorium, beryllium, or zirconium.

Uranium/Plutonium Oxide. Plutonium oxides mixed with enriched uranium oxides. Examples include powders or pellets that have been either low-fired (heated at temperatures below 700 °C) or high-fired (heated at temperatures greater than 700 °C).

Alloy Reactor Fuel and Oxide Reactor Fuel. Plutonium-containing reactor fuel that has been manufactured, but not irradiated in a reactor. The plutonium consists of 12 to 26 percent of plutonium 240 with total plutonium compositions being 13 to 27 percent of the material in the fuel. The fuel can be either alloy reactor fuel or reactor fuel containing plutonium oxide mixed with uranium oxide. The majority of alloy reactor fuel in DOE's plutonium inventory is fuel elements for the Zero Power Plutonium Reactor at ANL–W. Oxide fuels include experimental capsules, elements, and pins.

Source: DOE, *Feed Material Planning Basis for Surplus Weapons-Usable Plutonium Disposition*, MD-0009, 1997.

2.3 DEVELOPMENT OF THE ALTERNATIVES

This section describes the development process for those SPD EIS alternatives and technical issues that remained to be finalized after issuance of the *Storage and Disposition PEIS* ROD.

2.3.1 Development of Facility Siting Alternatives

In the ROD for the *Storage and Disposition PEIS,* DOE identified a large number of possible options to locate three disposition facilities at four sites, and limited the immobilization options to Hanford and SRS. In addition to the four different sites for potential facility locations, the options were further increased by considering the use of either existing or new facilities at the sites, and by considering whether disposition would occur by the hybrid approach (both MOX fuel and immobilization) or only through immobilization.

The following equally weighted screening criteria were used to reduce the large number of possible facility and site combinations to the range of reasonable alternatives:

- *Worker and public exposure to radiation.* This criterion was used to exclude the site combinations that involve large amounts of handling, packaging, and repackaging of the surplus plutonium for either intersite or intrasite transportation.

- *Proliferation concerns due to transportation of materials.* Application of this criterion eliminated those options that increased the transfers of the surplus plutonium, usually involving three sites.

- *Infrastructure cost.* This criterion was used to exclude the site combinations where a single disposition facility was located at a site with no benefit for the program or DOE. For example, collocation of two of the three hybrid case disposition facilities at a site would reduce program infrastructure costs such as those associated with safeguards and security features, whereas locating each facility at a separate site would not allow such functions to be shared.

Over 64 options were evaluated, yielding a range of 23 reasonable alternatives that met all the criteria. Examples of options that were eliminated include all those options placing three facilities at three different sites. In its Notice of Intent (NOI), DOE proposed to collocate the pit conversion and immobilization facilities for the immobilization-only alternatives. However, during the public scoping process, the comment was made that, under all situations, Pantex should be considered as a candidate site for the pit conversion facility because most of the surplus pits are currently stored there. After confirming that they met all the screening criteria, three additional immobilization-only alternatives (11B, 12C, and 12D), which placed the pit conversion facility at Pantex, were included in the range of reasonable alternatives. The resulting facility and building combinations being analyzed in this SPD EIS are presented in Table 2–2.

Table 2–2. Surplus Plutonium Disposition Facilities at Candidate Sites

	Proposed Facilities		
Candidate Sites	**Pit Disassembly and Conversion**	**Conversion and Immobilization**	**MOX Fuel Fabrication**
Hanford	Modification of FMEF	Modification of FMEF and use of HLWVF	Modification of FMEF or new construction
INEEL	Modification of FPF	NA	New construction
Pantex	New construction	NA	New construction
SRS	New construction	New construction or modification of Building 221–F and use of DWPF	New construction

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility (planned); NA, not applicable.

2.3.2 Alternatives Considered but Eliminated From Detailed Study

Technology alternatives for surplus plutonium disposition that were evaluated in the *Storage and Disposition PEIS*, but were not selected in the ROD and, therefore, are not being considered in this SPD EIS are: (1) deep-borehole direct disposition; (2) deep-borehole immobilized disposition; (3) electrometallurgical treatment; (4) MOX fuel irradiation in a partially completed light water reactor; and (5) MOX fuel irradiation in an evolutionary advanced light water reactor. The reasons why these technologies were not selected are explained in the ROD for the *Storage and Disposition PEIS*.

Alternatives considered for inclusion in this SPD EIS but later eliminated from further analysis fall into four categories: amounts of material to be dispositioned, disposition facility siting, feed preparation methods, and immobilization technologies.

2.3.2.1 Amounts of Material to Be Dispositioned

In the *Storage and Disposition PEIS* ROD, DOE committed to immobilizing at least 8 t (9 tons) of surplus, low-purity, nonpit plutonium. Since the ROD was issued, however, DOE has determined that an additional 9 t (10 tons) of low plutonium content materials would, therefore, require additional processing and would be unsuitable for MOX fuel fabrication.

2.3.2.2 Disposition Facility Siting Alternatives

In addition to alternatives eliminated by the screening process as described earlier, the following facility options were eliminated from further study. Several commentors at the public scoping meetings suggested that DOE consider locating the proposed surplus plutonium disposition facilities at three separate sites. As discussed in Section 2.3.1, DOE is striving to minimize worker and public exposure to radiation, minimize proliferation concerns associated with transportation, and reduce infrastructure cost. These goals would not be met if DOE were to build one facility at each of three candidate sites.

Locating all three surplus plutonium disposition facilities in FMEF at Hanford was listed as Alternative 2 in Table 1 of the NOI for preparation of this SPD EIS (DOE 1997b). After further evaluation of space requirements, DOE concluded that the available space in FMEF would not be sufficient to accommodate the efficient operation and maintenance of all three facilities. Therefore, Alternative 2 was modified to collocate only the pit conversion and immobilization facilities in FMEF, with the MOX facility in new construction adjacent to FMEF.

The Fast Flux Test Facility (FFTF) at Hanford is a liquid sodium-cooled reactor that is currently being maintained in standby. DOE will evaluate whether the FFTF could play any role in supplying tritium for U.S. national defense purposes. If DOE decides to propose FFTF for the tritium mission, a portion of the surplus plutonium addressed in this SPD EIS could be used to produce fuel to operate the reactor, particularly the plutonium from pits that is most suitable for the MOX approach. Depending on the amount of plutonium used for FFTF fuel, the MOX fuel/commercial reactor disposition approach might not be a reasonable, cost-effective approach to disposition the remainder of the surplus weapons-usable plutonium. If DOE proposes to use the FFTF for tritium production and to use surplus plutonium to fabricate FFTF fuel, appropriate NEPA review will be performed. A discussion of FFTF is presented in Appendix D of this SPD EIS and also in Appendix N of the *Storage and Disposition PEIS.*

2.3.2.3 Feed Preparation Methods for Immobilization

The homogenous ceramic immobilization facility evaluated in the *Storage and Disposition PEIS* was based on a wet-feed preparation process. Although the ceramic form of the can-in-canister approach evaluated in this SPD EIS could also use a wet-feed process, it would require larger quantities of water and generate greater amounts of waste than would a dry-feed process. For these reasons, wet-feed preparation processes for the ceramic can-in-canister approach were not considered to be reasonable, and were not considered further in this SPD EIS.

Next Section

2.3.2.4 Immobilization Technology Alternatives

DOE considered locating an adjunct melter adjacent to the Defense Waste Processing Facility (DWPF) at SRS. In the adjunct melter, a mixture of borosilicate glass frit and plutonium would be melted together and added directly to borosilicate glass containing high-level waste (HLW) from DWPF. Subsequent evaluations (UC 1997), however, have indicated that the adjunct melter approach would be less technically viable, would take longer to implement, and would cost twice that of the can-in-canister approach. A description of the vitrification process using the adjunct melter is presented in Appendix C, but this approach is not evaluated as a reasonable alternative.

The technology variants for the new immobilization facilities discussed in the *Storage and Disposition PEIS* considered using either radioactive cesium 137 or HLW as a radiation barrier. However, the *Storage and Disposition PEIS* further identified that, in the can-in-canister approach, the use of HLW to produce a radiation barrier eliminates the need for introducing cesium 137 (from cesium capsules currently in storage at Hanford) into the immobilization process, which in turn reduces radiation shielding requirements and potential exposures to workers and the public. Therefore, this SPD EIS does not include the use of cesium 137 in the can-in-canister analyses as a reasonable alternative.

2.4 OVERVIEW OF PROPOSED SURPLUS PLUTONIUM DISPOSITION FACILITIES AND TRANSPORTATION

As discussed previously, three facilities are proposed for surplus plutonium disposition: pit conversion, immobilization, and MOX fuel fabrication. The three disposition facilities are proposed for locations where the plutonium would have the levels of protection and control required by applicable DOE safeguards and security directives. Safeguards and security programs would be integrated programs of physical protection, information security, nuclear material control and accountability, and personnel assurance. Security for the facilities would be implemented in a graded manner, commensurate with the usability of the material in a nuclear weapon or improvised nuclear device. Each facility would be located at an existing DOE site that has sitewide security measures in place, including access control. In addition to DOE sitewide security services, each facility would have appropriate security features. Physical barriers; access control systems; detection and alarm systems; procedures, including the two-person rule (which requires at least two people to be present when working with special nuclear materials in the facility); and personnel security measures, including security clearance investigations and access authorization levels, would be used to ensure that special nuclear materials stored and processed inside are adequately protected. Nuclear material control and accountability would be ensured through a system that monitors storage, processing, and transfers. Closed-circuit television, intrusion detection, motion detection, and other automated material monitoring methods would be employed as part of the material control and accountability program. At any time, the total amount of special nuclear material in each facility, or in any material balance area within a specific facility, would be known. Physical inventories, measurements and inspections of material both in process and in storage would be used to verify inventory records. In addition, each of the three facilities would need to provide space and to varying degrees, access, for representatives of the International Atomic Energy Agency (IAEA). The IAEA is charged with verifying compliance with international nonproliferation policies.

Descriptions of the disposition facilities and process operations are provided in this section. The disposition facility layouts are renderings that show representative equipment layouts that demonstrate functional, but not final designs. These designs are subject to modification during the design and construction process, consistent with any construction project, as may be required to optimize equipment placement and process flow. Sections 2.5 through 2.16 describe, individually, each alternative being considered in this SPD EIS. Since the facilities would be implemented differently at each site and for each alternative, those differences are identified and described. Sections 2.4 through 2.16 were developed using data provided by the Regents of the University of California (UC 1998a–UC 1998n).

Each of the disposition facilities is proposed to operate for about 10 years. However, the operating life of the facilities may vary somewhat, depending on facility start up experiences and negotiations with other countries (e.g., Russia) regarding the pace of disposition. The operating period of the MOX facility could also be affected by the responses to the procurement discussed in Section 2.1.3 of this SPD EIS, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals. Slightly more or less material could be processed in any given year, potentially extending or shortening the operating period of any of the disposition facilities. Also, for the hybrid approach, it may be necessary, based on feed material quality, to process slightly more material by immobilization than currently envisioned. An analysis of how these adjustments could incrementally affect the potential impacts evaluated in this SPD EIS is provided in Section 4.30.

Because the disposition facilities would operate for about 10 years and would meet stringent safety and natural hazard requirements, they could still be used for other programs or activities. After completion of the surplus plutonium disposition mission, equipment would be removed, decontaminated, and disposed of, and the building would be decontaminated. It is expected that facility deactivation would take 3 years or less to complete.

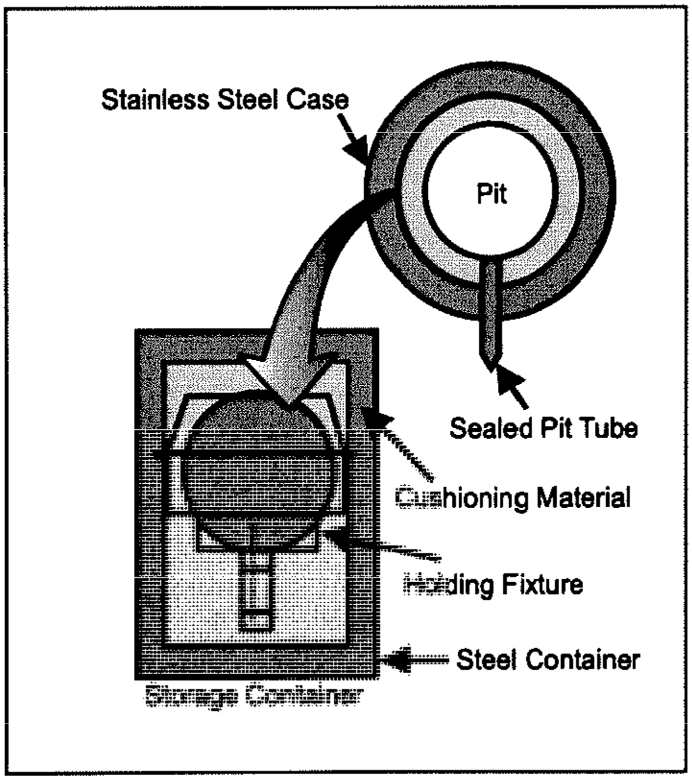


Figure 2–6. Depiction of a Pit

2.4.1 Pit Disassembly and Conversion

Each surplus plutonium disposition action alternative requires a pit conversion facility to produce appropriate feed material. That facility would recover plutonium from pits (see Figure 2–6) and clean plutonium metal (as described in Section 2.2); convert the plutonium to an unclassified (i.e., no longer exhibiting any characteristics that are protected for reasons of national security) oxide; and then transfer the oxide to either the immobilization facility or the MOX facility. This process would include the removal of gallium, a metallic element with a low melting point that is alloyed with plutonium in pits. It is considered an impurity in plutonium dioxide feed for MOX fuel fabrication. Given the national security sensitivity of information on pit materials and assembly, pit conversion facility operations would be classified (i.e., access restricted for national security reasons) through the material processing steps, and possibly through the final canning stage.

2.4.1.1 Pit Conversion Facility Description

The pit conversion facility would be designed to process up to 3.5 t (3.8 tons) of plutonium metal into plutonium oxide annually. Facility operation would require a staff of about 400 personnel. The general layout of the pit conversion facility, which approximates how the pit conversion process would be implemented, is presented in Figures 2–7 and 2–8. The specific layout and design of the facility would vary from site to site depending on a number of factors, as discussed in Sections 2.6 through 2.16.

The pit conversion facility would be built in a hardened space of thick-walled concrete that meets all applicable standards for processing special nuclear material. One or possibly both levels of the two-story building would be below grade. Areas of the facility in which plutonium would be processed or stored would be designed to survive natural phenomena such as earthquakes, floods, and tornadoes, as well as potential accidents associated with radioactive and fissile materials. Ancillary buildings would be required for support activities.

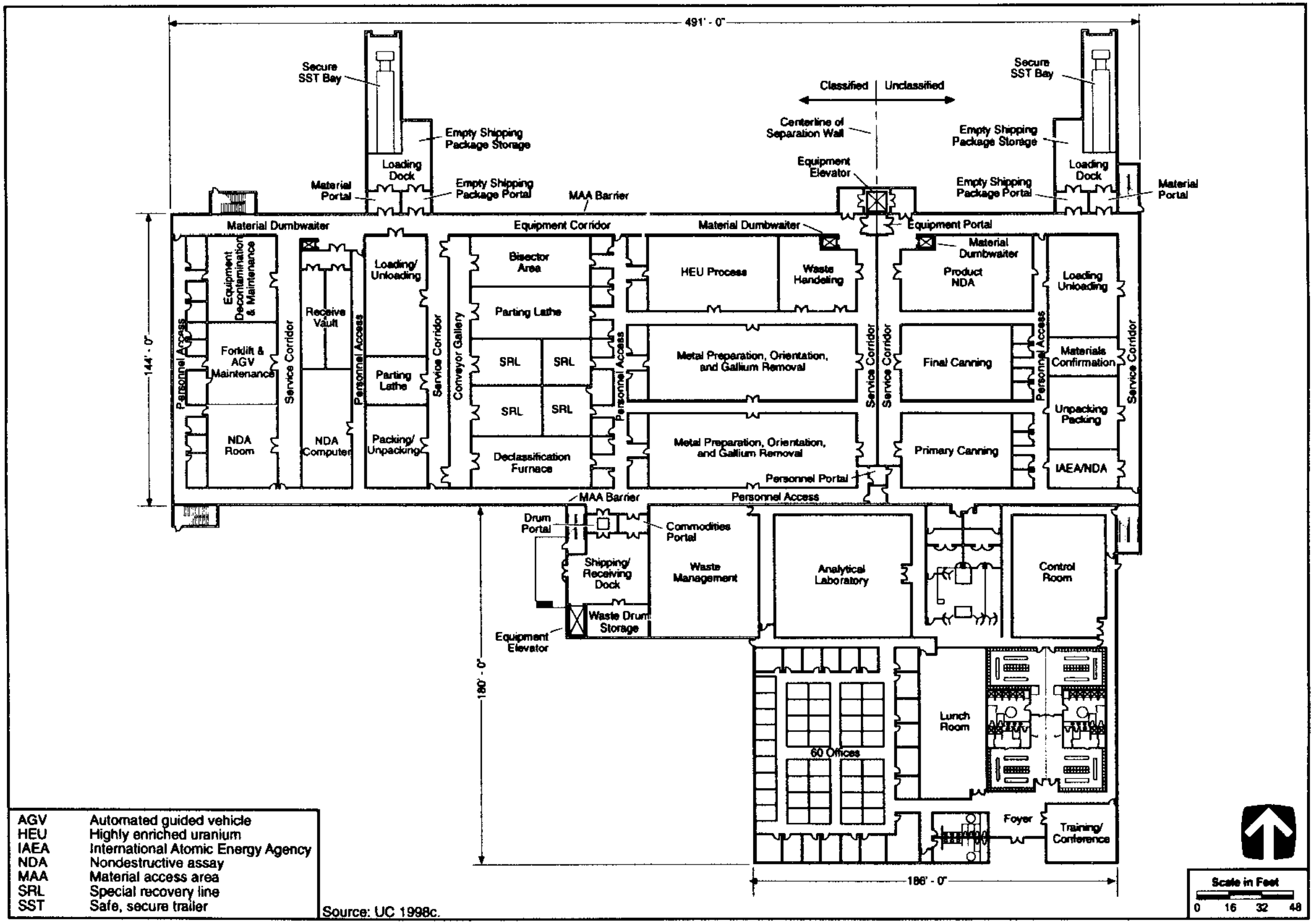
Activities involving radioactive materials or externally contaminated containers of radioactive materials would be conducted in gloveboxes. The gloveboxes would be interconnected by a contained conveyor system to move materials from one process step to the next. Gloveboxes would remain completely sealed and operate independently, except during material transfer operations. Built-in safety features would limit the temperature and pressure inside the gloveboxes and ensure that operations remained within criticality safety limits. When dictated by process needs or safety concerns, an inert atmosphere would be maintained in gloveboxes. The exhaust from the gloveboxes would be monitored continuously for radioactive contamination. The atmosphere in the gloveboxes would be kept at a lower pressure than that of the surrounding areas so that any leaks of gaseous or suspended particulate matter would be contained and filtered appropriately. The building ventilation system would include high-efficiency particulate air (HEPA) filters, and would be designed to maintain confinement, thus precluding the spread of airborne radioactive particulates or hazardous chemicals within the facility or to the outside environment. Both intake and exhaust air would be filtered, and exhaust gases would be monitored for radioactivity.

The pit conversion facility would accommodate the following surplus plutonium-processing activities: pit receipt, storage, and preparation; pit disassembly; plutonium conversion; gallium removal; oxide blending and sampling; nondestructive assay; product canning; product storage; product inspection and sampling for the IAEA; product shipping; declassification of parts not made from special nuclear materials; highly enriched uranium (HEU) decontamination, packaging, storage, and shipping; tritium capture, packaging, and storage; and waste packaging, sampling, and certification. Additional areas for support activities would be needed, including office space, change rooms, a central control room, a laboratory, mechanical equipment rooms, mechanical shops, an emergency generator to supply power to critical safety systems in the event of a power outage, a warehouse, shipping and receiving areas, waste storage, guard stations, entry portals, and parking. Because these facilities would not contain or process special nuclear materials, they would not be required to be in hardened space and thus could be located in other space available at the candidate sites. Separate truck bays in the hardened facility would accommodate DOE safe, secure trailers (SSTs).

2.4.1.2 Pit Disassembly and Conversion Process

The pit disassembly and conversion process is depicted in Figure 2–9. At the pit conversion facility, the storage containers would be removed from their overpacks (outer shipping containers), the contents verified, and information regarding the material entered into the facility's material accountability system. Pits and plutonium metal would be placed in a short-term receiving vault, checked for radiological contamination, and transferred to the pit storage vault until processing.

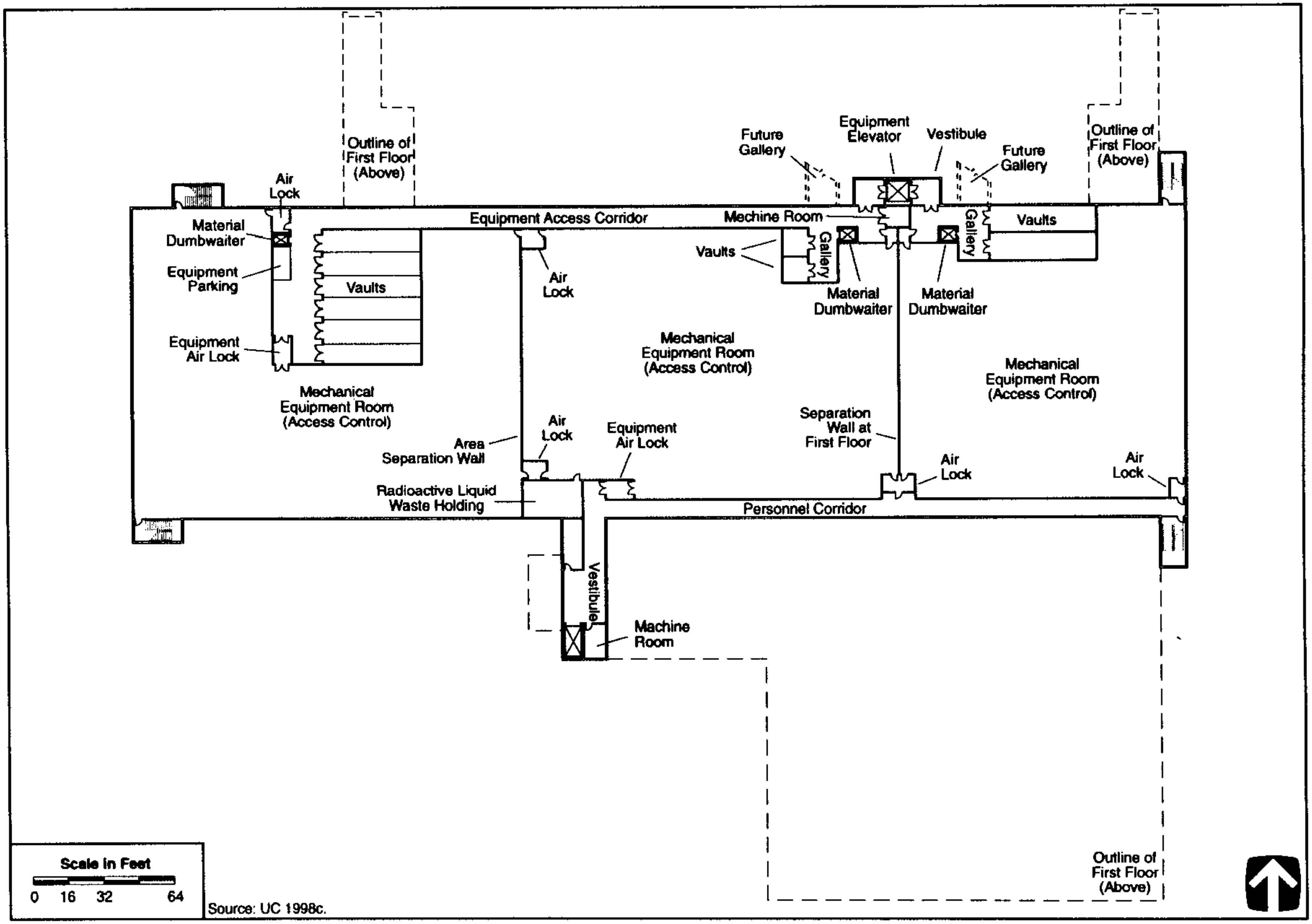
Pits would be processed first to separate the plutonium from the other components. Disassembly would occur by one of two processes, depending on whether the pit were contaminated with tritium, a radioactive isotope of hydrogen. Disassembly of uncontaminated pits would occur in the bisector module. Pits found to be contaminated with tritium would be opened in the Special Recovery Line, where the tritium would be recovered to the extent possible.



AGV	Automated guided vehicle
HEU	Highly enriched uranium
IAEA	International Atomic Energy Agency
NDA	Nondestructive assay
MAA	Material access area
SRL	Special recovery line
SST	Safe, secure trailer

Source: UC 1998c.

Figure 2–7. General Design of Pit Conversion Facility—Main Processing Level (First Floor)



Source: UC 1998c.

Figure 2–8. General Design of Pit Conversion Facility—Lower (Basement) Level

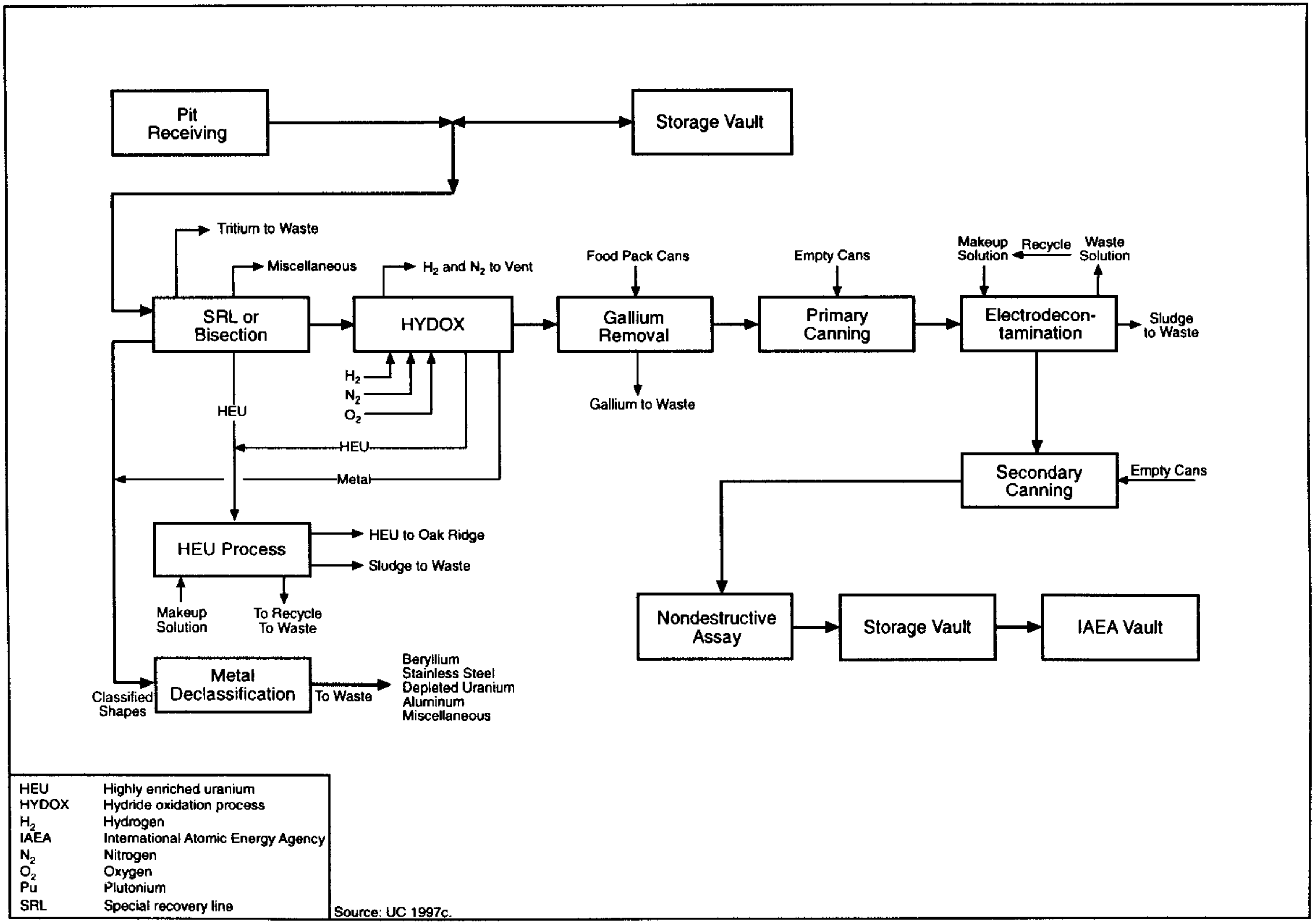


Figure 2–9. Pit Disassembly and Conversion Process

In the pit bisector, any external structures would be cut away from the pit, and the pit would be cut in half. Nonbonded pits (pits whose components separate easily) would be separated into plutonium metal, HEU, and classified metal shapes. The plutonium parts would be assayed as part of the material accountability program. HEU would be sent to the HEU-processing station, the classified metal shapes and metal shavings to the declassification furnaces, and the plutonium to the hydride-oxidation (HYDOX) station for the next step of the process. Bonded pits, which cannot be separated prior to processing, would be sent to the HYDOX process intact. HEU and classified metal shapes would be separated from the plutonium metal during the HYDOX process, then sent to the HEU-processing station and declassification furnaces, respectively.

Pits with tritium contamination would also be bisected, and the plutonium and HEU would be separated from the classified metal shapes. The plutonium would be processed in a vacuum furnace to drive off the tritium. HEU and classified metal shapes would be decontaminated and sent to the HEU-processing station and declassification furnaces, respectively. After confirmation that the plutonium metal was free of tritium, the plutonium would be assayed as part of the special nuclear material accountability program and transferred to the HYDOX station.

In the HYDOX module, plutonium metal would react with hydrogen, nitrogen and oxygen at controlled temperatures and pressures in a pressure vessel to produce plutonium dioxide. The plutonium metal would first be reacted with hydrogen gas to form a hydride. Then the vessel would be purged of the hydrogen and the hydride reacted with nitrogen gas to form a nitride. The nitrogen would then be purged and replaced with oxygen for the final reaction forming plutonium dioxide. The plutonium dioxide product would be collected and assayed for the material accountability program to confirm that all the plutonium metal entering HYDOX process left as an oxide.

Next in this process would be gallium removal. Gallium is a metallic element with a low melting point that is alloyed with plutonium in pits. However, it is considered an impurity in plutonium dioxide feed for MOX fuel fabrication, and its presence must be significantly reduced. As currently proposed and analyzed in this SPD EIS, the pit conversion process includes a gallium removal step in which heat would be used in a controlled manner to separate and collect gallium oxide from plutonium dioxide. Then, following gallium removal, the plutonium dioxide would be subjected to a series of tests to verify that it met specifications, sealed in a metal can, and sent to the primary canning module.

DOE is also considering the possibility of including a polishing step, utilizing a small-scale aqueous process, either as part of the pit conversion facility or the MOX facility. At this time, DOE believes that polishing is only a contingency, subject to inclusion only if scheduled research and development activities demonstrate that the heat treatment is insufficient. However, in response to public interest on this topic, and to ensure adequate NEPA review in the event that the polishing step is deemed necessary, a description of the polishing module and an evaluation of the potential environmental impacts of its implementation are presented in Appendix N.

In the primary canning module, the cans of plutonium dioxide would be placed into a primary storage can made of stainless steel. This can would then be welded shut and leak tested to ensure that the weld was sound. If the can failed the leak test, it would be reopened and rewelded. After passing the leak test, the primary can would be sent to the electrolytic decontamination module. After decontamination, each can would be rinsed, dried, and surveyed to verify decontamination, then sent to the secondary canning module.

In the secondary canning module, primary cans would be placed into secondary stainless steel storage cans meeting DOE's long-term storage requirements. Also in this module, secondary storage cans would be welded shut and leak tested. After leak testing, each can would be marked with a laser to identify the can and its contents, and passed to the nondestructive assay module. For alternatives where the pit conversion facility would be collocated with the MOX facility (or the immobilization facility for immobilization-only alternatives), and the plutonium dioxide would not need to be transported between sites, use of only a primary can, or another less rigorous primary and secondary can arrangement may be used.

In the nondestructive assay module, each can would be assayed to confirm its contents. Following assay, the cans would be moved into the main storage vault and then inspected by IAEA. After this inspection, the cans would be transferred to a vault that would be subject to IAEA inspection and safeguards. Once the storage containers were committed to IAEA oversight, they could only be stored in or moved to other locations subject to IAEA safeguards. For the disposition alternatives being studied in this SPD EIS, the storage containers would be transferred to either the immobilization facility or the MOX facility. All offsite shipments would be in DOE SSTs.

2.4.2 Plutonium Conversion and Immobilization

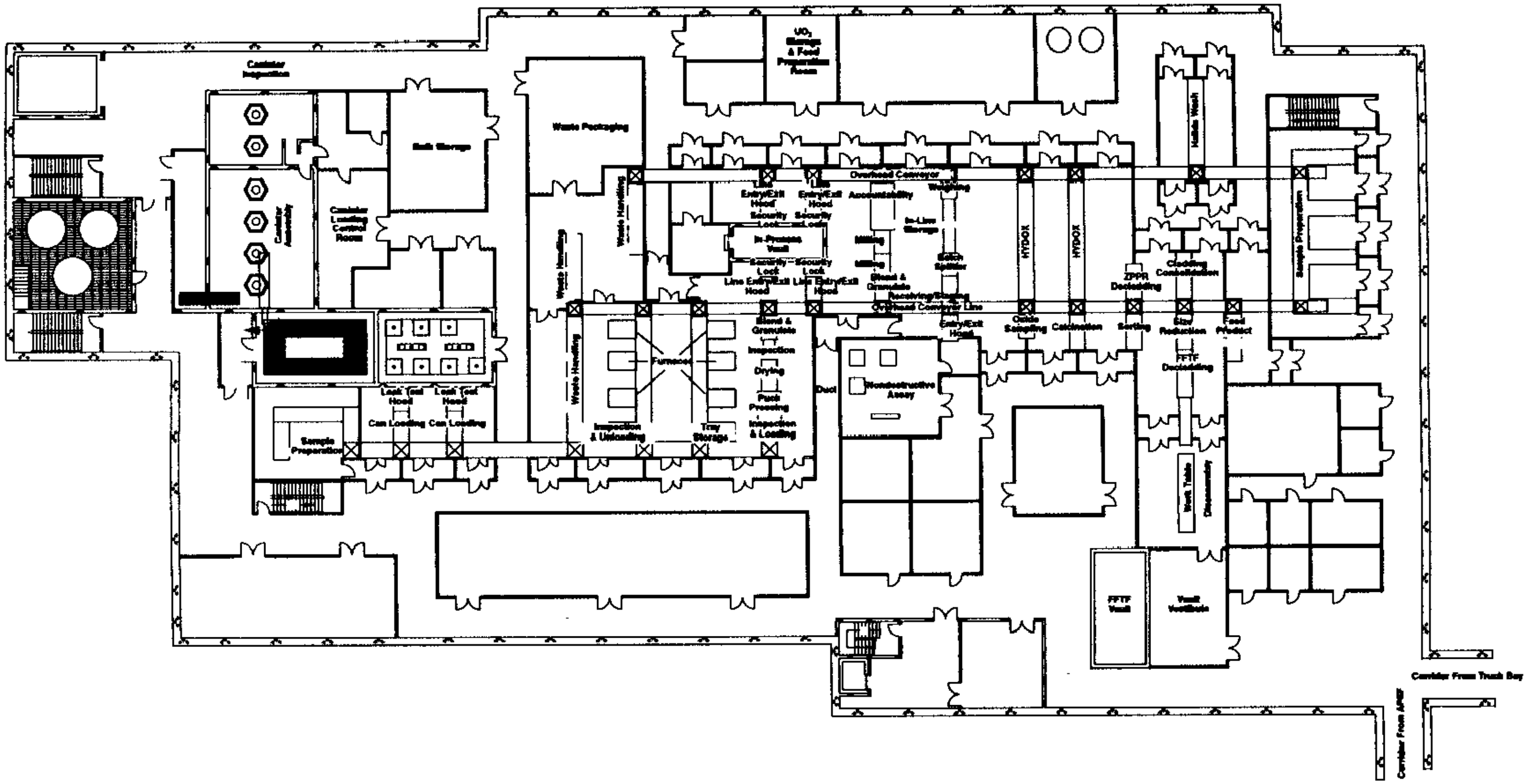
The immobilization facility would perform two operations on the surplus nonpit plutonium materials described in Section 2.2: (1) conversion of miscellaneous surplus plutonium that is not in pit form into plutonium dioxide for immobilization; and (2) immobilization of this plutonium dioxide, and possibly the plutonium dioxide from pits (if it were decided to also immobilize plutonium from pits), in a ceramic or glass form. This material would then be sealed in cans, and these cans would be placed inside canisters that would subsequently be filled with vitrified HLW (i.e., the can-in-canister approach). Filled and sealed waste canisters would be placed into storage for ultimate disposition in a geologic repository pursuant to the Nuclear Waste Policy Act (NWPA). The immobilization facility would be available to IAEA inspectors for oversight of disposition activities.

2.4.2.1 Immobilization Facility Description

The immobilization facility would consist of two primary components: a main process building and an HLW vitrification facility. It would be designed to immobilize up to 5 t (5.5 tons) of plutonium metal per year. This annual throughput would consist of up to 1.7 t (1.9 tons) of surplus nonpit plutonium and up to 3.3 t (3.6 tons) of surplus plutonium derived from pits. Operation of the facility would involve three shifts 7 days per week, and would require a workforce ranging from about 250 to 300 personnel. For 17 of the alternatives considered in this SPD EIS, a total plutonium immobilization throughput of 17 t (19 tons) was assumed. These alternatives involve the hybrid approach of disposition through both immobilization and MOX fuel fabrication. Six alternatives involve disposition only by immobilization, and the facility design for the two candidate sites would accommodate the assumed 50 t (55 ton) throughput of plutonium metal. The lower throughput for the hybrid approach would be reflected in differences in operational employment and resource requirements, but would not affect construction requirements.

The immobilization facility would be at either Hanford or SRS. At Hanford, the immobilization facility would occupy parts of both FMEF and the HLW vitrification facility planned to be constructed to support Hanford's tank waste remediation system. At SRS, immobilization would occur within Building 221–F or in a new building adjacent to the planned Actinide Packaging and Storage Facility (APSF), and at DWPF.

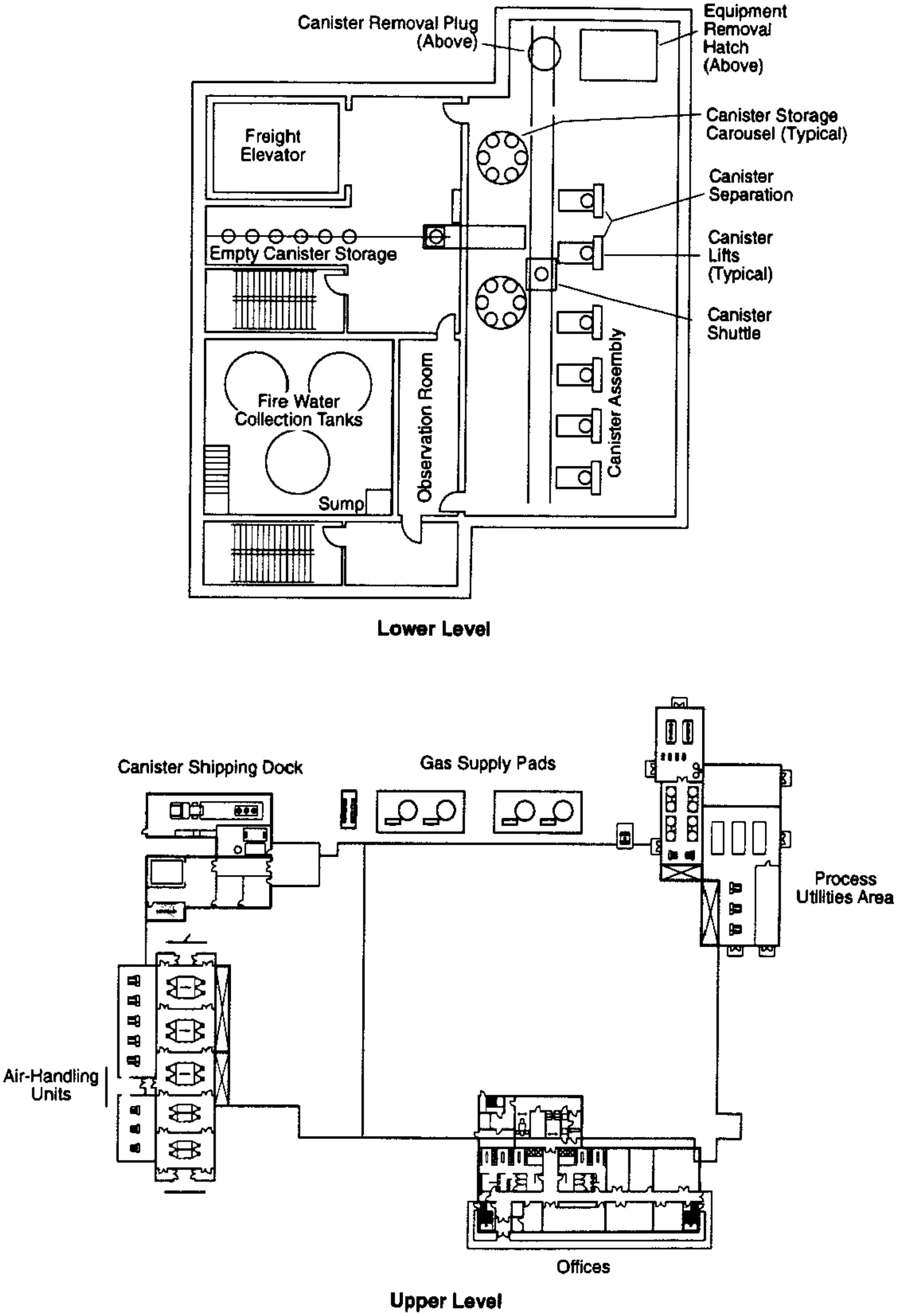
A general layout for the immobilization facility main process building is depicted in Figures 2–10 and 2–11. This layout approximates how the immobilization process would be implemented. However, the layout and design of the facility would vary depending on whether the facility were proposed as a new building, located in an existing building, or collocated in an existing building with either the pit conversion or MOX facility; and which immobilization process were selected. In addition to the main process building, the planned HLW vitrification facility at Hanford or DWPF at SRS would be used in part of the immobilization process. The design of the Hanford HLW vitrification facility would be modified as needed before the facility would be constructed. DWPF would have to be modified slightly to accommodate the proposed immobilization



APSF	Actinide Packaging and Storage Facility
FFTF	Fast Flux Test Facility
HYDOX	Hydride oxidation process
UO_2	Uranium dioxide
ZPPR	Zero Power Physics Reactor

Source: UC 1998i.

Figure 2–10. General Design of Immobilization Facility Main Processing Building—Main Level



Source: UC 1998i.

Figure 2–11. General Design of Immobilization Facility Main Processing Building—Upper and Lower Levels

activities. Modifications to DWPF would be needed to enable the receipt and storage of canisters containing immobilized plutonium. This would include modifications to security features as well as material handling systems. Minor changes within DWPF material processing or handling areas would be completed remotely. Construction worker exposures resulting from these modifications are expected to be negligible.

The main process building would house the following functions: material receiving, feed material storage, unpacking and sorting operations, fuel decladding, metal-to-oxide conversion, calcination, halide removal, sample preparation and product assay, in-process storage, feed blending and preparation, immobilization of the plutonium using either a ceramic or glass process, can loading, and canister loading. Separate truck bays would be designed to accommodate the DOE SSTs that would be used to transport plutonium feed materials. Functions of the planned HLW vitrification facility would include canister receipt and unloading, canister filling with HLW, decontamination, and closure.

The main process building would be a reinforced concrete structure meeting all applicable standards for the processing of special nuclear material. Areas of the building in which plutonium would be processed or stored would be designed to survive natural phenomena such as earthquakes, floods, and tornadoes, as well as potential accidents associated with the radioactive and fissile materials. Ancillary buildings would be required for support activities.

Confinement barriers would separate the immobilization facility into zones so as to control the spread of any airborne contamination. The exhaust from process operations would be properly confined, filtered, and monitored prior to release. The facility would have heating, ventilation, and air conditioning systems and HEPA filters, with provisions for redundant trains of HEPA filters and equipment to facilitate maintenance activities such as filter cleaning while maintaining zone-regulated air flow. An uninterruptible power supply and emergency generators would provide backup power for critical systems. This arrangement would ensure that critical systems remained in operation during any interruption of offsite power.

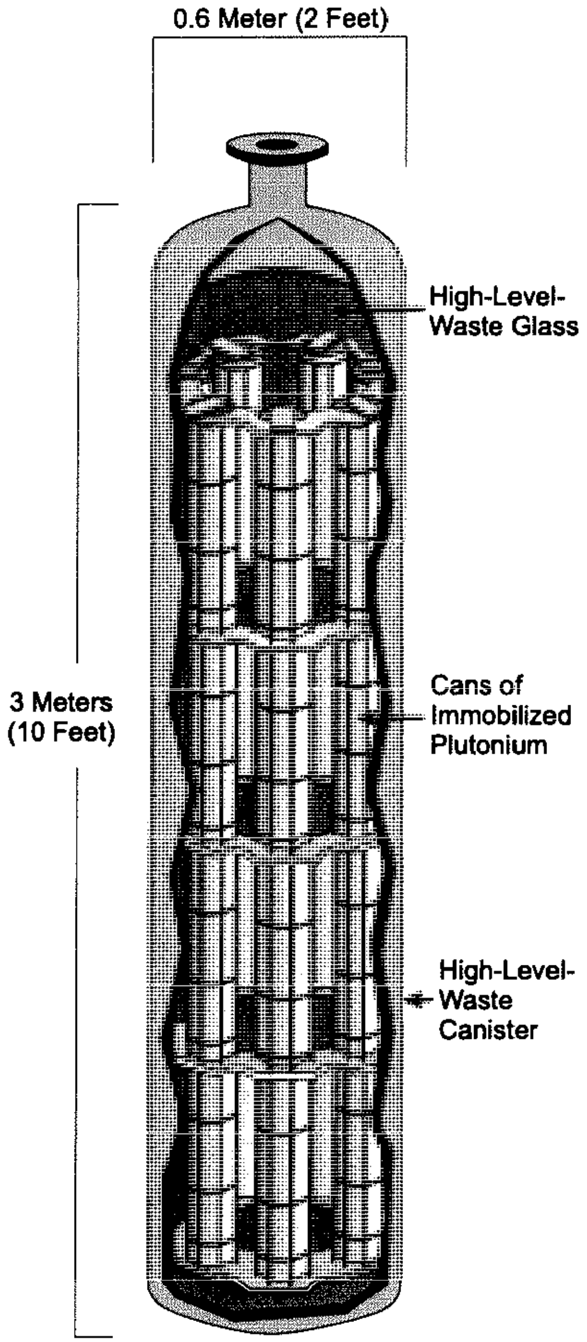
2.4.2.2 Plutonium Conversion and Immobilization Process

The plutonium conversion and immobilization process would have the capability to immobilize surplus plutonium material from both pit and nonpit sources. Surplus plutonium derived from pits and already processed by the pit conversion facility would be directly suitable for immobilization, whereas most surplus nonpit plutonium would first have to be converted to a suitable oxide. These oxides would then be incorporated into either a titanate-based ceramic material or a lanthanide borosilicate glass.

The plutonium immobilized in ceramic or glass would be placed inside stainless steel cans, which would be welded shut. The cans would be loaded onto a framework inside an HLW canister (the same type currently in use at DWPF at SRS), and a temporary closure plug inserted into the top of the canister head. At the HLW vitrification facility, the closure plug would be removed so that HLW could be poured into the canister to provide a radiation barrier for the final product. The filled canister, as depicted in Figure 2–12 would then be sealed and stored onsite pending final disposition in a geologic repository pursuant to the NWPA. Figure 2–13 provides an overview of the ceramic and glass can-in-canister immobilization processes.

2.4.2.2.1 Plutonium Conversion Process

Plutonium feed materials would be transported in DOE SSTs from the pit conversion facility (if not collocated with the immobilization facility) and the DOE sites storing surplus nonpit plutonium. The shipping containers would be unpacked and the nuclear material assayed at the immobilization facility. Several forms of surplus plutonium materials, all unclassified, would be received by the facility: metal reactor fuel in the form of pins and plates clad in stainless steel (from the Zero Power Physics Reactor [ZPPR] at INEEL), oxide reactor fuel



Source: UC 1997f.

Figure 2–12. Cut-Away View of Can-in-Canister Approach

consisting of fuel pins and bundles (from the FFTF at Hanford), plutonium alloys, metals, and oxides. Some of these feed materials would also have a uranium component. A feed material storage vault would be available to store up to 6 months of incoming plutonium feed materials.

Individual containers would be transferred from the feed material storage vault to a glovebox, unpacked, and inspected to determine the conversion process necessary to render the feed material suitable for immobilization. Metals and alloys would be converted to oxide using the HYDOX process. Metal reactor fuel may require decladding before HYDOX conversion. Oxide reactor fuel would also be decladded, and the individual fuel pellets removed and sorted according to fissile material content. Pellets containing plutonium or enriched uranium would then be ground to an acceptable particle size. Oxides containing moisture or other impurities would undergo a calcining process; oxides containing significant concentrations of halide impurities would be "washed" with water to remove the halides before calcining could take place.

Following these conversion processes, the plutonium materials would be stored in the in-process storage vault. Clean oxides—in particular, oxides received from the pit conversion facility, if the decision were made to immobilize all the surplus plutonium—would not require conversion and would be transferred directly to the vault.

2.4.2.2.2 Immobilization Process

Ceramic Process. The ceramic immobilization process would be conducted in a series of glovebox operations that would incorporate the plutonium oxide into ceramic disks, stack the disks inside stainless steel cans, and load the cans into a HLW canister.

In the feed-blending step, plutonium dioxide feed materials would be selected from in-process storage for blending with depleted uranium dioxide. Uranium dioxide would be added to generate a consistent product and reduce criticality concerns, and neutron absorbers (for example, the elements gadolinium or hafnium) would be added to provide criticality safety in the ceramic product. As

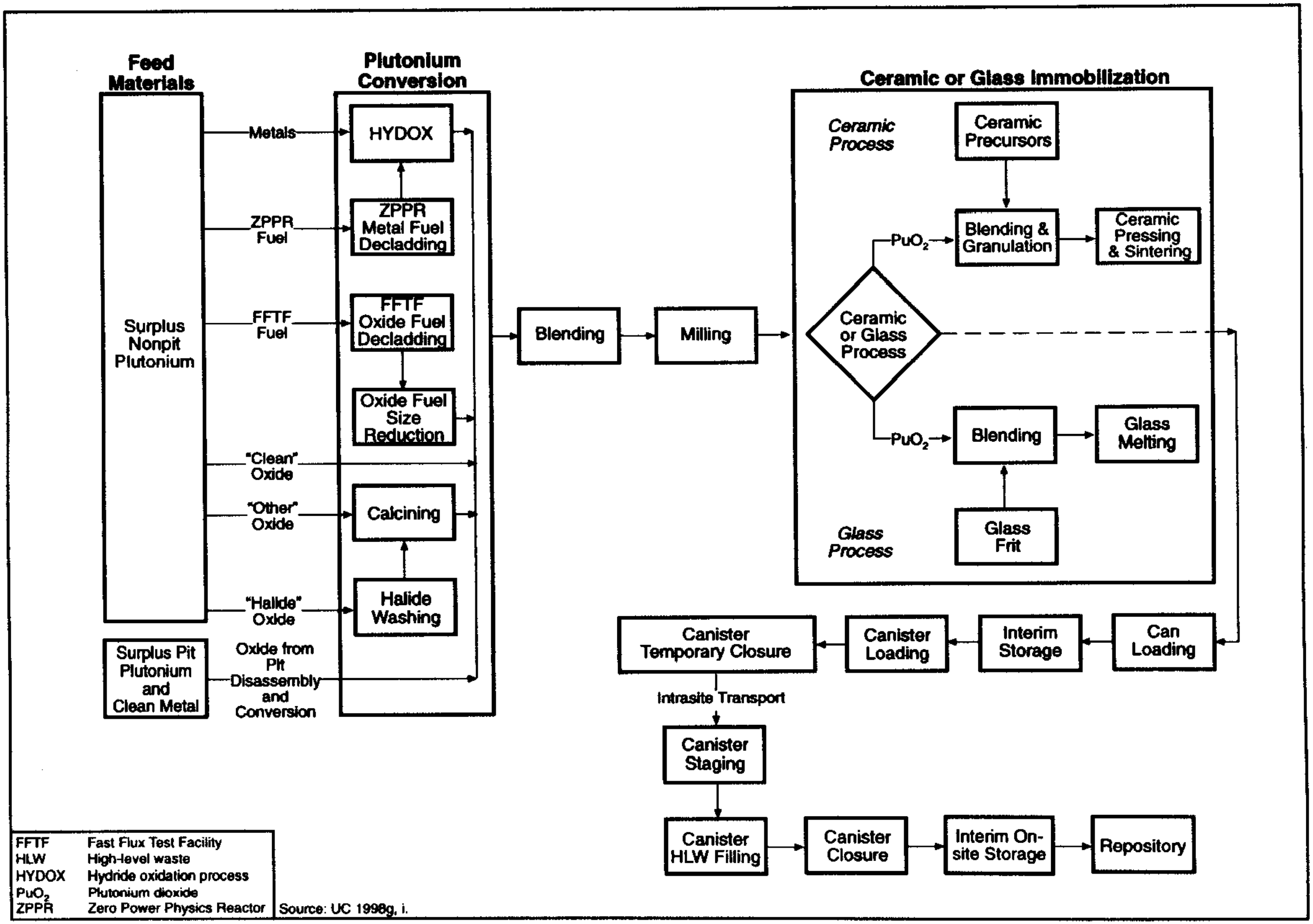


Figure 2–13. Can-in-Canister Process

explained in Section 1.5, uranium dioxide made from depleted uranium hexafluoride in storage at the gaseous diffusion plants previously operated by DOE, such as the Portsmouth Gaseous Diffusion Plant, would be used for this purpose.

After blending, each batch of feed material would be milled to reduce the size of the oxide powder, then blended with ceramic precursors. This mixture would then be granulated with an organic binder to produce a pourable feed that would hold together adequately when compacted into disks. In the press and sinter step, the mixture would be fed into a hydraulic press to form disks, which in turn would be baked in a furnace for reactive sintering to produce the desired mineral phases in the ceramic form. The final product would consist of homogeneous disks about 6.3 cm (2.5 in) in diameter by 2.5 cm (1 in) in height, containing about 10 weight-percent plutonium and 20 weight-percent uranium. These disks would then be stacked and sealed inside stainless steel cans, leak tested, assayed, and stored in the product vault until removed for canister-filling operations.

The cans of ceramic disks would be removed from storage as needed and placed onto a canister rack inside a HLW canister. A temporary closure plug would be installed, and following leak testing, the canister would be loaded into a shielded transportation box for intrasite shipment from the main process building to the HLW vitrification facility in a specialized canister transport vehicle.

Glass Process. The glass immobilization process would be conducted in a series of glovebox operations that would incorporate the plutonium oxide into molten lanthanide borosilicate glass, pour it into stainless steel cans, and load the cans into an HLW canister.

In the feed-blending step, plutonium oxide feed materials would be selected from in-process storage for blending to produce individual batches with the desired isotopic composition. Each batch would be milled to reduce the size of the oxide powder to achieve faster dissolution during the melting process. The milled oxide would then be blended with glass frit (small glass pebbles) containing neutron absorbers (e.g., gadolinium and hafnium) to form a mixture of about 8 weight-percent plutonium and 3 to 8 weight-percent uranium.

This mixture would be fed at a controlled rate into electrically heated melters operating at about 1500 °C (2732 °F) to melt the frit and dissolve the plutonium oxide. The homogenous glass melt would be drained into stainless steel cans, which in turn would be sealed, leak tested, assayed, and stored in the product vault. As needed, these cans would be removed from storage and placed onto a canister rack inside a HLW canister. A temporary closure plug would be installed, and following leak testing, the canister would be loaded into a shielded transportation box for intrasite shipment from the main process building to the HLW vitrification facility in a specialized canister transport vehicle.

Canister Filling. Canister filling, the last major step of the immobilization process, would occur at the HLW vitrification facility. The canisters received from the main process building would be moved individually through an inspection area to the HLW melt cell. In the melt cell, molten, vitrified HLW would be poured into the canister around the stainless steel cans of immobilized plutonium. After removal of any contamination from its outside surface, the canister would be plugged and welded closed. Following inspection and verification that the exterior of the canister was free of contamination, the canister would be transported to an onsite storage vault for interim storage pending final disposition at a geologic repository pursuant to NWPA.

The HLW canisters would measure 0.6 m (2 ft) in diameter by 3 m (10 ft) in height, and, when filled, would weigh about 2,500 kg (5,500 lb). As each canister of plutonium immobilized in ceramic would contain about

27 kg (59 lb) of plutonium,[3] about 1,860 of these canisters would be required to process all 50 t (55 tons) of surplus plutonium. This would result in 210 canisters more than planned for the DOE HLW vitrification program. Each canister of plutonium immobilized in glass would contain about 26 kg (58 lb) of plutonium.[3] About 1,900 canisters would be required to vitrify the 50 t (55 tons) of surplus plutonium, which would result in 340 canisters more than planned for the DOE HLW vitrification program. For the hybrid alternatives, about 680 canisters of plutonium immobilized as a ceramic or 690 canisters of vitrified plutonium would be produced. This would result in 77 or 124 additional canisters, depending on whether the immobilized form were ceramic or glass, respectively, than planned for the DOE HLW vitrification program.

2.4.3 MOX Fuel Fabrication

The MOX facility would produce completed MOX fuel assemblies for use in domestic, commercial nuclear power reactors. Feed materials would be the plutonium dioxide from the pit conversion facility and uranium dioxide, made from either the DOE stockpile of depleted uranium hexafluoride at a representative DOE site, (i.e., the Portsmouth Gaseous Diffusion Plant) or another source selected by the fuel fabricator and approved by DOE. MOX fuel fabrication involves blending the plutonium dioxide with uranium dioxide; forming the mixed oxide into pellets; loading the pellets into fuel rods; and assembling the fuel rods into fuel assemblies. Once assembled, the fuel would be transported to a domestic, commercial reactor for use as fuel. Following irradiation, the MOX fuel would be removed from the reactor and managed at the reactor site as spent fuel. Final disposition would be at a geologic repository pursuant to NWPA.

2.4.3.1 MOX Facility Description

The MOX facility would be designed to process up to 3.5 t (3.8 tons) of surplus plutonium (as plutonium dioxide from the pit conversion facility) annually. Facility operation would require a staff of about 350 personnel. As depicted in Figures 2–14 and 2–15, the MOX facility would be a two-story, hardened, reinforced concrete structure with a below-grade basement and an at-grade first floor. The facility would meet all applicable standards for processing special nuclear material. The walls, floors, and roof of the building would be constructed of about 46-cm (18-in) thick reinforced concrete. Areas of the facility in which plutonium would be processed or stored would be designed to survive natural phenomena such as earthquakes, floods, and tornadoes, as well as potential accidents associated radioactive and fissile materials. Ancillary buildings would be required for support activities.

The fuel fabrication areas, two parallel process lines, would be at ground level. To accommodate the potential for fabricating a different type of fuel, such as for the Canadian Deuterium Uranium (CANDU) reactors,[4] the MOX facility would have sufficient unused space for the installation of another production-scale MOX fuel line. An inert atmosphere would be maintained in gloveboxes where dictated by process needs or safety concerns. The exhaust from the gloveboxes would be monitored continuously for radioactive contamination. The atmosphere in the gloveboxes would be kept at a lower pressure than that of the surrounding areas so that any leaks of gaseous or suspended particulate matter would be contained and filtered appropriately. The building ventilation system would include HEPA filters, and would be designed to maintain confinement, thus precluding the spread of airborne radioactive particulates or hazardous chemicals within the facility and to the outside environment. Both intake and exhaust air would be filtered, and exhaust gases would be monitored for radioactivity. Power would be supplied to the MOX facility by two independent offsite power supplies. An uninterruptible power supply and standby generators would provide backup power for critical systems.

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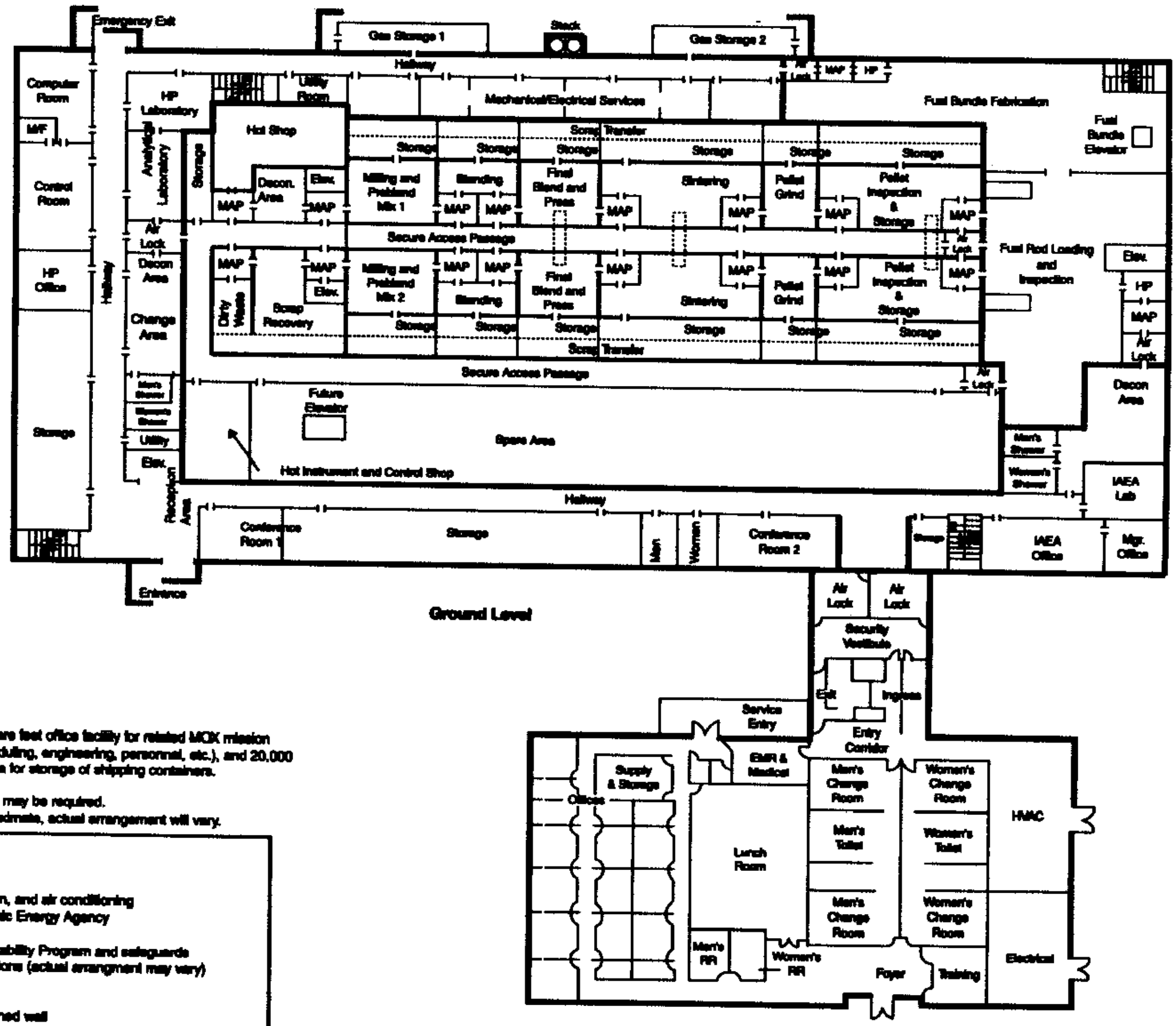
[3] Plutonium loading in the final design specification and between individual canisters may vary slightly.

[4] As discussed in Section 1.1, DOE reserves the option to use some of the surplus plutonium as MOX fuel in CANDU reactors in the event that a multilateral agreement were negotiated among Russia, Canada, and the United States.



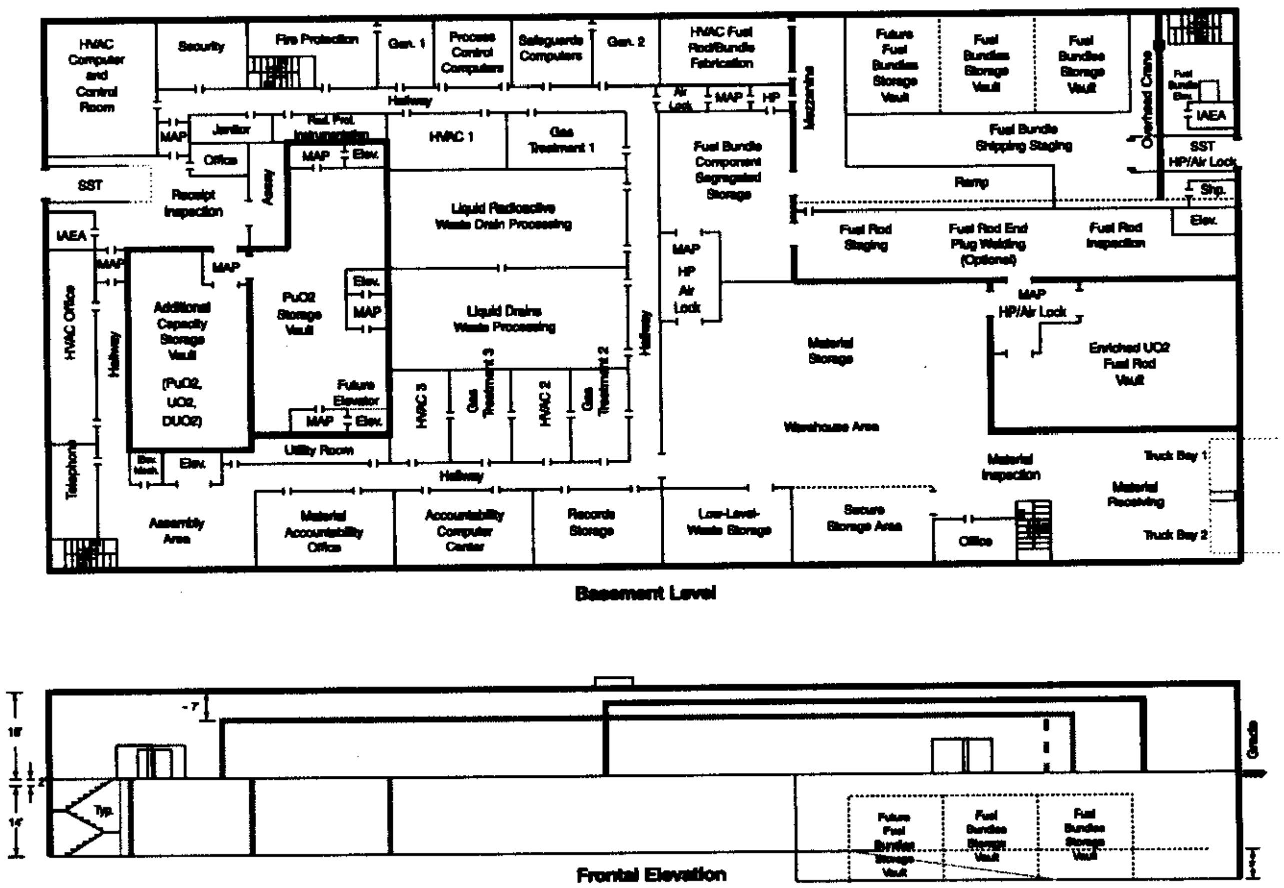
Notes:

1. Not shown, 10-20,000 square feet office facility for related MOX mission support (e.g. training, scheduling, engineering, personnel, etc.), and 20,000 square feet warehouse area for storage of shipping containers.
2. Category 1 Building
3. Additional security facilities may be required.
4. Room/area sizes are approximate, actual arrangement will vary.

Decon	Decontamination
Elev	Elevator
HP	Health physics
HVAC	Heating, ventilation, and air conditioning
IAEA	International Atomic Energy Agency
Lab	Laboratory
MAP	Materials Accountability Program and safeguards and security functions (actual arrangment may vary)
Mgr	Manager's
RR	Rest room
▬▬	Structurally hardened wall
——	Shield wall

Source: UC 1998m.

Figure 2–14. General Design of MOX Facility—Ground Level



Source: UC1996m.

DUO_2	Depleted uranium dioxide	Mech	Mechanical
Elec	Electrical	Prot	Protection
Elev	Elevator	PuO_2	Plutonium dioxide
Gen	Generator	Rad	Radiation
HP	Health physics	Shp	Shipping
HVAC	Heating, ventilation, and air conditioning	SST	Safe, secure trailer
IAEA	International Atomic Energy Agency	UO_2	Uranium dioxide
MAP	Materials Accountability Program and safeguards and security functions (actual arrangment may vary)	(thick line)	Structurally hardened wall
		(thin line)	Shield wall

Notes:
1. Not shown, 10-20,000 square feet office facility for related MOX mission support (e.g. training, scheduling, engineering, personnel, etc.), and 20,000 square feet warehouse area for storage of shipping containers.
2. Category 1 Building
3. Additional security facilities may be required.
4. Room/area sizes are approximate, actual arrangement will vary.

Figure 2–15. General Design of MOX Facility—Basement Level and Frontal Elevation

This arrangement would ensure continued operation of critical systems during any interruption of offsite power.

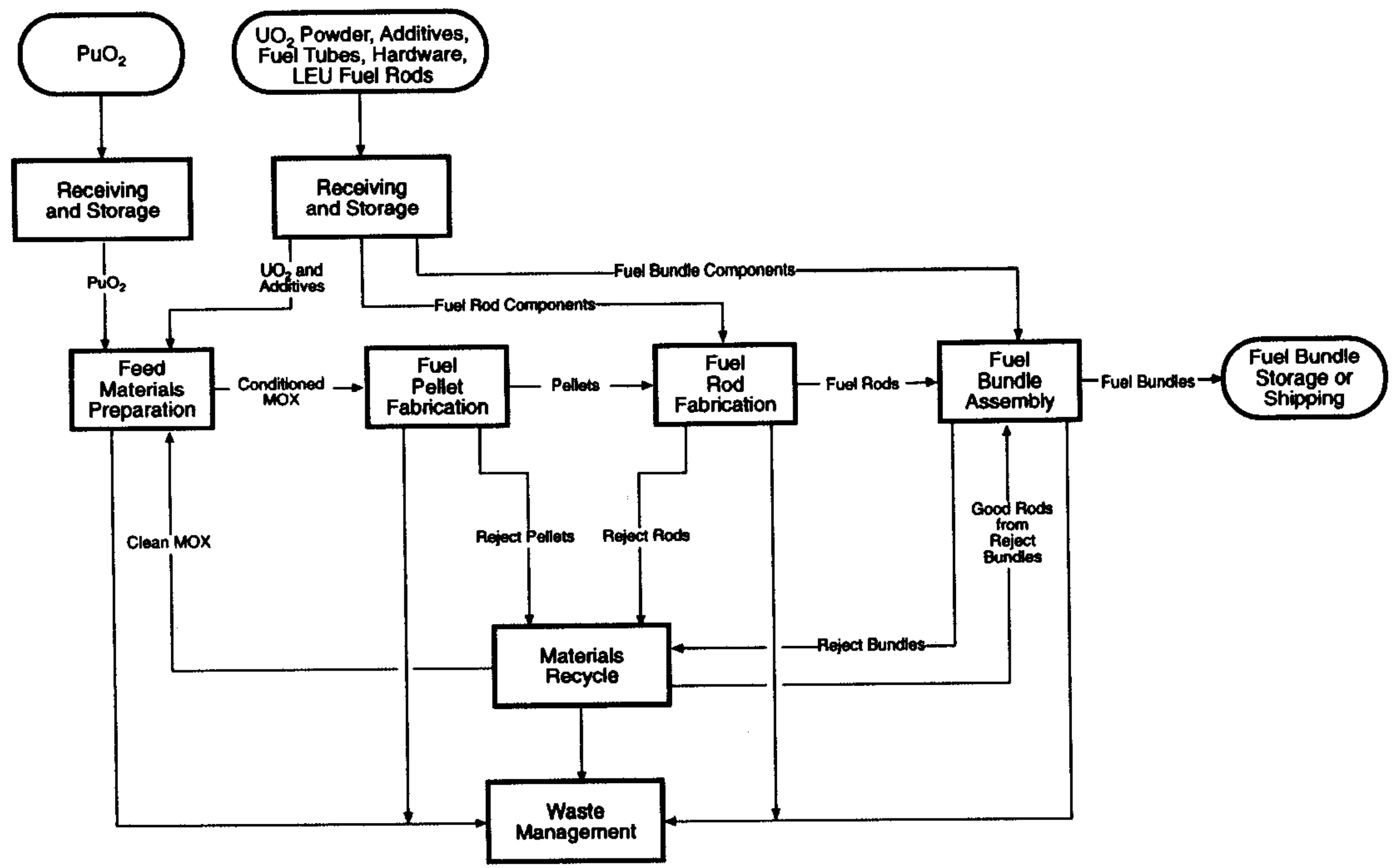
The basement level of the MOX facility would contain areas for support activities, including special nuclear material vault areas; general shipping and receiving docks; a general warehouse area; radioactive waste storage; assay facilities; emergency generators; heating, ventilation, and air conditioning equipment; process gas and waste processing and treatment areas; the fuel rod fabrication area; and the fuel bundle assembly, storage, and shipping areas. Separate truck bays would be designed to accommodate the DOE SSTs that would be used to transport the plutonium dioxide powder and the unirradiated fuel assemblies. Access control, office space, and warehouse facilities have been proposed for areas outside the secure MOX facility building. Facilities to support IAEA inspection and oversight activities would also be provided. Existing DOE site security and emergency services and environmental monitoring would support the MOX fuel fabrication mission.

MOX fuel is made from a mixture of plutonium dioxide and uranium dioxide. The uranium dioxide would be received from a commercial, NRC-licensed conversion facility. Conversion services for low-enriched uranium hexafluoride are commercially available in the United States at five facilities. As explained in Sections 2.4.4.2 and 2.4.4.3, for purposes of the analyses in this SPD EIS, General Electric (GE) Nuclear Energy Production Facility in Wilmington, North Carolina, was used as a representative conversion facility. The Portsmouth Gaseous Diffusion Plant near Piketon, Ohio, was analyzed as the representative facility for the depleted uranium hexafluoride to be converted into uranium dioxide.

2.4.3.2 MOX Fuel Fabrication Process

Figure 2–16 provides an overview of the MOX fuel fabrication process. The vast majority of the MOX fuel matrix, about 95 percent, is uranium dioxide. MOX fuel fabrication is essentially the same process that is used to produce low-enriched uranium fuel for commercial nuclear power reactors, once the plutonium and uranium dioxide powders are blended together into a mixed oxide. Processing of feed materials would begin by verifying that the materials met fabrication requirements, then would proceed to blending and milling the plutonium dioxide powder to ensure general consistency in enrichment and isotopic concentration. The uranium and plutonium powders would be blended and milled together to ensure uniform distribution of the plutonium in the MOX, and to adjust the particle size of the MOX powder. The MOX powder would then be made into pellets by pressing the powder into shape, sintering (baking at high temperature) the formed pellets, and grinding the sintered pellets to the proper dimensions. Materials and pellets would be inspected at each stage, and any rejected materials would be returned to the process for reuse. All operations would be performed in sealed gloveboxes with inert atmospheres. Sintering furnaces would also be sealed, and offgases would be filtered and monitored prior to release to the atmosphere.

The finished pellets would be moved to the fuel rod fabrication area, where they would be loaded into empty rods. The rods would be sealed, inspected, and decontaminated, then bundled together to form fuel assemblies. Fuel assemblies would consist of only MOX rods or a mixture of MOX and low-enriched uranium rods. Low-enriched uranium rods used in fuel assembly fabrication would be fabricated at another of the fuel fabricator's facilities and brought to the MOX facility for final assembly with the MOX rods. Any rejected fuel bundles would be disassembled, and the materials recycled. Useable rods would be reassembled into new fuel assemblies. Pellets from rods not meeting final product specifications would be crushed and returned to the fabrication process, and decontaminated tubes and hardware would be recycled offsite as scrap metal. Storage for a year's production of fuel assemblies would be provided at the MOX facility. Individual fuel assemblies could be stored for as long as 18 months prior to shipment to the designated domestic, commercial reactor, although production would likely closely follow product need.



LEU	Low enriched uranium
MOX	Mixed oxide
PuO_2	Plutonium dioxide
UO_2	Uranium dioxide

Source: UC 1998m.

Figure 2–16. MOX Fuel Fabrication Process

As discussed in Section 2.4.1.2, a polishing step is being analyzed as a process contingency that would ensure levels of gallium in the MOX fuel feed material are routinely within specification. This step could be added to either the pit conversion or MOX facility.[5] A description of this polishing step, and an evaluation of the potential environmental impacts of its implementation at either the pit conversion or MOX facility are presented in Appendix N.

2.4.4 Transportation Activities

The plutonium disposition alternatives examined in this SPD EIS would require DOE to ship surplus plutonium-bearing materials from their current storage locations, shown in Figure 1–1, to the proposed disposition facility locations for processing. Table 2–3 is an overview of the different types of shipments that would be required for each proposed disposition facility, and the vehicles in which the shipments would be made.

The overland transportation of any commodity involves a risk to both the transportation crew and members of the public. The risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of hazardous or radioactive materials pose an additional risk due to the unique nature of the material being transported. Chapter 4 and Appendix L discuss the risks associated with the transportation of these materials and the steps that would be taken to mitigate these risks as they relate to this SPD EIS.

2.4.4.1 Pit Conversion Transportation Requirements

To implement any of the disposition alternatives being considered in this SPD EIS, clean plutonium metal and surplus pits would need to be shipped from current storage locations around the DOE complex to the proposed location of the pit conversion facility. Due to the attractiveness of these materials for use in constructing nuclear weapons, all intersite shipments would be made in DOE SSTs.[6] In the alternatives that include locating the pit conversion facility at Pantex, where surplus pits are stored, the transfer of the surplus pits from onsite storage to the pit conversion facility would be made in specially designed transport vehicles that are routinely used to transport pits around the site. This would reduce the number of intersite trips and the distance that would have to be traveled to transport pits to the pit conversion facility. Also, as discussed in Appendix L, the dose from pit-handling activities could be reduced by nearly 40 percent because the pits would be transferred from their current storage locations to the pit conversion facility without being repackaged into the shipping containers that would be required for intersite transport.

After conversion, the plutonium from the pit conversion facility would be in the form of plutonium dioxide. For most of the alternatives, this material would be transferred from the pit conversion facility to either the immobilization or MOX facility through a secure underground tunnel. In alternatives 6B, 6D, and 11A, where the pit conversion facility is collocated in the same building with the associated disposition facility, the plutonium dioxide would be transferred within the building. However, several alternatives (4A and B; 5A and B; 11B; and 12C and D) locate the pit conversion facility at Pantex and immobilization and/or MOX

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[5] In response to the RFP discussed in Section 2.1.3, the offerors may propose to include a polishing process in the MOX Facility.

[6] The SST is a specially designed component of an 18-wheel tractor-trailer vehicle. Although the details of the vehicle enhancements are classified, key characteristics are not, and include: enhanced structural supports and a highly reliable tie-down system to protect cargo from impact; heightened thermal resistance to protect the cargo in case of fire; deterrents to protect the unauthorized removal of cargo; couriers who are armed federal officers and receive rigorous training and are closely monitored through DOE's Personnel Assurance Program; an armored tractor to protect the crew from attack and advanced communications equipment; specially designed escort vehicles containing advance communications and additional couriers; 24 hour-a-day real-time monitoring of the location and status of the vehicle; and significantly more stringent maintenance standards.

Table 2–3. Facility Transportation Requirements

Required Shipment	Vehicle[a]
Pit Conversion Facility	
Surplus pits and clean metal to the pit conversion facility	SST
Recovered HEU from the pit conversion facility to ORR	SST
Recovered pit parts from the pit conversion facility to LANL	SST
Plutonium dioxide to the immobilization or MOX facility	SST
Immobilization Facility	
Under Alternatives 11B, 12C, and 12D, plutonium dioxide from the pit conversion facility[b]	SST
Surplus nonpit plutonium to the immobilization facility	SST
Depleted uranium hexafluoride from one of DOE's sites at a gaseous diffusion plant to a conversion facility (ceramic immobilization option only)	Commercial truck[c]
Uranium dioxide from the conversion facility to the immobilization facility (ceramic immobilization option only)	Commercial truck
Immobilized plutonium from immobilization facility to the HLW vitrification facility (intrasite transport)	Special transport vehicle
Vitrified HLW with immobilized plutonium to a geologic repository	Commercial truck
MOX Facility	
Under Alternatives 4 and 5, plutonium dioxide from the pit conversion facility[d]	SST
Depleted uranium hexafluoride from one of DOE's sites at a gaseous diffusion plant to a commercial conversion facility	Commercial truck
Uranium dioxide from the conversion facility to the MOX facility	Commercial truck
Uranium fuel rods from a commercial fuel fabrication facility to the MOX facility	Commercial truck
MOX fuel bundles to a domestic, commercial nuclear reactor	SST
Lead Assembly Fabrication Facility	
Plutonium dioxide from LANL to a lead assembly facility at a location other than LANL	SST
For lead assembly fabrication at LANL, intrasite movement of plutonium materials	Special transport vehicle
Depleted uranium hexafluoride from one of DOE's sites at a gaseous diffusion plant to a commercial conversion facility	Commercial truck
Uranium dioxide from the conversion facility to the lead assembly facility	Commercial truck
Uranium fuel rods from a commercial fuel fabrication facility to the MOX facility	Commercial truck
MOX fuel bundles to a domestic, commercial nuclear reactor	SST
Irradiated lead assemblies or rods from a reactor to an examination site	Commercial truck

[a] All containers and vehicles will meet Department of Transportation requirements.
[b] Under Alternatives 11A, 12A, and 12B, the two facilities would be collocated; therefore, the transfer of the plutonium dioxide would not require any over-the-road transportation.
[c] Commercial trucks will be driven by drivers certified to meet all radioactive materials transportation requirements.
[d] Under Alternatives 2, 3, 6, 7, 9, and 10, the two facilities would be collocated; therefore, the transfer of the plutonium dioxide would not require any over-the-road transportation.

Key: HEU, highly enriched uranium; HLW, high-level waste; LANL, Los Alamos National Laboratory; ORR, Oak Ridge Reservation; SST, safe, secure trailer.

facilities at another site. The reason for including these alternatives is that the vast majority of the surplus pits are stored at Pantex, so less intersite transportation would be required to move these pits to the pit conversion facility. Under these alternatives, the plutonium dioxide from the pit conversion facility would be shipped in SSTs to the other proposed disposition facilities.

As a result of pit disassembly, some HEU and classified pit parts would be recovered. The HEU would be shipped via SST to Oak Ridge Reservation for storage[7] and the reusable pit parts would be shipped via SST to LANL.

2.4.4.2 Immobilization Transportation Requirements

To implement the immobilization disposition alternatives being considered in this SPD EIS, surplus nonpit plutonium in various forms, excluding clean metal, would be moved from their current storage locations (i.e., Hanford, INEEL, LANL, the Rocky Flats Environmental Technology Site [RFETS], and SRS), to the proposed immobilization facility location, either Hanford or SRS. The quantity of the plutonium contained in these materials dictates that they be subjected to the same safeguards and security requirements as materials that could be used in nuclear weapons. Therefore, intersite shipments would be made in SSTs.

For Alternatives 11 and 12, where all the surplus plutonium would be immobilized, the plutonium dioxide from the pit conversion facility would also be transferred to the immobilization facility. For Alternative 11A, both facilities would be collocated in FMEF and the transfer would take place within the same building, requiring no additional transportation. For Alternative 12A, the transfer would be made between the two facilities through a secure underground tunnel and would not require any vehicular transportation. Under Alternative 12B, the transfer would be made within the security fence at F-Area, where the material would be moved between buildings in a specially designed transport vehicle with a security escort. The material would not be transported on public roads. However, as discussed in Section 2.4.4.1, for Alternatives 11B, 12C, and 12D, the plutonium dioxide would be shipped from the pit conversion facility at Pantex to the immobilization facility at either Hanford or SRS in SSTs.

Surplus plutonium destined for immobilization would be immobilized in either a ceramic or glass form, placed in small stainless steel cans and then into HLW canisters at the immobilization facility. The canisters would then be transported in specially designed intrasite transport vehicles to a HLW vitrification facility (either DWPF at SRS, or the planned HLW vitrification facility at Hanford). In keeping with the current practice at these sites for this type of shipment, this intrasite transportation could require roads at Hanford or SRS to be closed temporarily while the material would be transported from one area of the site to another. This practice would provide all needed security measures and mitigate potential risk to the public, without requiring the use of SSTs for intrasite transfers.

Immobilization of the plutonium as a ceramic material also requires a small amount of depleted uranium dioxide (e.g., less than 10 t per year) as discussed in Section 2.4.2.2.2. This depleted uranium dioxide could be produced by shipping depleted uranium hexafluoride from one of DOE's storage areas at a gaseous diffusion plant in Kentucky, Ohio, or Tennessee via commercial truck to a commercial site for conversion to depleted uranium dioxide. Possible sites for this conversion include nuclear fuel fabrication facilities in Missouri, North Carolina, South Carolina, or Washington, or a uranium conversion facility in Illinois. After conversion to uranium dioxide at one of these sites, it would be shipped on a commercial truck to either Hanford or SRS for use in the immobilization facility. Because the risks associated with transporting either

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7 Shipments would be in accordance with *The Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee* (DOE/EA-0929, September 1994; FONSI, September 1995). Storage would be in accordance with the *ROD for the Storage and Disposition PEIS*.

depleted uranium hexafluoride or depleted uranium dioxide are extremely low, the shipments could be made to or from any of the locations discussed above and not significantly affect the overall risks associated with the transportation required in this SPD EIS. For the purposes of quantifying the transportation analysis in this SPD EIS, it was assumed that the depleted uranium hexafluoride would be shipped from the DOE facility at the Portsmouth Gaseous Diffusion Plant near Piketon, Ohio, to a conversion facility in Wilmington, North Carolina.

After the immobilized plutonium would be encased by HLW at the HLW vitrification facility, it would eventually be shipped to a geologic repository for ultimate disposal. Because the cans of immobilized plutonium would displace some of the HLW that would otherwise fill the canister, additional canisters would have to be filled over the life of the immobilization program to address this displaced HLW. It is estimated that up to 340 additional canisters of HLW would result from the decision to immobilize all 50 t (55 tons) of surplus plutonium. The *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (WM PEIS) analyzed a number of different options for the shipment of these canisters using either trucks or trains. The analysis in the WM PEIS indicated that the risks would be lower if the canisters were shipped by train. However, no ROD has been issued regarding these shipments. To bound the risks, this SPD EIS has taken the most conservative analytical approach (i.e., the approach that results in the highest risk to the public) and assumed that all of these shipments would be made by truck to the geologic repository, with one canister being loaded on each truck.

2.4.4.3 MOX Transportation Requirements

To implement the MOX disposition alternatives being considered in this SPD EIS, plutonium dioxide from the pit conversion facility would have to be transferred to the MOX facility. Under all the MOX alternatives except Alternatives 4 and 5, the pit conversion and MOX facilities would be located at the same site. For Alternatives 6B and D, the transfer would take place within the same building (FMEF). Under Alternatives 2, 3A, 3B, 6A, 6C, 7A, 7B, 8, 9A, 9B, and 10, current designs assume that facility materials would be transferred between the two facilities through a secure, underground tunnel. No vehicular transportation over public roads would be required for any of these alternatives. However, as discussed in Section 2.4.4.1, for Alternatives 4A, 4B, 5A, and 5B, the plutonium dioxide would be shipped in SSTs from the pit conversion facility at Pantex to the MOX facility at either Hanford or SRS.

MOX fuel fabrication also requires uranium dioxide. Depleted uranium dioxide could be produced by shipping depleted uranium hexafluoride from one of DOE's storage areas at a gaseous diffusion plant in Kentucky, Ohio, or Tennessee via commercial truck to a commercial site for conversion to depleted uranium dioxide. Possible sites for this conversion include nuclear fuel fabrication facilities in Missouri, North Carolina, South Carolina, or Washington, or a uranium conversion facility in Illinois. After conversion to uranium dioxide at one of these sites, it would be shipped on a commercial truck to Hanford, INEEL, Pantex, or SRS for use in the MOX facility. Because the radiological risks associated with transporting either depleted uranium hexafluoride or depleted uranium dioxide are extremely low, the shipments could be made from or to any of the locations discussed above and not significantly change the overall risks associated with the transportation required in this SPD EIS. For the purposes or quantifying the transportation analysis in this SPD EIS, representative sites for obtaining the depleted uranium dioxide were chosen. The Portsmouth Gaseous Diffusion Plant near Piketon, Ohio, represents the source of the depleted uranium hexafluoride and an NRC-licensed commercial nuclear fuel fabrication facility, GE Nuclear Energy Production Facility in Wilmington, North Carolina, represents the conversion facility.

After conversion, the depleted uranium dioxide would be shipped on a commercial truck from the conversion facility to the MOX facility. After fabrication, the MOX fuel would be shipped to a domestic, commercial reactor site where it would be inserted into the reactor and irradiated. These shipments would be made in SSTs because unirradiated MOX fuel in large enough quantities is subject to security concerns similar to those associated with weapons-grade plutonium. Because the actual reactors that would be used for this purpose have not yet been identified, the transportation analysis assumes that the reactor will be 4,000 km (2,500 mi) from the MOX facility.

2.4.4.4 Lead Assembly Transportation Requirements

To implement the MOX disposition alternatives being considered in this SPD EIS, MOX fuel assemblies campaign may be fabricated, irradiated and tested before the actual production of MOX fuel. As described in Section 2.17, plutonium dioxide from the pit conversion demonstration at LANL would be shipped in SSTs to one of four candidate DOE facilities (Hanford, ANL–W, LLNL, or SRS) or remain at LANL for fabrication into lead assemblies. If the lead assemblies were to be fabricated at LANL, the plutonium dioxide would be transferred from the pit conversion demonstration to the lead assembly fabrication facility within the same plutonium processing building (PF–4), in Technical Area 55 (TA–55), for MOX pellet production. Any intrasite transfers of plutonium outside of TA–55 would be in special vehicles in accordance with site practices for this type of shipment. This intrasite transportation could require temporary road closures while the material moved from one area of the site to another. This practice would provide all needed security and mitigate potential risk to the public, without requiring the use of SSTs for intrasite transfers.

The depleted uranium needed to support this effort is assumed to be shipped from one of DOE's storage areas at the Portsmouth Gaseous Diffusion Plant near Piketon, Ohio, to the nuclear fuel fabrication facility in Wilmington, North Carolina, for conversion, and then to the lead assembly fabrication site. All the transportation associated with depleted uranium would be via commercial truck.

After fabrication, the lead assemblies would be shipped to a domestic, commercial reactor for irradiation. These shipments would be made in SSTs because unirradiated MOX fuel in large enough quantities is subject to security concerns similar to those associated with weapons-grade plutonium. Because the actual reactors that would be used for this purpose have not yet been identified, the transportation analysis assumes that the reactor will be 4,000 km (2,500 mi) from the lead assembly fabrication facility.

After irradiation, the lead assemblies may be shipped from the reactor site to a postirradiation examination facility for analysis, as discussed in Section 2.17. Postirradiation examination, if required, would occur at one of two DOE sites, ANL–W or ORNL. As discussed in Section 2.1.3, these are the only two sites that have the capability to conduct postirradiation examination without major modifications to facility and processing capabilities. These shipments would be via commercial truck because the MOX fuel would be irradiated, thereby removing the proliferation concerns associated with plutonium. Because the actual postirradiation facility that would be used has not yet been identified, the transportation analysis assumes that it will be 4,000 km (2,500 mi) from the reactor site where the lead assemblies were irradiated. Any postirradiation examination activities and shipments would comply with the Consent Order and Settlement Agreement in Public Service Company of Colorado v. Batt (if the work were performed at ANL–W), and all other applicable agreements and orders, including provisions concerning removal of the material from the applicable examination site and limits on the number of truck shipments to the site.

2.4.4.5 Other Transportation Requirements

All the alternatives being considered in this SPD EIS require some overland transportation of wastes from the proposed disposition facilities to treatment, storage or disposal facilities. The proposed action does not result in a large increase in waste generation at any of the candidate sites, and transportation would be handled in the same manner as other site waste shipments. In addition, the shipments would not represent any new, different or additional risks beyond those associated with existing waste shipments at these sites, as analyzed in the WM PEIS. The possible exceptions are the alternatives that consider siting disposition facilities at Pantex and the alternative that considers placing the lead assembly fabrication facility at LLNL. Because Pantex does not currently generate any transuranic (TRU) waste and does not have any TRU waste in storage, the WM PEIS did not consider TRU waste being shipped from Pantex to Waste Isolation Pilot Plant (WIPP). Therefore, a small number of shipments of TRU waste to WIPP via commercial truck have been included in the transportation analysis in this SPD EIS. In addition, the projected amount of LLW generated by the proposed action would represent a large percentage of this waste type at both Pantex and LLNL, as analyzed in the WM PEIS. Because these sites ship LLW to the Nevada Test Site (NTS) for disposal, the transportation analysis in this SPD EIS includes a small number of shipments of LLW from Pantex and LLNL to NTS via commercial carrier.

2.5 ALTERNATIVE 1: NO ACTION

In the No Action Alternative, surplus weapons-usable plutonium materials in storage at various DOE sites shown in Figure 1–1 would remain at those locations. The vast majority of pits would continue to be stored at Pantex, and the remaining plutonium in various forms would continue to be stored at Hanford, INEEL, LANL, RFETS, and SRS. The No Action Alternative would not satisfy the purpose and need for the proposed action because DOE's disposition decisions in the *Storage and Disposition PEIS* ROD would not be implemented. The ROD announced that, consistent with the Preferred Alternative in the *Storage and Disposition PEIS*, DOE had decided to reduce, over time, the number of locations where the various forms of plutonium are stored, through a combination of storage and disposition alternatives. Implementation of much of this decision requires the movement of surplus materials to disposition facility locations. Without disposition facilities, only pits that are being moved from RFETS to Pantex would be relocated in accordance with the *Storage and Disposition PEIS* ROD. All other surplus materials would continue to be stored indefinitely at their current locations.[8]

2.6 ALTERNATIVE 2: ALL FACILITIES AT HANFORD
Pit Conversion in FMEF; Immobilization in FMEF and the HLW Vitrification Facility; MOX Fuel Fabrication in New Construction

This alternative would involve locating the three proposed surplus plutonium disposition facilities in the 400 Area at Hanford, combining the use of an existing building, FMEF, with new construction (see Figure 2–17). Canister filling would be accomplished at the planned HLW vitrification facility in the 200 East Area[9] (see Figure 2–18), about 24 km (15 mi) northwest of the 400 Area. FMEF, completed in 1984, is a reinforced concrete process building with an attached mechanical equipment wing on the west side, and an entry wing with administrative space across the south side. The building has six levels, two of which are below grade. FMEF was designed and constructed to fabricate fast breeder reactor fuel, but it has not been used for any major projects to date. The building has been modified since 1984, and the utility systems and support systems, including the ventilation system, have been completed. Designed to handle highly radioactive materials, FMEF includes a number of thick-walled cells surrounded by corridors. Space for offices, laboratories, control rooms, utilities, and other activities is available around the interior perimeter of the building. Modification to the interior spaces would be required to use the building for surplus plutonium disposition activities. No radioactive materials have been introduced into the building, so the modification

[8] Recent studies have indicated that cost savings could be realized from the transfer of nonpit materials from RFETS and Hanford to SRS earlier than specified in the *Storage and Disposition PEIS* ROD. A supplement analysis is being prepared to determine if a supplemental PEIS would be needed.

[9] The planned HLW vitrification facility is described in the *Tank Waste Remediation System Final Environmental Impact Statement*, and is currently scheduled to be available in a timeframe that would meet the needs of the Surplus Plutonium Disposition Program.

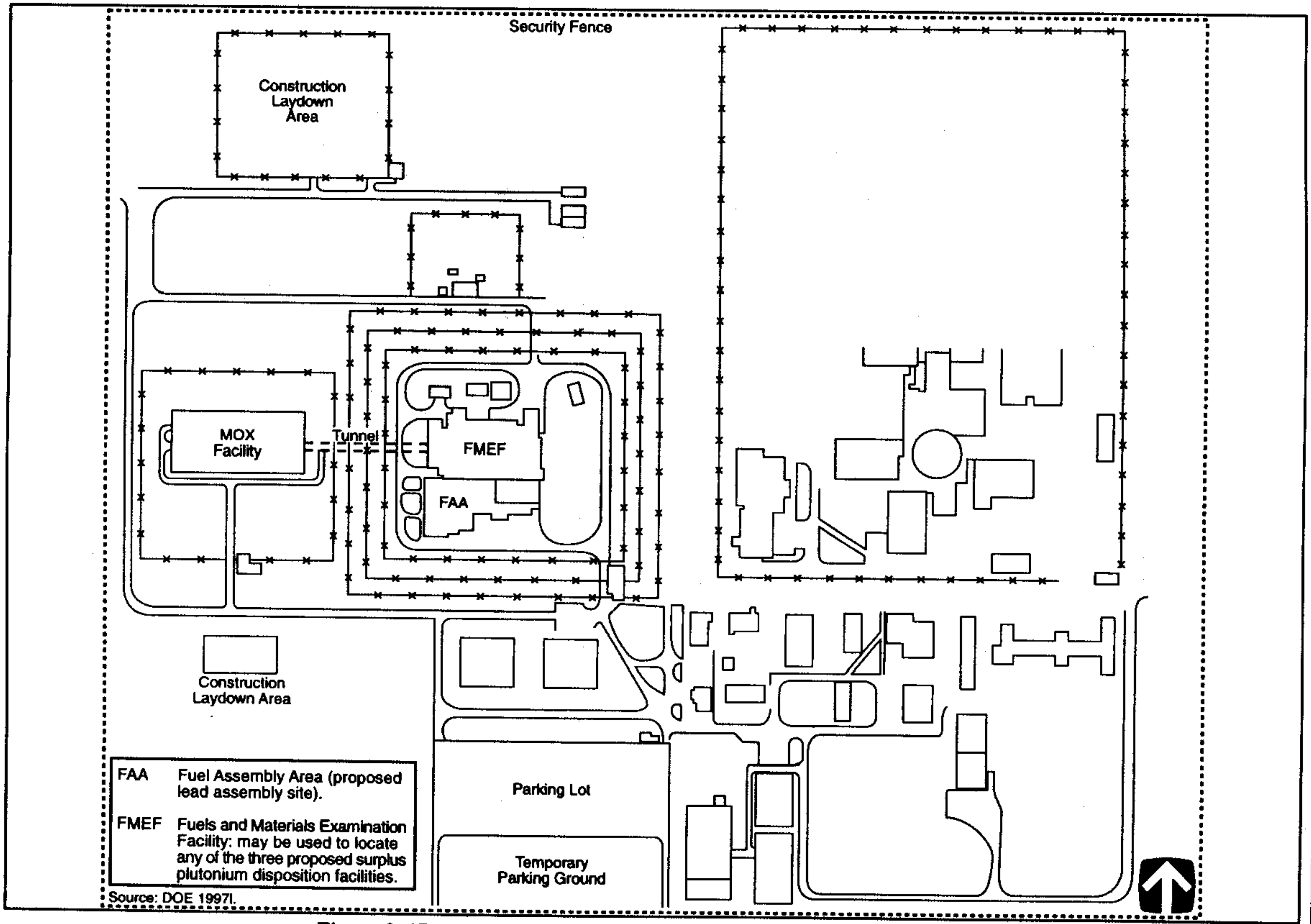
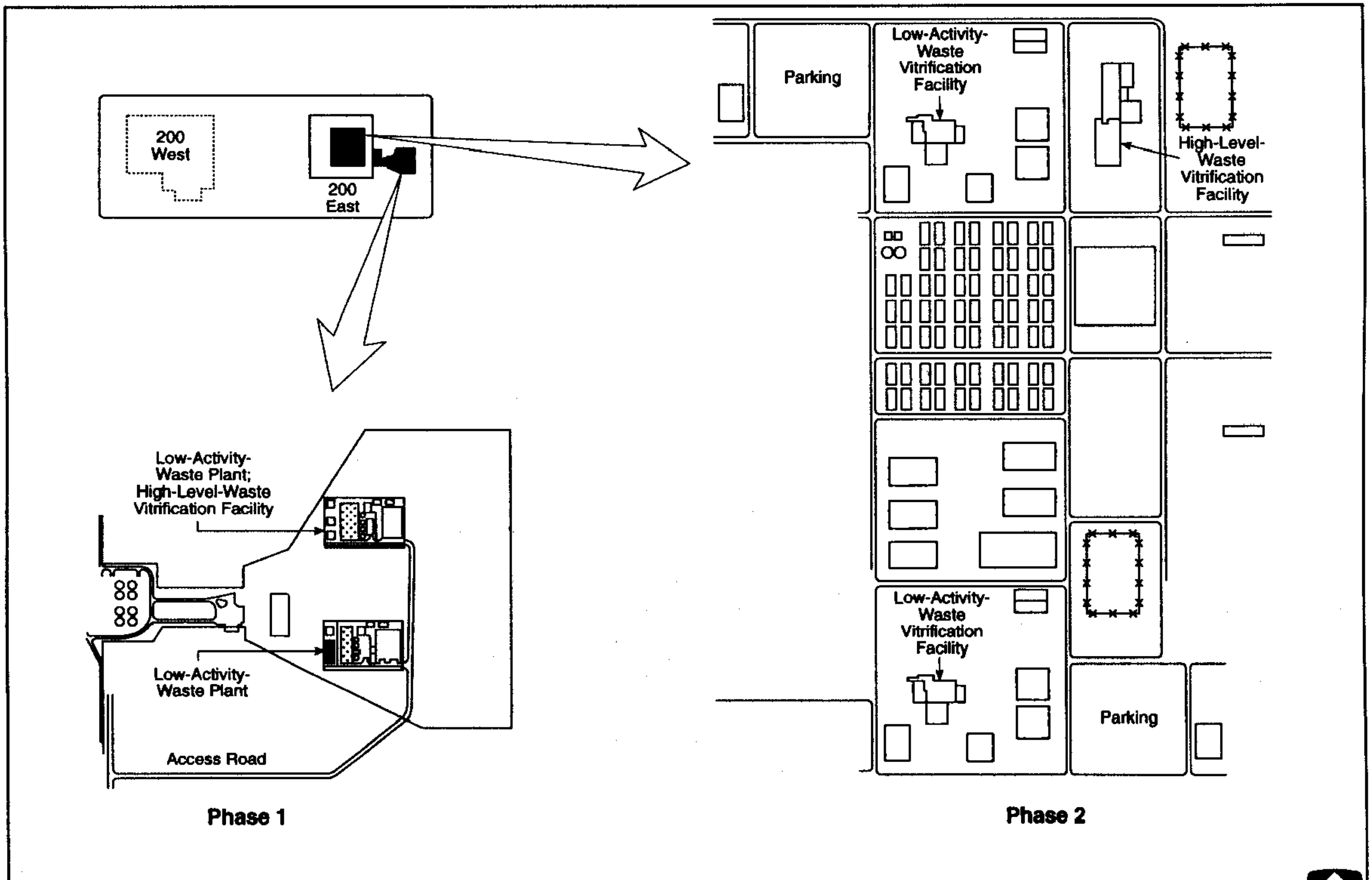


Figure 2–17. Proposed Facility Locations in the 400 H-Area at Hanford



Phase 1	Demonstration-scale facility operational from 2002 until 2012.
Phase 2	Full-scale facility operational from 2011 until 2028.

Source: DOE 1996b.

Figure 2–18. Location of Planned HLW Vitrification Facility in the 200 Area at Hanford (Proposed Location of Canister-Filling Operation)

would neither generate radioactive waste nor contribute radiological dose to the construction workforce. The building is large enough to house facilities for only two of the three proposed disposition activities. Therefore, this alternative calls for collocation of the pit conversion and immobilization facilities in FMEF, and the construction of a new building close to FMEF to house the MOX facility.

In this alternative, the pit conversion facility would occupy the lower floors of FMEF, and the immobilization facility, the upper two floors. About 14,000 m^2 (150,700 ft^2) of space on the -35-ft, -17-ft, ground, and +21-ft levels would be modified to support pit disassembly and conversion activities. Not all the space on every floor would be required for pit disassembly and conversion activities, but the floors would be predominately associated with that process.

Plutonium conversion and immobilization activities would primarily occupy the +42- and +70-ft levels. While a portion of the +42-ft level would be shared by the two facilities, most of the floor would be dedicated to the immobilization facility. These floors occupy about 9,067 m^2 (97,600 ft^2). Both facilities would share utilities, loading docks, and security assets. The large shipping and receiving area of FMEF would allow for housing a number of SSTs.

For the MOX facility, a new two-story building of about 11,150 m^2 (120,000 ft^2) would be constructed west of FMEF. A secure underground tunnel would connect the two buildings for special nuclear material transfers. This tunnel would be locked and alarmed under normal operating conditions, and subject to the same security measures on both sides as the building perimeters, both to ensure the protection of the special nuclear materials and to maintain the independence of the MOX facility. The tunnel would be opened in accordance with safeguards and security procedures for the transfer of plutonium dioxide from the pit conversion facility to the MOX facility, and would be closed immediately upon completion of transfer activities. Other than being joined to it by this tunnel, the MOX facility would be independent of FMEF, and would be inside its own fenced security area. Various nonhardened support buildings would be needed to support the mission, and an additional 4,645 m^2 (50,000 ft^2) would be required. The proposed surplus plutonium disposition facilities would use such existing Hanford services as sitewide security (although there would be additional security assigned to each of the three disposition facilities), emergency services, environmental monitoring, and waste management.

Construction would begin in about 2001, with modifications to FMEF for the pit conversion facility, and would continue through completion of the MOX facility in about 2006. Operations would commence in about 2004 with pit disassembly and conversion, and would continue until about 2015 when the MOX and immobilization facilities have completed their missions. Operation of the MOX facility would not begin until the pit conversion facility had been operating for a year, so that feed material would be available for MOX fuel fabrication.[10]

2.7 ALTERNATIVE 3: ALL FACILITIES AT SRS

2.7.1 Alternative 3A
Pit Conversion and MOX Fuel Fabrication in New Construction; Immobilization in New Construction and DWPF

This alternative would involve locating the three proposed surplus plutonium disposition facilities in newly constructed buildings adjacent to APSF in F-Area at SRS (see Figure 2–19). In addition, the canister receipt

[10] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.

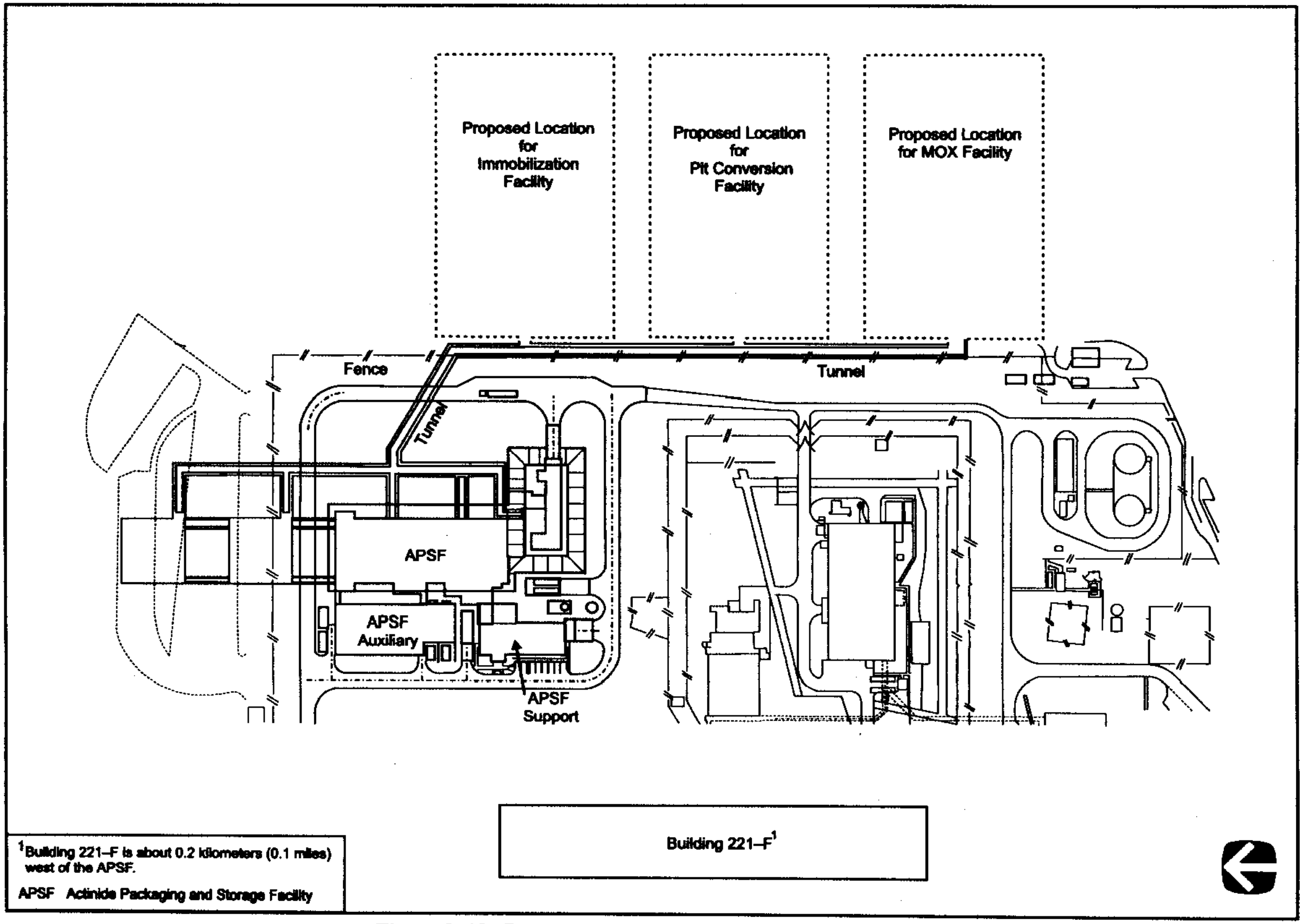


Figure 2–19. Proposed Facility Locations in F-Area at SRS

area at DWPF in S-Area (see Figure 2–20) would be modified as described in Section 2.4.2.1 to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. APSF is designed to receive, store, restabilize, and can plutonium metal and oxide as part of the compliance activities for Defense Nuclear Facilities Safety Board Recommendation 94–1. Compliance activities are scheduled to be completed by May 2002, after which time the building would be staffed and operated as a storage vault. Certain APSF capabilities would be useful for the surplus plutonium disposition facilities, in particular the receiving facilities for DOE SSTs; nondestructive assay facilities; and storage vaults.

As shown in Figure 2–19, the immobilization facility would be east of APSF, the pit conversion facility due south of the immobilization facility, and the MOX facility due south of the pit conversion facility. To accommodate all three disposition facilities at this location, it would be necessary to move the F-Area fence line to incorporate more area. These facilities would be connected by material transfer tunnels to APSF. These tunnels would be locked and alarmed under normal operating conditions, and subject to the same security measures on both sides as the building perimeters, both to ensure the protection of the special nuclear materials and to maintain the independence of the MOX facility. The tunnels would be opened in accordance with safeguards and security procedures for the transfer of special nuclear materials and would be closed immediately upon completion of transfer activities. Other than being joined by the tunnel, the MOX facility would be independent of APSF and the other plutonium disposition facilities and would be inside its own fenced security area.

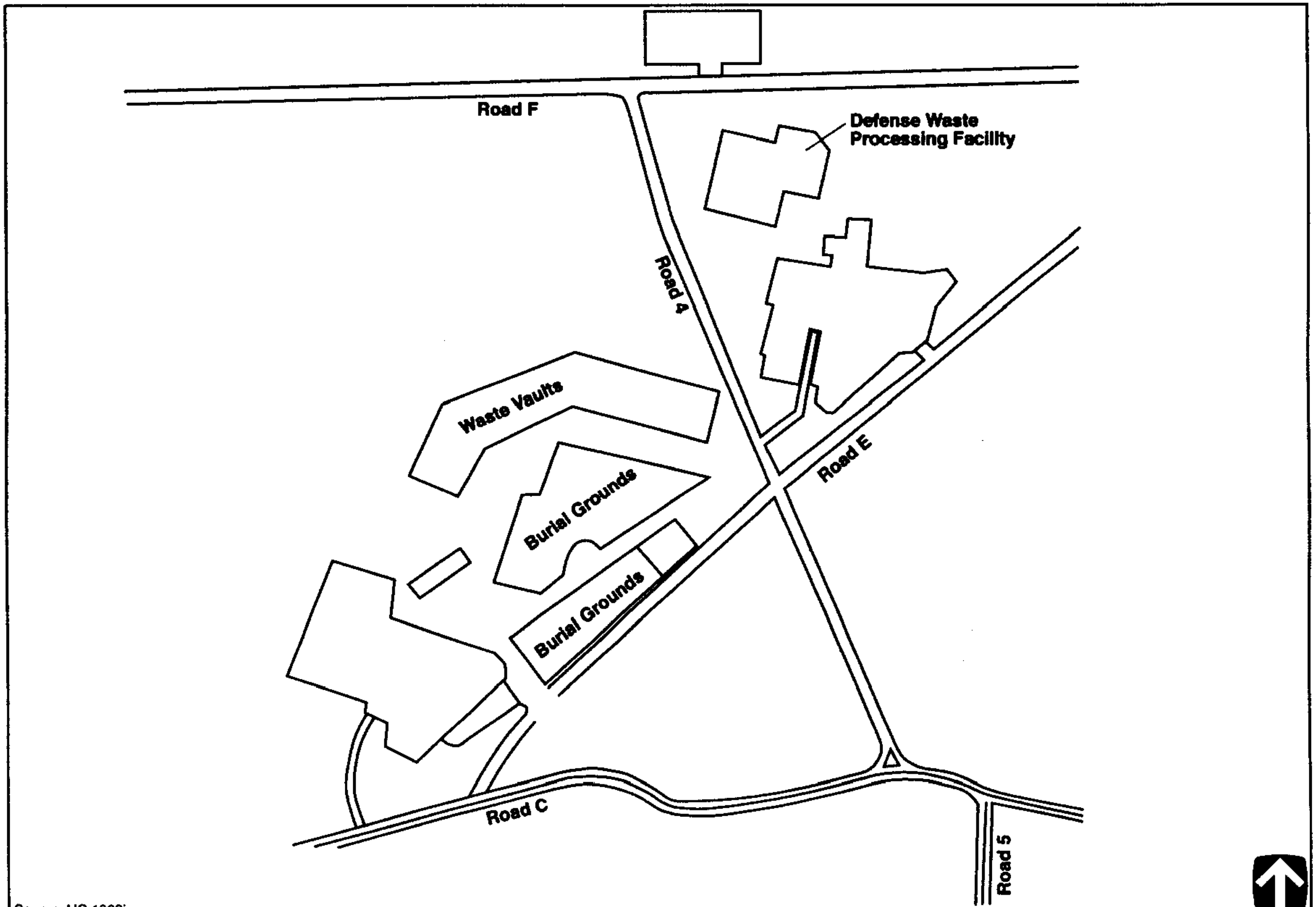
The pit conversion facility would occupy about 12,400 m^2 (133,000 ft^2) on two levels, one or both of which may be below grade, and another 1,840 m^2 (19,800 ft^2) would be required for a utility building and an electrical substation in F-Area. The total space required for the immobilization facility would be about 13,000 m^2 (140,000 ft^2). Of that, 10,000 m^2 (108,000 ft^2) would be in new facilities in F-Area. The facility would have three levels, two below grade. A small structure housing the building entrance and office space would be at ground level, with the main processing area and a small basement area below grade. The MOX facility would occupy about 10,600 m^2 (114,000 ft^2) on two levels, one below grade. Another 4,600 m^2 (50,000 ft^2) would be required for new support buildings in F-Area. The proposed surplus plutonium disposition facilities would use such existing SRS services as sitewide security (although there would be additional security assigned to each of the three disposition facilities), emergency services, environmental monitoring, and waste management.

Construction would commence in about 2001 with the pit conversion facility, and would continue through completion of the MOX facility in about 2006. Operations would commence in about 2004 with pit conversion, and would continue until about 2015, when the MOX and immobilization facilities have completed their missions. Operation of the MOX facility would not begin until the pit conversion facility had been operating for a year, so that feed material would be available for MOX fuel fabrication.[11]

2.7.2 Alternative 3B Pit Conversion and MOX Fabrication in New Construction; Immobilization In Building 221–F and DWPF

This alternative would involve locating the three proposed surplus plutonium disposition facilities in F-Area at SRS (see Figure 2–19), combining the use of an existing building (Building 221–F) with new construction. In addition, the canister receipt area at DWPF in S-Area (see Figure 2–20) would be modified as described in Section 2.4.2.1 to accommodate receipt and processing of the canisters transferred from the immobilization

[11] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.



Source: UC 1998i.

Figure 2–20. Location of DWPF in S-Area at SRS (Proposed Location of Canister-Filling Operation)

facility for filling with vitrified HLW. Building 221–F, completed in 1954, was designed and constructed to separate and recover plutonium, irradiated natural or depleted uranium, and radioactive decay products using radiochemical processes. Building 221–F would be modified to house the immobilization facility, an action that would generate radioactive waste and contribute a radiological dose to the construction workforce. This alternative differs from Alternative 3A in that the immobilization facility would be in Building 221–F at SRS, rather than in a new building adjacent to APSF. Modification of the Building 221–F process areas, administrative areas, and utilities would affect about 5,286 m^2 (56,900 ft^2) of space. A new canister-loading facility adding another 1,365 m^2 (14,700 ft^2) of space to Building 221–F would have to be built to support this alternative.

The pit conversion and MOX facilities would be in new construction adjacent to APSF. Their locations and designs would be unaffected by location of the immobilization facility in Building 221–F, and therefore would be as described in Section 2.7.1. The distance between the two proposed locations in F-Area is about 0.2 km (0.1 mi). To accommodate both the pit conversion and MOX facilities, it would be necessary to move the F-Area fence line to incorporate more area. The proposed surplus plutonium disposition facilities would use such existing SRS services as sitewide security (although there would be additional security assigned to each of the three disposition facilities), emergency services, environmental monitoring, and waste management.

Construction would commence about 2001, with the pit conversion facility, and continue through completion of the MOX facility in about 2006. Operation would commence in about 2004 with pit conversion, and continue until 2015, when both the MOX and immobilization facilities would be expected to have completed their missions. Operation of the MOX facility would not begin until the pit conversion facility had been operating for a year, so that feed material would be available for MOX fuel fabrication.[12]

2.8 ALTERNATIVE 4: PIT CONVERSION AT PANTEX; MOX FUEL FABRICATION AND IMMOBILIZATION AT HANFORD

2.8.1 Alternative 4A
Pantex: Pit Conversion in New Construction
Hanford: MOX Fuel Fabrication in New Construction; Immobilization in FMEF and HLW Vitrification Facility

This alternative would involve locating the pit conversion facility at Pantex and the immobilization and MOX facilities at Hanford. The pit conversion and MOX facilities would be in new construction, and FMEF would be modified to house the immobilization facility. Canister filling would be accomplished at the planned HLW vitrification facility scheduled for construction in the 200 East Area, about 24 km (15 mi) northwest of the 400 Area (see Figures 2–17 and 2–18).

At Pantex, the pit conversion facility would be in a new building in Zone 4, with some support facilities to the west of, and adjacent to, Zone 4 (see Figure 2–21). Utilities and storage vaults would be on the ground floor of the pit conversion facility; and the main processing and loading areas, offices, and support areas, in a below-grade basement. The building would occupy about 17,345 m^2 (186,700 ft^2). New buildings totaling 5,270 m^2 (56,730 ft^2) would have to be constructed to support the pit conversion facility. Additional space in existing buildings in Zone 4 would be used for administration, access control, warehousing, and other services. New or upgraded electrical, water, and gas supply lines would be constructed from existing trunk lines. The proposed pit conversion facility would use such existing Pantex services as sitewide security

[12] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.

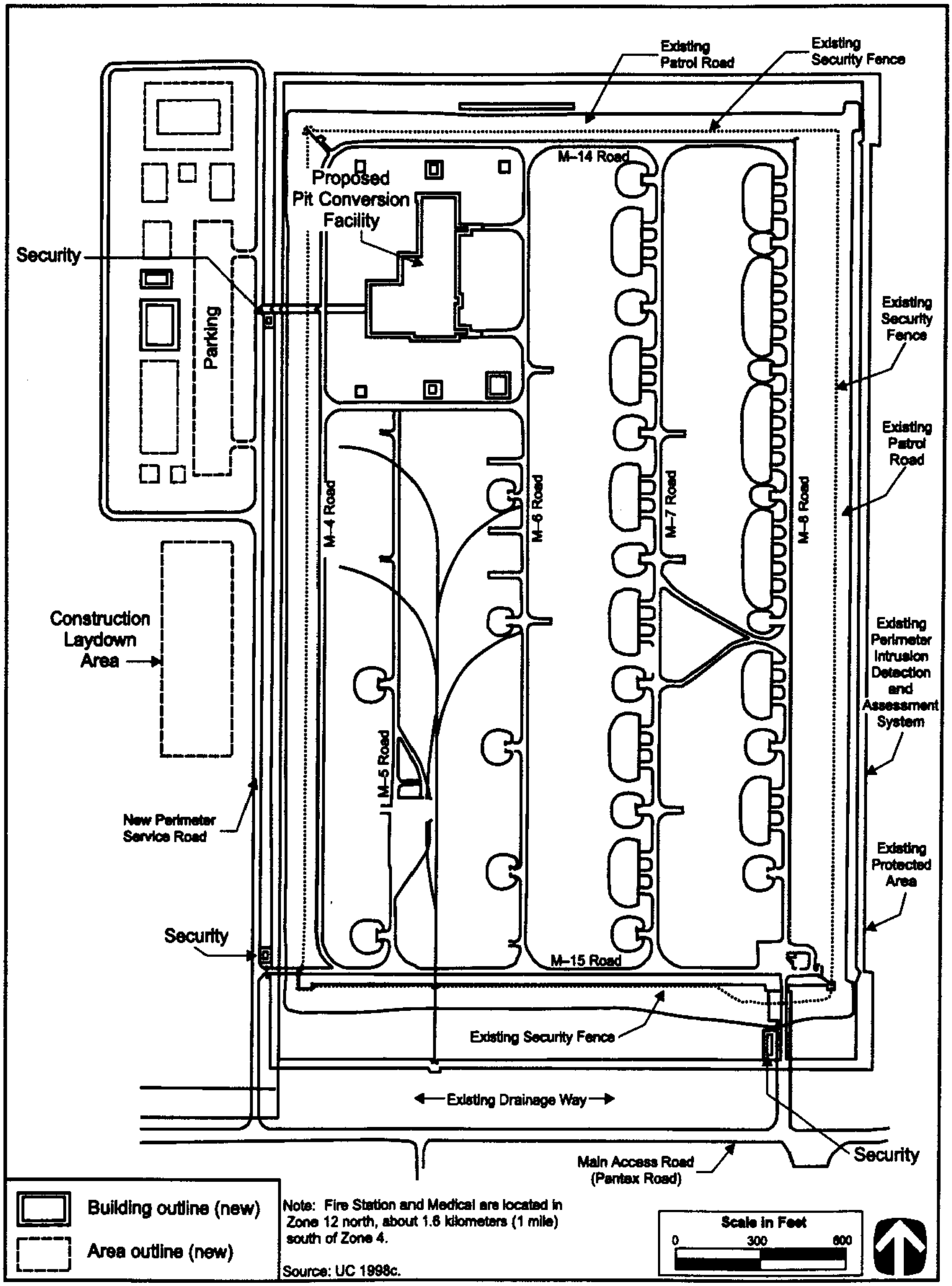


Figure 2–21. Proposed Pit Conversion Facility Location in Zone 4 at Pantex

(although there would be an additional security assigned to the facility), emergency services, environmental monitoring, and waste management. TRU waste storage would be provided in the main pit conversion facility or in ancillary facilities. Construction would commence in about 2001 and continue through about 2003. Operation would commence in about 2004 and continue until about 2014.

Facilities at Hanford would be in the 400 Area, the immobilization facility in the FMEF and the MOX facility in new construction near FMEF. Immobilization would be concentrated on the +42- and +70-ft levels of FMEF, although process support functions would be conducted on all six floors of the building. The total space required for the immobilization facility would be about 13,694 m^2 (147,400 ft^2); the remainder of FMEF would be available for other missions.

For the MOX facility a new two-story building of, about 11,150 m^2 (120,000 ft^2) would be constructed west of FMEF. This facility would be independent of FMEF and inside its own fenced security area. In addition to the main process building, the MOX facility would require 4,645 m^2 (50,000 ft^2) of new support buildings throughout the 400 Area. The proposed disposition facilities would use such existing Hanford services as sitewide security (although there would be additional security assigned to each of the disposition facilities), emergency services, environmental monitoring, and waste management.

Modification and new construction at Hanford would commence in about 2002 and continue through about 2006. The immobilization facility would commence operations in about 2005; the MOX facility, in about 2006. Both facilities would continue to operate until about 2015. Operation of the MOX facility would not begin until the pit conversion facility had been operating for at least a year, so that feed material would be available for MOX fuel fabrication.[13]

2.8.2 Alternative 4B
Pantex: Pit Conversion in New Construction
Hanford: Plutonium Conversion and Immobilization in FMEF and HLW Vitrification Facility; and MOX Fuel Fabrication in FMEF

This alternative would involve locating the pit conversion facility in new construction at Pantex and the immobilization and MOX facilities in FMEF at Hanford. Canister filling would be accomplished at the planned HLW vitrification facility scheduled for construction in the 200 East Area, about 24 km (15 mi) northwest of the 400 Area. At Pantex, the pit conversion facility would be the same as the one described for Alternative 4A in Section 2.8.1. This alternative differs from Alternative 4A in that the MOX facility would be located in FMEF rather than in new construction.

At Hanford, FMEF would be modified to contain both the MOX and immobilization facilities. While these facilities would share the building, they would be totally separate from each other to accommodate possible NRC regulation of the MOX facility. The immobilization facility would occupy about 6,698 m^2 (72,100 ft^2), primarily on the ground and +21-ft levels. Only the receiving area would be shared by the two facilities, but the area would be modified to physically separate the two sides and provide independent access to the two facilities.

To implement the MOX mission at FMEF, the building would be remodeled and annexes added to accommodate the functions and processes required for MOX fuel fabrication. The MOX facility would occupy about 6,700 m^2 (72,000 ft^2) on the ground, +42-ft, and +70-ft levels of FMEF. New annex areas on the north

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[13] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.

and east sides of the building for utilities and an entrance area with office space would add another 1,858 m^2 (20,000 ft^2) to the FMEF structure. Partition walls and other isolation mechanisms would be used to completely segregate the MOX portion of the building from the other portions. In addition to the main process building, the MOX facility would require 4,600 m^2 (50,000 ft^2) of new support buildings throughout 400 Area. The proposed disposition facilities would use such existing Hanford services as sitewide security (although there would be additional security assigned to each of the disposition facilities), emergency services, environmental monitoring, and waste management.

Modification of FMEF would commence in about 2002 and continue through about 2006. The immobilization facility would commence operation in about 2005; the MOX facility, in about 2006. Both facilities would continue to operate until about 2015. Operation of the MOX facility would not begin until the pit facility had been operating for at least a year, so that feed material would be available for MOX fuel fabrication.[14]

2.9 ALTERNATIVE 5: PIT CONVERSION AT PANTEX; MOX FUEL FABRICATION AND IMMOBILIZATION AT SRS

2.9.1 Alternative 5A
Pantex: Pit Conversion in New Construction
SRS: MOX Fuel Fabrication in New Construction; and Immobilization in New Construction and DWPF

This alternative would involving locating the pit conversion facility at Pantex and the immobilization and MOX facilities in new construction adjacent to APSF at SRS. In addition, the canister receipt area at DWPF in S-Area (see Figure 2–20) would be modified as described in Section 2.4.2.1 to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. At Pantex, the pit conversion facility would be the same as the one described for Alternative 4A in Section 2.8.1.

As shown in Figure 2–19, the immobilization facility would be east of APSF, and the MOX facility south of the immobilization facility. (The pit conversion facility, shown on this map, would not be located at SRS.) To accommodate both the immobilization and MOX facilities, it would be necessary to move the F-Area fence line to incorporate more area. These facilities would be connected by material transfer tunnels to APSF, and would be constructed as for Alternative 3A in Section 2.7.1.

Construction at SRS would commence in about 2002 and continue through about 2006. The immobilization facility would commence operation in about 2005; the MOX facility, in about 2006. Both facilities would continue to operate until about 2015. Operation of the MOX facility would not begin until the pit facility had been operating for at least a year, so that feed material would be available for MOX fuel fabrication.[14]

2.9.2 Alternative 5B
Pantex: Pit Conversion in New Construction
SRS: MOX Fuel Fabrication in New Construction; and Immobilization in Building 221–F and DWPF

This alternative would involve locating the pit conversion facility in new construction at Pantex and the immobilization and MOX facilities at SRS. The MOX facility would be in new construction adjacent to APSF; the immobilization facility, in Building 221–F. In addition, the canister receipt area at DWPF in S-Area

[14] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.

(see Figure 2–20) would be modified as described in Section 2.4.2.1 to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. At Pantex, the pit conversion facility would be the same as the one discussed for Alternative 4A in Section 2.8.1.

This alternative differs from Alternative 5A in that the immobilization facility would be in Building 221–F at SRS, rather than in new construction adjacent to APSF. Modifications of the Building 221–F process areas, administrative areas, and utilities would affect about 5,286 m^2 (56,900 ft^2) of space. In addition, a new canister loading facility of 1,365 m^2 (14,700 ft^2) would have to be built onto Building 221–F to support this alternative. The MOX facility would still be adjacent to APSF in new construction, its location and design unaffected by the location of the immobilization facility in Building 221–F. To locate the MOX facility near APSF, it would be necessary to move the F-Area fence line out to incorporate more area. The proposed disposition facilities would use such existing SRS services as sitewide security (although there would be security assigned to each of the disposition facilities), emergency services, environmental monitoring, and waste management.

The MOX facility would occupy about 10,590 m^2 (114,000 ft^2) on two levels, one below grade. In addition, the MOX facility would require 4,645 m^2 (50,000 ft^2) of new support buildings. Plutonium dioxide received from the pit conversion facility at Pantex would be placed in storage in the APSF vault and would be transferred to the MOX facility via a secure underground tunnel when needed for process operations.

Construction of the MOX facility and modification of Building 221–F would commence in about 2002 and continue through about 2006. The immobilization facility would commence operation in about 2005; the MOX facility, in about 2006. Both facilities would continue to operate through about 2015. Operation of the MOX facility would not begin until the pit facility had been operating for at least a year, so that feed material would be available for MOX fuel fabrication.[15]

2.10 ALTERNATIVE 6: PIT CONVERSION AND MOX FUEL FABRICATION AT HANFORD; IMMOBILIZATION AT SRS

2.10.1 Alternative 6A
Hanford: Pit Conversion in FMEF; MOX Fuel Fabrication in New Construction
SRS: Immobilization in New Construction and DWPF

This alternative would involve locating the pit conversion and MOX facilities at Hanford, in FMEF and new construction, respectively; and the immobilization facility in new construction adjacent to APSF at SRS. In addition, the canister receipt area at DWPF in S-Area (see Figure 2–20) would be modified as described in Section 2.4.2.1 to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. In this alternative, the pit conversion facility would occupy about 14,000 m^2 (150,700 ft^2) of space on the -35-ft, -17-ft, ground, and +21-ft levels of FMEF, as described in Section 2.6; the remainder of FMEF would be available for other missions. A new two-story building would be constructed for the MOX facility, as described in Section 2.6. The proposed disposition facilities would use such existing Hanford services as sitewide security (although there would be additional security assigned to each of the disposition facilities), emergency services, environmental monitoring, and waste management.

Construction would commence in about 2001, with modifications to FMEF for the pit conversion facility, and would continue through completion of the MOX facility in about 2006. The pit conversion facility would

[15] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.

commence operation in about 2004; the MOX facility, in about 2006. Operations would continue until about 2015, when the MOX facility has completed its mission. Operation of the MOX facility would not begin until the pit conversion facility had been operating for at least a year, so that feed material would be available for MOX fuel fabrication.[16]

The new immobilization facility at SRS would be east of, and connected by a material transfer tunnel to, APSF, as described in Section 2.7.1. The total space required for that facility would be about 13,000 m^2 (140,000 ft^2). Of that, 10,132 m^2 (109,000 ft^2) would be in new facilities; the remainder would be space in existing facilities that would not require further modification. To accommodate the immobilization facility, it would be necessary to move the F-Area fence line out to incorporate more area. The immobilization facility would use such existing SRS services as sitewide security (although there would be an additional security assigned to the facility), emergency services, environmental monitoring, and waste management. Construction would commence in about 2002 and continue through about 2004. Operation would commence in about 2005 and continue until about 2015.

2.10.2 Alternative 6B
Hanford: Pit Conversion and MOX Fuel Fabrication Collocated in FMEF
SRS: Immobilization in New Construction and DWPF

This alternative would involve locating both the pit conversion and MOX facilities in FMEF at Hanford, and the immobilization facility in new construction adjacent to APSF at SRS. In addition; the canister receipt area at DWPF in S-Area (see Figure 2–20) would be modified as described in Section 2.4.2.1 to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. In this alternative, the immobilization facility would be constructed and operated at SRS as described for Alternative 6A in Section 2.10.1.

FMEF would be modified to contain both the pit conversion and MOX facilities. While these facilities would share the building, they would be totally separate from each other to accommodate possible NRC regulation of the MOX facility. The pit conversion facility would occupy about 14,000 m^2 (146,400 ft^2) of space on the -35-ft, -17-ft, ground, and +21-ft levels of FMEF, as described in Section 2.6. Plutonium dioxide would be moved from the pit conversion facility to the MOX facility in a secure elevator.

To implement the MOX mission at FMEF, the building would be remodeled and annexes added to accommodate all the functions and processes required for MOX fuel fabrication. The MOX facility would occupy about 6,698 m^2 (72,100 ft^2) on the ground, +42-ft, and +70-ft levels of FMEF. The new annex areas on the north and east sides of the building for utilities and an entrance area with office space would add another 1,858 m^2 (20,000 ft^2) to the FMEF structure. Partition walls and other isolation mechanisms would be used to completely segregate the MOX portion of the building from the other portions. In addition to the main process building, the MOX facility would require 4,645 m^2 (50,000 ft^2) of new support buildings throughout 400 Area. The proposed disposition facilities would use such existing Hanford services as sitewide security (although there would be additional security assigned to each of the disposition facilities), emergency services, environmental monitoring, and waste management.

Modification of FMEF would commence in about 2001 and would continue through about 2006. The pit conversion facility would commence operation in about 2004; the MOX facility, in about 2006. Operations would cease when the MOX facility has shut down in about 2015. Operation of the MOX facility would not

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[16] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.

begin until the pit facility had been operating for at least a year, so that feed material would be available for MOX fuel fabrication.[17]

2.10.3 Alternative 6C
Hanford: Pit Conversion in FMEF; MOX Fuel Fabrication in New Construction
SRS: Immobilization in Building 221-F and DWPF

In this alternative, the pit conversion and MOX facilities would be at Hanford, in FMEF and new construction, respectively. These facilities would be implemented as described for Alternative 6A in Section 2.10.1. The immobilization facility would be at SRS in Building 221–F, with canister filling occurring in DWPF, as described for Alternative 3B, Section 2.7.2.

2.10.4 Alternative 6D
Hanford: Pit Conversion and MOX Fuel Fabrication Collocated in FMEF
SRS: Immobilization in Building 221–F and DWPF

This alternative would involve locating both the pit conversion facility and the MOX facility in FMEF at Hanford, as described for Alternative 6B in Section 2.10.2. The immobilization facility would be at SRS in Building 221–F, with canister filling occurring in DWPF, as described for Alternative 6C in Section 2.10.3.

2.11 ALTERNATIVE 7: PIT CONVERSION AND MOX FUEL FABRICATION AT INEEL; IMMOBILIZATION AT SRS

2.11.1 Alternative 7A
INEEL: Pit Conversion in the Fuel Processing Facility; MOX Fuel Fabrication in New Construction
SRS: Immobilization in New Construction and DWPF

This alternative would involve locating the pit conversion facility in the Fuel Processing Facility (FPF) and the MOX facility in new construction in the Idaho Nuclear Technology and Energy Center (INTEC) area at INEEL, and the immobilization facility in new construction adjacent to APSF at SRS. In addition, the canister receipt area at DWPF in S-Area (see Figure 2–20) would be modified as described in Section 2.4.2.1 to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. The immobilization facility would be implemented at SRS as described for Alternative 6A in Section 2.10.1.

FPF has six levels, three below grade. It is structurally complete, but has never been used. Construction was started in 1986, but discontinued in 1993, leaving essentially a concrete shell with temporary lighting and ventilation. As the building was designed to handle highly radioactive materials, it includes a number of interior thick-walled cells surrounded by corridors and access ways. Building utility areas and office space surround the corridors of the above-grade stories. Modification to the interior spaces would be required to accommodate surplus plutonium disposition activities. No radioactive materials have been introduced into the building, so the modification would neither generate radioactive waste nor contribute a radiological dose to the construction workforce. In this alternative, the pit conversion facility would occupy about 14,819 m^2 (159,500 ft^2) on three levels of FPF. No new support buildings would have to be built, as the facility's needs would be met by existing facilities at INTEC.

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[17] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.

A new two-story building of about 11,150 m^2 (120,000 ft^2) would be constructed for the MOX facility. As shown in Figure 2–22, this building would be south of FPF. A secure underground tunnel would connect the two buildings for special nuclear material transfers. This tunnel would be locked and alarmed under normal operating conditions, and subject to the same security measures on both sides as the building perimeters, both to ensure protection of the special nuclear materials and to maintain the independence of the MOX facility. The tunnel would be opened in accordance with safeguards and security procedures for the transfer of plutonium dioxide from the pit conversion facility to the MOX facility, and would be closed immediately upon completion of transfer activities. Other than being joined to it by this tunnel, the MOX facility would be independent of FPF, and would be inside its own fenced security area. In addition to the main process building, the MOX facility would require 4,645 m^2 (50,000 ft^2) of new support buildings throughout the INTEC Area. The proposed disposition facilities would use such existing INEEL services as sitewide security (although there would be additional security assigned to each of the disposition facilities), emergency services, environmental monitoring, and waste management.

Construction would commence in about 2001, with modifications to FPF for the pit conversion facility, and would continue through completion of the MOX facility in about 2006. Operations would commence in about 2004, with pit conversion, and would continue until about 2015, when the MOX facility has completed its mission. Operation of the MOX facility would not begin until the pit conversion facility had been operating for at least a year, so that feed material would be available for MOX fuel fabrication.[18]

2.11.2 Alternative 7B
INEEL: Pit Conversion in FPF; MOX Fuel Fabrication in New Construction
SRS: Immobilization in Building 221–F and DWPF

This alternative would involve locating the pit conversion facility in FPF and the MOX facility in new construction in the INTEC area at INEEL, and the immobilization facility in Building 221–F at SRS. This alternative differs from Alternative 7A in that the immobilization facility would be in Building 221–F rather than in new construction adjacent to APSF. The pit conversion and MOX facilities would be implemented at INEEL as described for Alternative 7A, Section 2.11.1, and the immobilization facility would be implemented at SRS as described for Alternative 6C, Section 2.10.3.

2.12 ALTERNATIVE 8: PIT CONVERSION AND MOX FUEL FABRICATION AT INEEL; IMMOBILIZATION AT HANFORD
INEEL: Pit Conversion in FPF; MOX Fuel Fabrication in New Construction
Hanford: Immobilization in FMEF and HLW Vitrification Facility

This alternative would involve locating the pit conversion facility in FPF and the MOX facility in new construction in the INTEC area at INEEL; and the immobilization facility in FMEF at Hanford. The pit conversion and MOX facilities would be implemented at INEEL as described for Alternative 7A in Section 2.11.1.

At Hanford, FMEF would be modified to house the immobilization facility as described for Alternative 4A, Section 2.8.1. Canister filling would be accomplished at the planned HLW vitrification facility scheduled for construction in the 200 East Area, about 24 km (15 mi) northwest of the 400 Area. Modification of FMEF would commence in about 2002 and continue through about 2004. Operation of the immobilization facility would commence in about 2005 and continue until about 2015.

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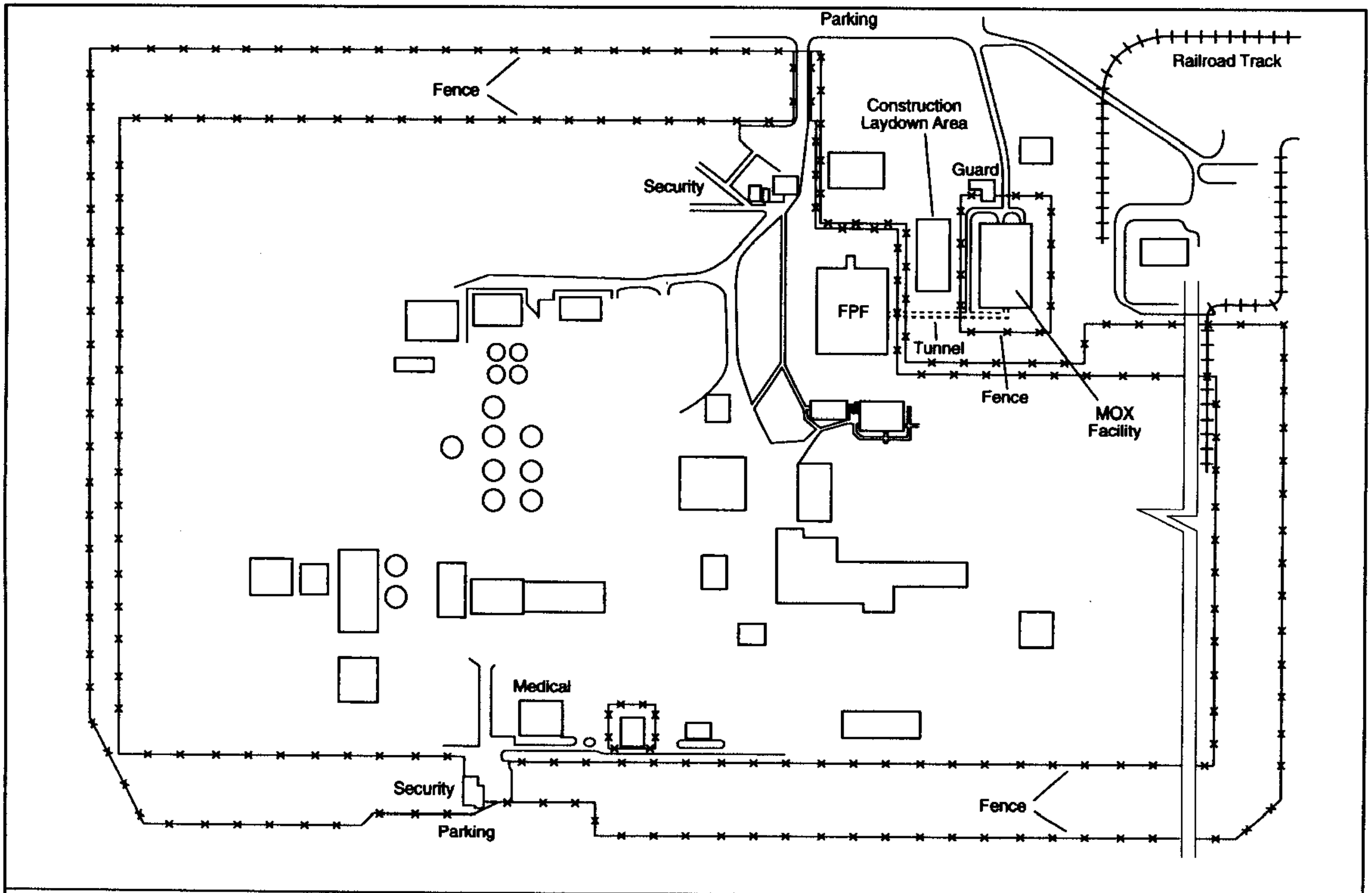
[18] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.



Note: Fire station is at Central Facilities Area, about 3 miles south of the Idaho Nuclear Technology and Engineering Center

FPF Fuel Processing Facility (proposed location for pit conversion facility)

Source: UC 1998l.

Figure 2–22. Proposed Pit Conversion and MOX Facility Locations in INTEC at INEEL

Next Section

2.13 ALTERNATIVE 9: PIT CONVERSION AND MOX FUEL FABRICATION AT PANTEX; IMMOBILIZATION AT SRS

2.13.1 Alternative 9A
Pantex: Pit Conversion and MOX Fuel Fabrication in New Construction
SRS: Immobilization in New Construction and DWPF

This alternative would involve locating both the pit conversion and the MOX facilities at Pantex, and the immobilization facility in new construction adjacent to APSF at SRS. In addition, the canister receipt area at DWPF in S-Area (see Figure 2–20) would be modified as described in Section 2.4.2.1 to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. The immobilization facility would be as described in Section 2.10.1.

At Pantex, the pit conversion and MOX facilities would be in new construction in Zone 4 (see Figure 2–23). The pit conversion facility in this alternative would be the same as that described in Section 2.8.1. For the MOX facility, a new two-story building of about 11,150 m^2 (120,000 ft^2) would be constructed south of the pit conversion facility. A secure underground tunnel would connect the two buildings for special nuclear material transfers.[19] This tunnel would be locked and alarmed under normal operating conditions, and subject to the same security measures on both sides as the building perimeters, both to ensure protection of the special nuclear materials and to maintain the independence of the MOX facility. The tunnel would be opened in accordance with safeguards and security procedures for the transfer of plutonium oxide from the pit conversion facility to the MOX facility, and would be closed immediately upon completion of transfer activities. Other than being joined by this tunnel, the MOX facility would be independent of the pit conversion facility, and would be inside its own fenced security area. In addition to the main process building, the MOX facility would require 4,645 m^2 (50,000 ft^2) of new support buildings throughout Zone 4. TRU waste storage would be provided in the main pit conversion and MOX facilities or in ancillary facilities. The proposed disposition facilities would use such existing Pantex services as sitewide security (although there would be additional security assigned to each of the disposition facilities), emergency services, environmental monitoring, and waste management.

Construction at Pantex would commence in about 2001 with the pit conversion facility, and continue through completion of the MOX facility in about 2006. Operations would commence in about 2004 with pit conversion, and continue until about 2015, when the MOX facility has completed its mission. Operation of the MOX facility would not begin until the pit conversion facility had been operating for at least a year, so that feed material would be available for MOX fuel fabrication.[20]

2.13.2 Alternative 9B
Pantex: Pit Conversion and MOX Fuel Fabrication in New Construction
SRS: Immobilization in Building 221–F and DWPF

This alternative would involve locating both the pit conversion and MOX facilities in new construction at Pantex, as described for Alternative 9A in Section 2.13.1. This alternative differs from Alternative 9A in that the immobilization facility would be in Building 221–F at SRS, as described for Alternative 6C in Section 2.10.3.

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[19] Current facility design includes a tunnel for material transfers. Intrasite transfers of special nuclear materials in accordance with current site practices may be considered in lieu of a tunnel in the facility design.

[20] The operating period of the MOX facility could be affected by responses to the RFP for MOX fuel fabrication and irradiation services discussed in Section 2.1.3, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals.

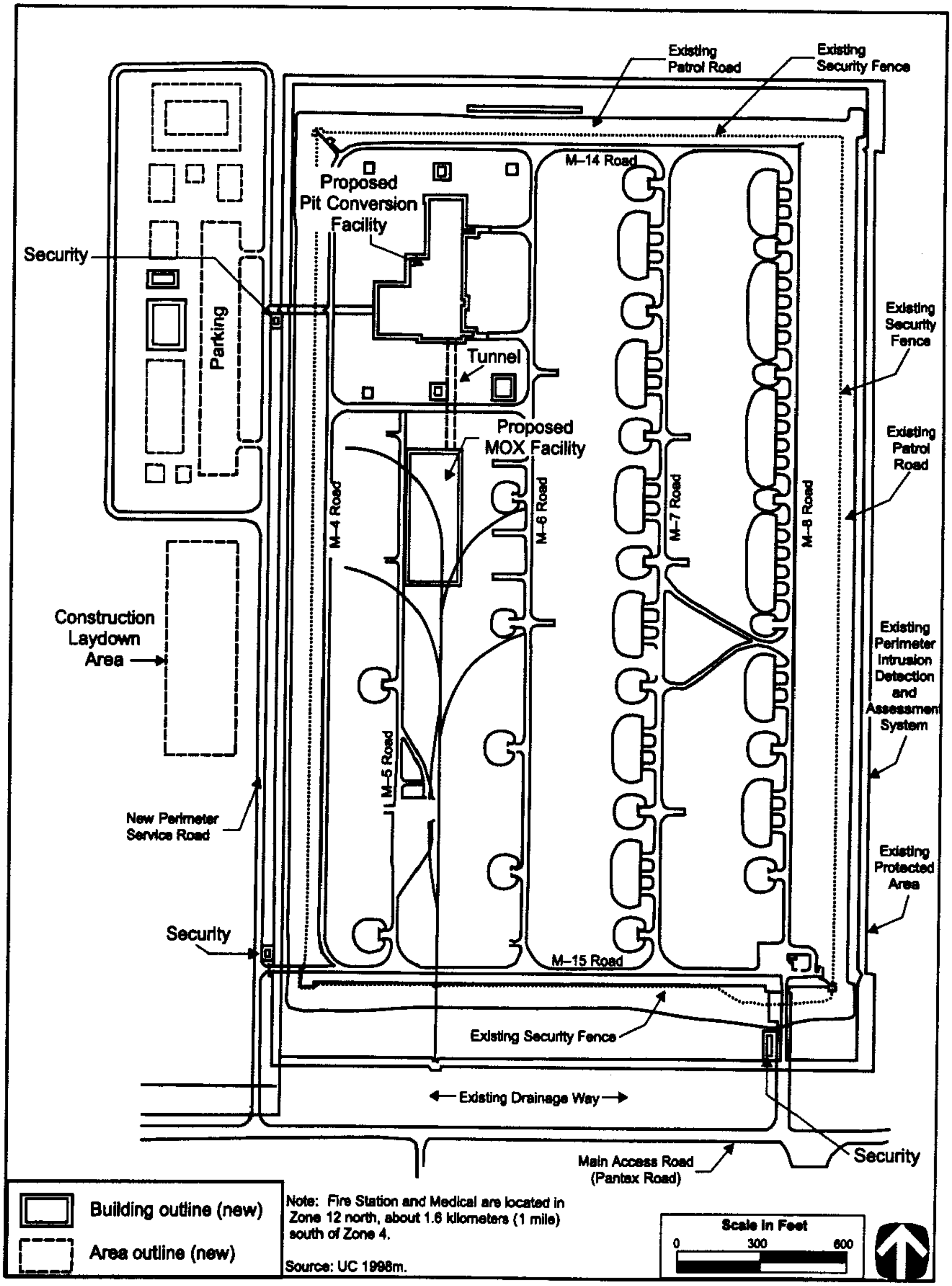


Figure 2–23. Proposed Pit Conversion and MOX Facility Locations in Zone 4 at Pantex

2.14 ALTERNATIVE 10: PIT CONVERSION AND MOX FUEL FABRICATION AT PANTEX; IMMOBILIZATION AT HANFORD
Pantex: Pit Conversion and MOX Fuel Fabrication in New Construction
Hanford: Immobilization in FMEF and HLW Vitrification Facility

This alternative would involve locating both the pit conversion and MOX facilities in new construction at Pantex, as described for Alternative 9A in Section 2.13.1. The immobilization facility would be in FMEF at Hanford, and canister filling would be accomplished at the planned HLW vitrification facility scheduled for construction in the 200 East Area, about 24 km (15 mi) northwest of the 400 Area. Immobilization would be implemented as described for Alternative 8 in Section 2.12.

2.15 ALTERNATIVE 11: 50 METRIC TON IMMOBILIZATION; IMMOBILIZATION AT HANFORD; PIT CONVERSION AT HANFORD OR PANTEX

2.15.1 Alternative 11A
***Hanford:* Pit Conversion in FMEF; Immobilization in FMEF and the HLW Vitrification Facility**

This alternative would involve immobilizing all the nominal 50 t (55 tons) of surplus plutonium at Hanford. Therefore, only two facilities, the pit conversion and the immobilization facilities, would be needed to accomplish the surplus plutonium disposition mission. The pit conversion facility would be collocated with the immobilization facility in FMEF, as described for Alternative 2 in Section 2.6. However, all the plutonium dioxide produced in the pit conversion facility would be transferred to the immobilization facility, which would be operated at a higher throughput (5 t [5.5 tons] rather than 1.7 t [1.9 tons]) to accommodate the additional approximately 33 t (36 tons) of plutonium that would be received from the pit conversion facility. Also, the operating workforce at the immobilization facility would be increased as discussed in Section 4.20.2.3 to process the additional amount of material. Construction would commence around 2001 with the pit conversion facility, and would continue through completion of the modifications to the FMEF for the immobilization facility around 2004. Operation would commence in around 2004 with the pit conversion facility, and continue until around 2015, when the immobilization facility has completed its mission.

2.15.2 Alternative 11B
Pantex: Pit Conversion in New Construction
Hanford: Immobilization in FMEF and the HLW Vitrification Facility

This alternative would involve immobilizing all the nominal 50 t (55 tons) of surplus plutonium. Therefore, only two facilities, the pit conversion facility and the immobilization facility, would be needed to accomplish the surplus plutonium disposition mission. The pit conversion facility would be located at Pantex as described in Alternative 4A, Section 2.8.1, and the immobilization facility would be located at Hanford as described for Alternative 11A, in Section 2.15.1. All the plutonium dioxide produced in the pit conversion facility would be shipped to the immobilization facility, which would be operated as described in Section 2.15.1.

Construction would commence in about 2001 with the pit conversion facility, and would continue through completion of the modifications to the FMEF for the immobilization facility in about 2004. Operation would commence in about 2004 with the pit conversion facility, and continue until about 2015, when the immobilization facility has completed its mission.

2.16 ALTERNATIVE 12: 50 METRIC TON IMMOBILIZATION; IMMOBILIZATION AT SRS; PIT CONVERSION AT PANTEX OR SRS

2.16.1 Alternative 12A
SRS: Pit Conversion in New Construction; Immobilization in New Construction and DWPF

This alternative would involve immobilizing all 50 t (55 tons) of surplus plutonium at SRS. Therefore, only two facilities, the pit conversion facility and the immobilization facility, would be needed to accomplish the surplus plutonium disposition mission. Both the pit conversion and immobilization facilities would be in new construction adjacent to APSF in F-Area, as described in Section 2.7.1. In addition, the canister receipt area at DWPF in S-Area (see Figure 2–20) would be modified to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. The pit conversion and immobilization facilities would be the same as those described for Alternative 3A in Section 2.7.1, except that all the plutonium dioxide produced in the pit conversion facility would be transferred to the immobilization facility. To accommodate the additional 33 t (36 tons) of plutonium that would be received from the pit conversion facility, the immobilization facility would be operated at a higher throughput (5 t [5.5 tons] rather than 1.7 t [1.9 tons]), and the operating workforce at the immobilization facility would be increased as discussed in Section 4.22.2.3.

Construction would commence in about 2001 with the pit conversion facility, and continue through completion of the immobilization facility in about 2004. Operation would commence in about 2004 with the pit conversion facility, and continue until about 2015, when the immobilization facility has completed its mission.

2.16.2 Alternative 12B
SRS: Pit Conversion in New Construction; Immobilization in Building 221–F and DWPF

This alternative would involve immobilizing all the nominal 50 t (55 tons) of surplus plutonium at SRS. Therefore, only two facilities, the pit conversion facility and the immobilization facility, would be needed to accomplish the surplus plutonium disposition mission. The pit conversion facility would be in a new building adjacent to APSF in F-Area, and the immobilization facility in Building 221–F. In addition, the canister receipt area at DWPF in S-Area (see Figure 2–20) would be modified to accommodate receipt and processing of the canisters transferred from the immobilization facility for filling with vitrified HLW. This alternative differs from Alternative 12A in that the immobilization facility would be in Building 221–F rather than in new construction adjacent to the APSF. In this alternative, both the pit conversion and immobilization facilities would be the same as those described for Alternative 3B in Section 2.7.2, except that all the plutonium dioxide produced in the pit conversion facility would be transferred to the immobilization facility. To accommodate the additional 33 t (36 tons) of plutonium that would be received from the pit conversion facility, the immobilization facility would be operated at a higher throughput (5 t [5.5 tons] rather than 1.7 t [1.9 tons]),and the operating workforce at the immobilization facility would be increased as discussed in Section 4.23.2.3.

Construction would commence in about 2001 with the pit conversion facility, and continue through completion of modifications of Building 221–F for the immobilization facility in about 2004. Operation would commence in about 2004 with the pit conversion facility, and continue until about 2015 when the immobilization facility would complete its mission.

2.16.3 Alternative 12C
Pantex: Pit Conversion in New Construction
SRS: Immobilization in New Construction and DWPF

This alternative would involve immobilizing all the nominal 50 t (55 tons) of surplus plutonium. Therefore, only two facilities, the pit conversion facility and the immobilization facility, would be needed to accomplish the surplus plutonium disposition mission. The pit conversion facility would be located at Pantex as described in Alternative 4A, Section 2.8.1, and the immobilization facility would be located at SRS as described for Alternative 12A, in Section 2.16.1. All the plutonium dioxide produced in the pit conversion facility would be shipped to the immobilization facility, which would be operated as described in Section 2.16.1.

Construction would commence in about 2001 with the pit conversion facility, and continue through completion of the immobilization facility in bout 2004. Operation would commence in bout 2004 with the pit conversion facility, and continue until about 2015, when the immobilization facility has completed its mission.

2.16.4 Alternative 12D
Pantex: Pit Conversion in New Construction
SRS: Immobilization in Building 221–F and DWPF

This alternative would involve immobilizing all the nominal 50 t (55 tons) of surplus plutonium. Therefore, only two facilities, the pit conversion facility and the immobilization facility, would be needed to accomplish the surplus plutonium disposition mission. The pit conversion facility would be located at Pantex as described in Alternative 4A, Section 2.8.1, and the immobilization facility would be located at SRS as described for Alternative 12B, in Section 2.16.2. All the plutonium dioxide produced in the pit conversion facility would be shipped to the immobilization facility, which would be operated as described in Section 2.16.2 to accommodate the additional approximately 33 t (36 tons) of plutonium that would be received from the pit conversion facility.

Construction would commence in about 2001 with the pit conversion facility, and continue through completion of the immobilization facility in about 2004. Operation would commence in about 2004 with the pit conversion facility, and continue until about 2015, when the immobilization facility has completed its mission.

2.17 LEAD ASSEMBLIES

Five sites are proposed for fabrication of lead assemblies. They are LLNL, LANL, and three of the four candidate sites for the proposed surplus weapons-grade plutonium disposition activities: Hanford, INEEL (ANL–W facilities), and SRS.[21] These sites would have the experience and facilities with safeguards Category I[22] and natural phenomenon hazards protection to handle the plutonium for fabricating the lead assemblies. After irradiation in a domestic, commercial nuclear reactor, the lead assemblies may be examined at a DOE site such as ANL–W or ORNL. Sites[23] considered for lead assembly activities are depicted in Figure 2–1. Lead assembly fabrication and postirradiation examination would be implemented only if required

[21] Pantex was not considered for lead assembly fabrication because it does not currently have any facilities capable of MOX fuel fabrication.

[22] DOE uses a graded safeguards approach to protect nuclear materials, based on the relative attractiveness of the materials in constructing a weapons and/or improvised nuclear device. Category I facilities provide the highest level of safeguards and security.

[23] Specific reactor sites are not included because they have not been identified. The SPD Final EIS will include information on the specific reactors named by the contractor selected in response to DOE's *Request for MOX Fuel Fabrication and Reactor Irradiation Services*.

to support NRC licensing activities and fuel qualification efforts. If the MOX fuel approach could be implemented without fabricating lead assemblies, or DOE decides to immobilize all 50 t (55 tons) of surplus plutonium, then these activities would not occur. This section was developed using data provided by O'Connor et al. 1997a-e.

2.17.1 Process Description

Lead assembly fabrication would involve the same basic process described for the full-scale fabrication of MOX fuel in Section 2.4.3.2. Up to ten lead assemblies would be produced at the lead assembly fabrication facility. The fabrication effort would be implemented in existing facilities at the selected location, and the fabrication phase would be completed in about 3 years. Up to four fuel assemblies would be produced in any given year, for a maximum of 10 assemblies at the end of the 3-year fabrication phase. About 100 kg (220 lb) plutonium would be made into MOX fuel each year, using a total of about 321 kg (708 lb) plutonium. For purposes of the transportation analysis in this SPD EIS, it is assumed that the plutonium would come from dismantled pits or existing supplies of surplus metal and oxide at LANL. It is expected that eight of these assemblies would be irradiated in domestic, commercial nuclear power reactors, while the rods from two would be maintained as unirradiated archives. The archived rods would be stored at the lead assembly shipping area until the completion of all the lead assembly fabrication, irradiation, and testing. The rods would then be shipped to the MOX facility for storage until it was determined that the rods were no longer needed as archived material for fuel qualification purposes. At that time, the archived rods would either be irradiated or dismantled and the materials reused in the MOX fabrication process.

At the lead assembly fabrication site, plutonium dioxide would be blended with uranium dioxide originating from depleted uranium hexafluoride in DOE storage at, for example, the Portsmouth Gaseous Diffusion Plant, then formed into pellets, sintered, and loaded into rods. After fabrication, the rods would either be assembled into fuel assemblies and transported to the reactor, or transported as rods to the reactor site for insertion into special assemblies prior to irradiation. The lead assemblies would be inserted into the reactor during a refueling outage and left in the reactor for up to three fuel cycles. After removal from the reactor, the irradiated assemblies would be managed at the reactor site as spent fuel while cooling down for approximately 6 months. After the cooldown period, several fuel rods removed from the lead assemblies at the reactor site would be transported to a DOE site, such as ANL–W or ORNL, for postirradiation examination. The rest of the rods would remain in the spent fuel pool and would be managed as spent nuclear fuel.

During postirradiation examination, several of the fuel rods would be subjected to a series of nondestructive and destructive tests to evaluate the physical and chemical changes to the fuel material and cladding resulting from irradiation. Activities would be conducted remotely, with the irradiated fuel rods inside a hot cell. Operators would remain outside the hot cell and would be shielded by the walls and windows of that cell. Any postirradiation examination activities and shipments would comply with the Consent Order and Settlement Agreement in Public Service Company of Colorado vs. Batt (if the work were performed at ANL–W) and all other applicable agrements and orders, including provisions concerning removal of the material from the applicable examination site and limits on the number of truck shipments to the site.

The lead assembly fabrication facility would be operational by October 2002, with the first lead assemblies available for insertion by late 2003. After lead assembly fabrication is completed, deactivation would take about 3 years and could involve conversion of the space for another mission.

2.17.2 Lead Assembly Fabrication Siting Alternatives

If required, lead assembly fabrication and postirradiation examination would be conducted at operating DOE sites in facilities that can accommodate the proposed activities with minimal alteration of interior spaces, are authorized to handle plutonium, and are situated in hardened spaces of thick-walled concrete that meet the standards for processing special nuclear material. Areas of the buildings in which plutonium would be handled are designed to survive natural phenomena such as earthquakes, floods, and tornadoes, as well as potential accidents associated with the processing of radioactive and fissile materials.

Security at these facilities, implemented at several levels, would provide maximum protection for the special nuclear materials. Each facility would be on an existing DOE site that has safeguards and security measures in place, including access control. In addition to DOE sitewide security services, each building in which special nuclear materials are handled has physical security and procedures commensurate with the amount and type of material authorized in the area. Physical barriers; access control systems; detection and alarm systems; procedures, including the two-person rule (requiring at least two people to be present during work with special nuclear materials in the facility); and personnel security measures, including security clearance investigations and access authorization levels—all ensure that special nuclear materials are adequately protected. Nuclear material control and accountability are ensured through a system for monitoring storage, processing, and transfers. At any time, the total amount of special nuclear material in each facility, or in any material balance area within a facility, would be known. As appropriate, closed-circuit television, intrusion detection, motion detection, and other automated methods are used as part of the material control and accountability program. Physical measurements and inspections of material are used to verify inventory records.

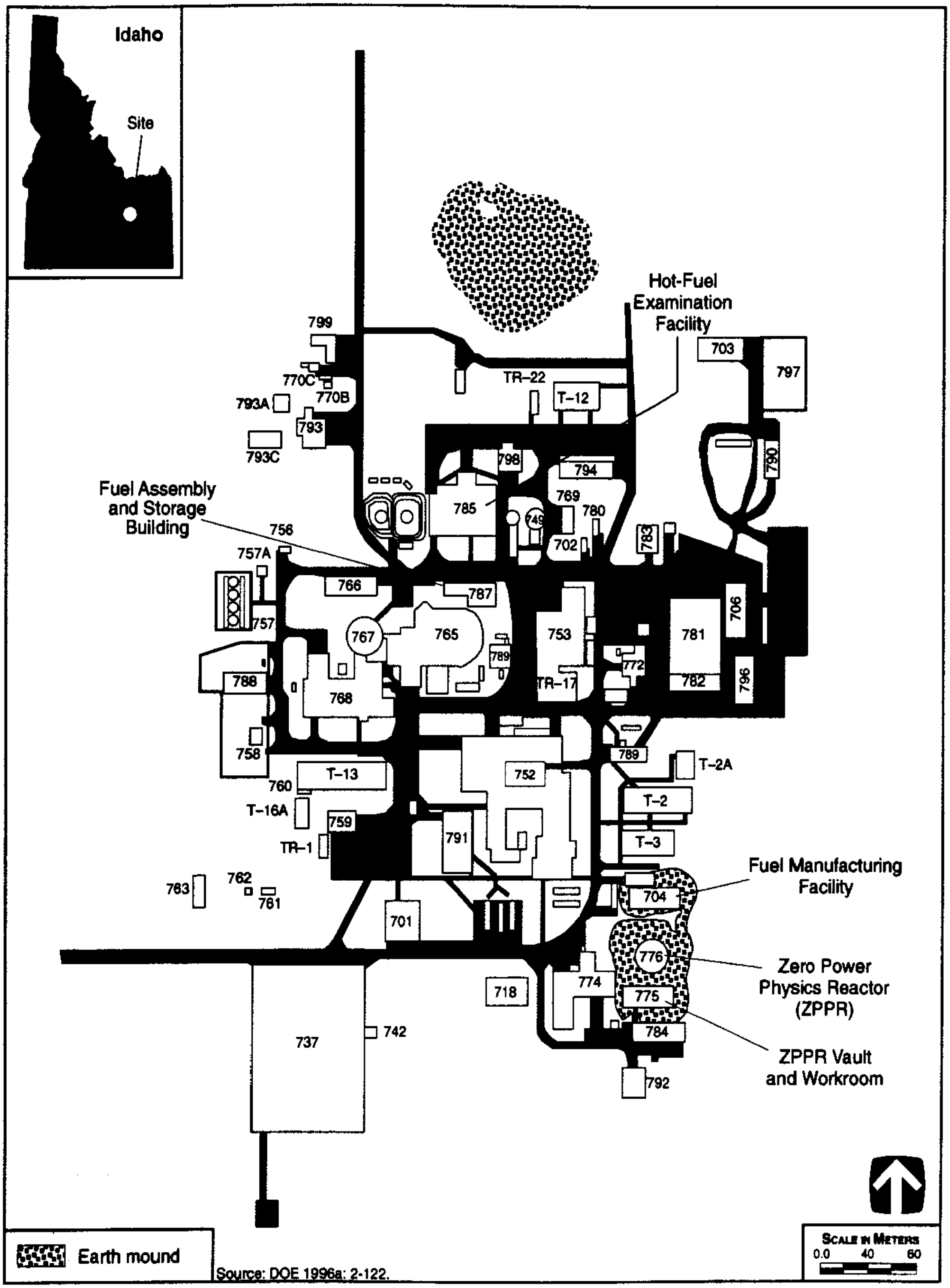
2.17.2.1 Hanford Site

The Fuel Assembly Area of FMEF, within Hanford's 400 Area (see Figures 2–2 and 2–17) has been proposed as a location for lead assembly fabrication. FMEF, also proposed as a candidate location for the pit conversion, immobilization, and MOX facilities, is described in detail in Section 2.6.

FMEF consists of several connected buildings. Building 427, the main part of the facility, is a six-level processing building with an attached mechanical wing on the west side and an emergency power wing on the northwest corner. The Fuel Assembly Area (Building 4862) is appended to the southeastern end of FMEF. This area is divided into two sections, the entry (administrative) wing, and the lower-level operations portion, the Fuel Assembly Area, designed for the fabrication of fuel assemblies for FFTF. The lower level of the Fuel Assembly Area would be used for fuel rod and assembly fabrication. The upper level contains independent ventilation equipment. Storage of plutonium feed materials would occur in the operating vaults of Building 427, or in reconfigured below-grade storage tubes in the Fuel Assembly Area.

2.17.2.2 Argonne National Laboratory–West

ANL–W is in the southeast portion of INEEL (see Figure 2–3). Established in the mid-1950s, the facility had as its primary mission the support of advanced liquid metal reactor research. In 1995, ANL–W began conducting research in the treatment of DOE spent nuclear fuel and in technologies for reactor decontamination and decommissioning. The ZPPR Vault and Workroom (Building 775), ZPPR Reactor Cell (Building 776), Fuel Manufacturing Facility (FMF, Building 704), and Fuel Assembly and Storage Building, (FASB, Building 787) within ANL–W have been proposed to support lead assembly fabrication (see Figure 2–24). As discussed in Sections 2.17.1 and 2.17.2.6, postirradiation examination could also be conducted at ANL–W.



Source: DOE 1996a: 2-122.

Figure 2–24. Proposed MOX Fuel Lead Assembly Fabrication Facilities, ANL–W at INEEL

ZPPR began operation at ANL–W in 1969 and was placed on standby in 1989. The facility is large enough to enable core physics studies of full-scale breeder reactors. The principal experimental area has a very thick foundation and thick concrete walls covered with an earthen mound, and a sand/gravel/HEPA filter roof. FMF, adjacent to the ZPPR facility, is buried under an earthen mound similar to that of ZPPR. This facility is currently supporting a furnace and glovebox operation for the dismantlement of damaged ZPPR fuel plates and the packaging of recovered plutonium oxide for shipment. FMF is also used as a test site for the development of safeguards and security systems. ZPPR and FMF share security assets, including a common security area surrounded by security fences, perimeter intrusion detection, and alarm systems. ZPPR and FMF are both Safeguards Category I, hardened buildings which meet natural phenomenon protection requirements currently approved for handling and special nuclear materials.

All the 336 m^2 (3,620 ft^2) in the ZPPR Workroom has been proposed for fuel manufacture and storage, and the ZPPR Reactor Cell, as the high-bay fuel assembly and inspection area. Space within FMF would be used for fuel storage. The FASB would also be used for lead assembly fabrication. This facility was constructed to provide space, equipment, and services for manufacturing fuel elements and components for an experimental breeder reactor. A metallurgical laboratory is housed in the building's west end. The FASB would provide controlled vault storage for special nuclear materials, including fuel assemblies.

2.17.2.3 Savannah River Site

SRS is in the southern portion of South Carolina, approximately 19 km (12 miles) south of Aiken (see Figure 2–5). Chemical processing facilities are situated within the F- and H-Canyon areas at SRS. Their primary mission was to separate special nuclear materials from spent reactor fuels and irradiated targets. A portion of the 221–H Canyon facility, located within the H-Area, has been proposed for the fabrication of lead assemblies (see Figure 2–25). This unused space originally constructed for the Uranium Solidification Facility (USF), was never completed. The 221–H facility is entirely within a protected safeguards and security area. Existing USF utilities, access control, administrative and laboratory space, and waste management systems would also be used for the proposed lead assemblies fabrication activities. Because SRS is a candidate site for disposition facilities, detailed site information may be found in Section 3.5.

2.17.2.4 Los Alamos National Laboratory

LANL, in northern New Mexico, was established in 1943 to design, develop, and test nuclear weapons (see Figure 2–26). Its mission has expanded from the primary task of designing nuclear weapons to include nonnuclear defense programs and a broad array of nondefense programs. Current programs include research and development of nuclear safeguards and security, medium-energy physics, space nuclear systems, biomedicine, computational science, and lasers. As discussed in Section 2.17.1, the plutonium dioxide feed material for the lead assembly fabrication effort is expected to be produced at LANL.

LANL consists primarily of Technical Areas, of which 49 are actively in use. Most of the facilities proposed for lead assembly fabrication are in Building PF–4 within TA–55 (see Figure 2–27), although facilities in TA–3, –18, and –50 have been identified for support activities such as inspection and storage of the fuel assemblies.[24] Most of TA–55, including the main complex, is inside a restricted area surrounded by a double security fence. In addition to Building PF–4, the TA–55 main complex consists of the Administration Building (PF–1), Support Office Building (PF–2), Support Building (PF–3), Warehouse (PF–5), and other miscellaneous support buildings.

[24] For the purposes of the SPD EIS analysis, it is assumed that bundle assembly, inspection, and storage would occur in the Chemistry and Metallurgical Research Building; the Radioactive Materials Research, Operations and Demonstration (RAMROD) Facility; or the Critical Assembly Building Kivas.

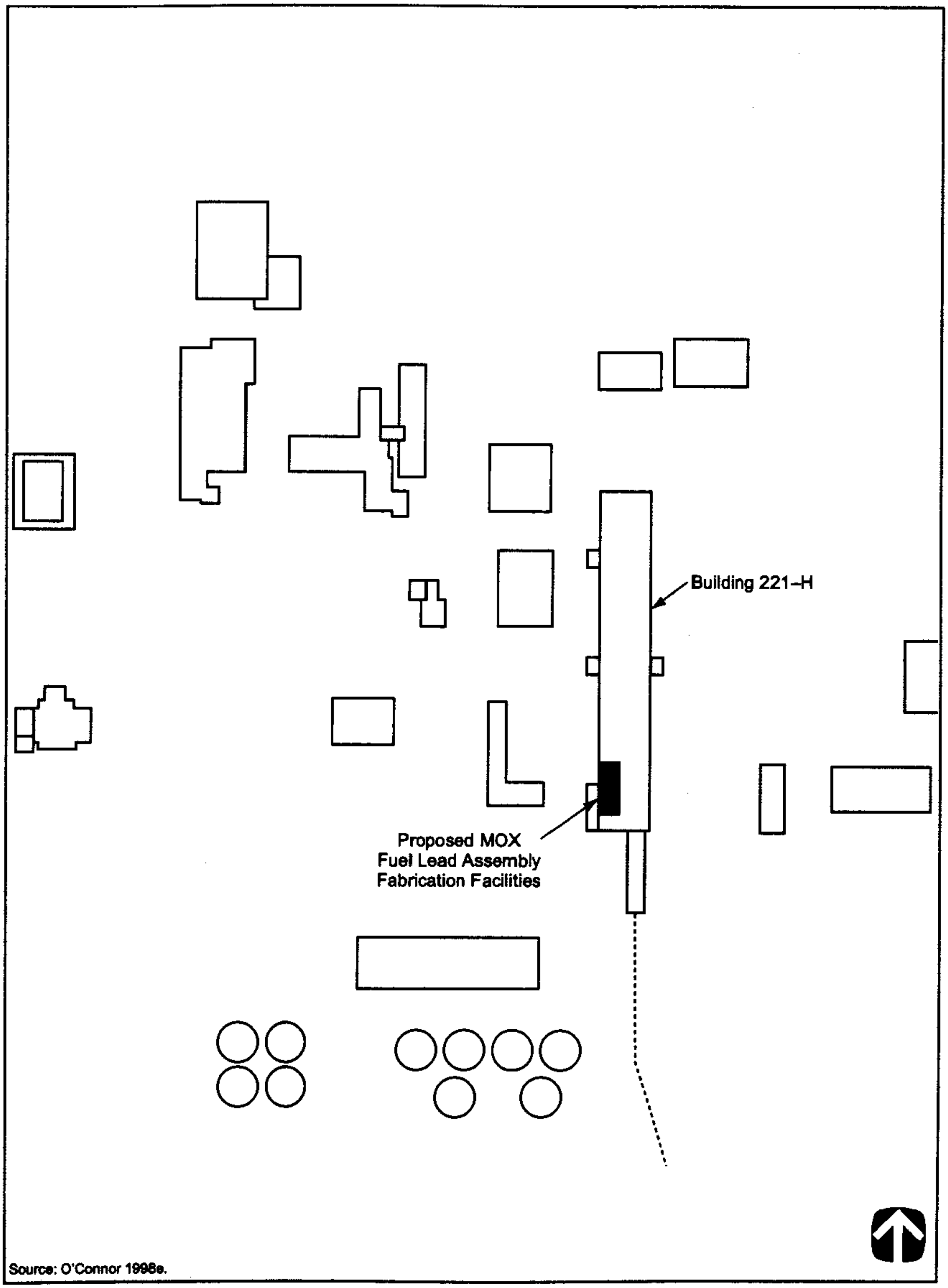


Figure 2–25. Proposed MOX Fuel Lead Assembly Fabrication Facilities, H-Area at SRS

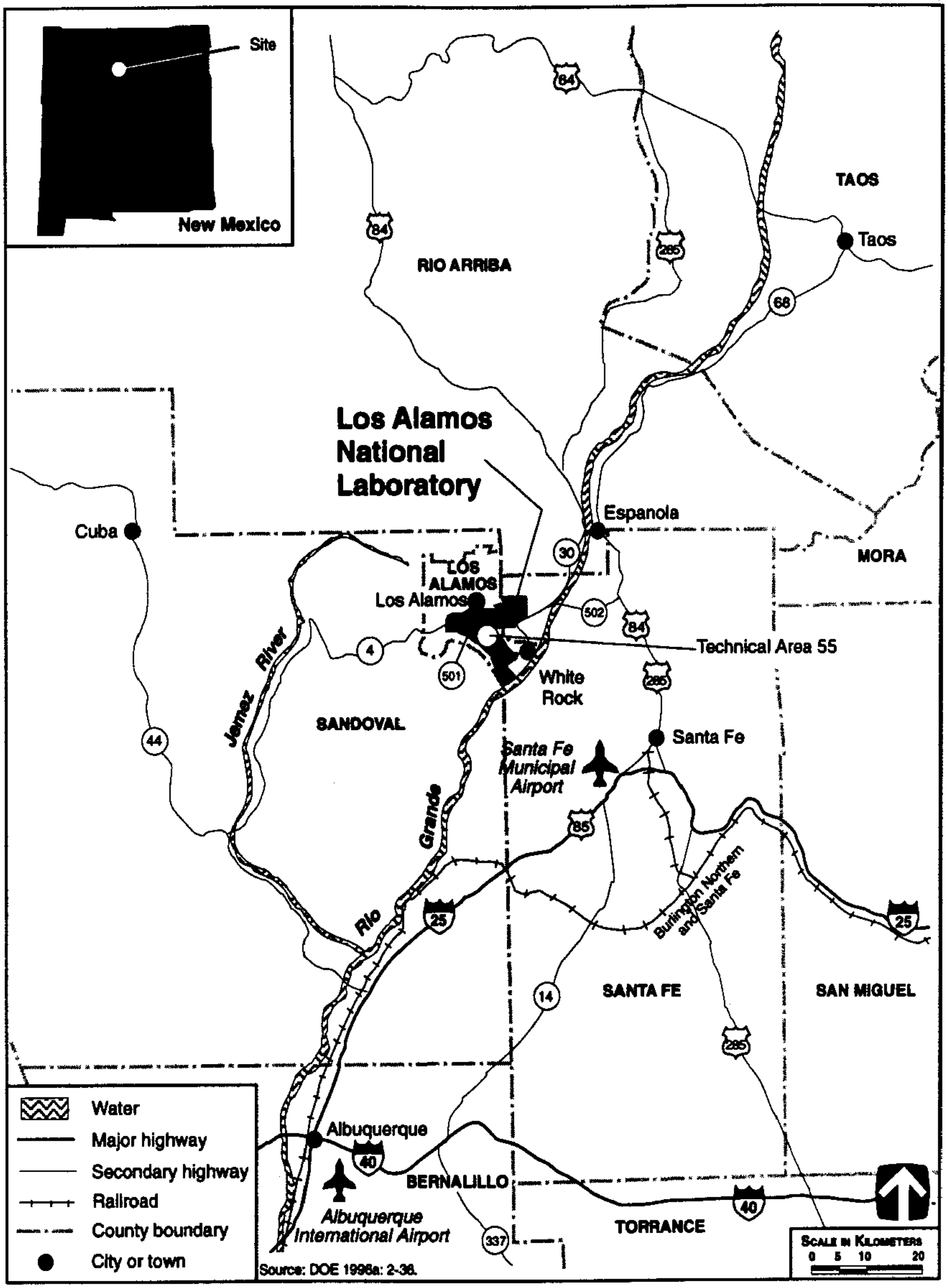


Figure 2–26. LANL, New Mexico

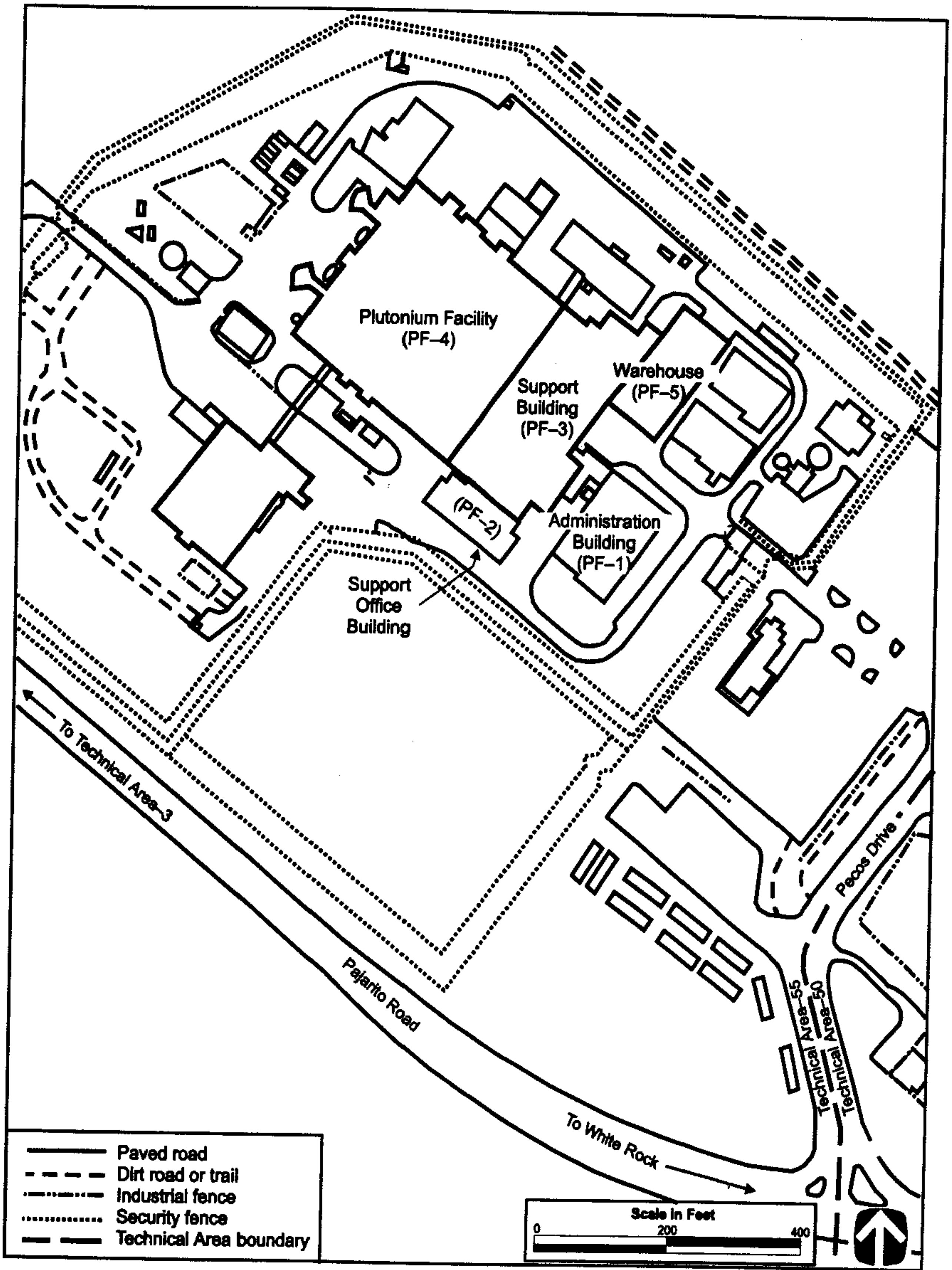


Figure 2–27. Proposed MOX Fuel Lead Assembly Fabrication Facilities, TA–55 at LANL

Fuel fabrication activities have been proposed for currently operational fuel fabrication laboratories in Building PF–4 which became operational in 1978 for conducting state-of-the-art plutonium processing. Current activities in the building include plutonium recovery, fabrication of plutonium components, weapons disassembly, plutonium 238 and actinide processing, and fabrication of ceramic-based reactor fuels.

2.17.2.5 Lawrence Livermore National Laboratory

The main LLNL site, originally a naval air training station, is approximately 80 km (50 mi) east of San Francisco and 6.4 km (4 mi) from downtown Livermore (see Figure 2–28). LLNL was established in 1952 to conduct nuclear weapons research. Its current mission is research, testing, and development focusing on national defense and security, energy, the environment, and biomedicine. Within recent years, the Laboratory's mission has broadened to include global security, ecology, and mathematics and science education.

Buildings 332, 334, and 335 are the three primary facilities proposed to support fabrication of lead assemblies. The Plutonium Facility (Building 332) is inside LLNL's Superblock, a 500-ft by 700-ft protected area surrounded by an alarmed double security fence (see Figure 2–29). Building 332 comprises several buildings constructed over the past three decades, including the Plenum Building, an office structure, plutonium-handling laboratories, mechanical shops, office space, a small nonradioactive materials laboratory, two plutonium storage vaults, and a cold machine shop. Current activities in the Plutonium Facility include the receipt, storage, and shipping of special nuclear materials; plutonium and fissile uranium operations and experiments, special nuclear material control and accountability, scrap recovery, and waste operations. For the lead assembly fabrication effort, Building 332 would be used to receive and store bulk plutonium dioxide powder, fabricate MOX pellets, and assemble fuel rods.

Building 334, adjacent to Building 332 in the Superblock, can handle maximum quantities of encapsulated special nuclear materials. This three-floor facility comprises the Engineering Test Bay (ETB) and the Radiation Measurements Facility (RMF). The ETB is used to conduct thermal and dynamic tests on weapon components; the RMF, located in the Intrinsic Radiation (INRAD) bay, to make intrinsic radiation measurements of various components. The INRAD and ETB bays provide primary and secondary confinement of radioactive material. For the proposed lead assembly fabrication, the ETB would be used for assembling, storing, packaging, and shipping fuel assemblies. Building 334 also contains analytical, metallography, scrap recovery, and other equipment to support the proposed activities.

Building 335, also adjacent to Building 332, is used as a staging area for nonradioactive equipment and systems being readied to move into Building 332. There are also areas for training, document storage, and change rooms, as well as access into the radioactive materials area of Building 332. For the lead assembly fabrication effort, Building 335 would be used for assembly and testing of equipment, storage of spare parts and supplies, and electrical and mechanical shop areas.

2.17.2.6 Postirradiation Examination Siting Alternatives

Postirradiation examination is used to collect information about fuel assemblies after irradiation. Tests on the lead assemblies would begin with remote nondestructive examination, which typically involves a visual examination of the fuel rods to detect signs of damage or wear, as well as the measurement of physical parameters such as length, diameter, and weight. The nondestructive tests would continue with more rigorous tests such as ultrasonic tests, X- or gamma spectroscopy, and neutron radiography. After completion of the nondestructive testing, which does not compromise the integrity of the material being examined, the rods would be subjected to destructive testing: they would be punctured to collect contained gases, then cut into segments for metallurgical and ceramographic testing, chemical analysis, electron microscopy, and other

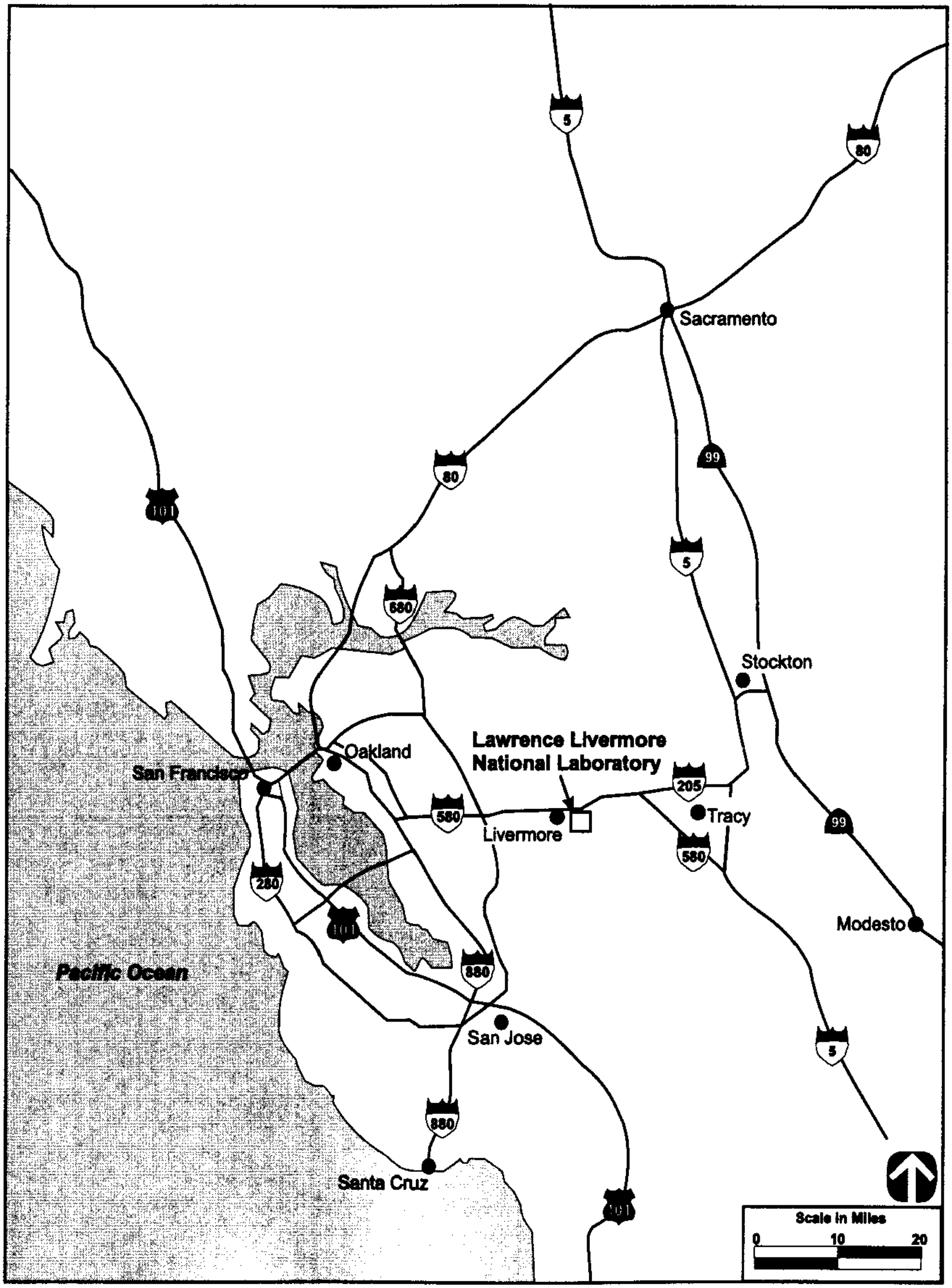


Figure 2–28. LLNL, California

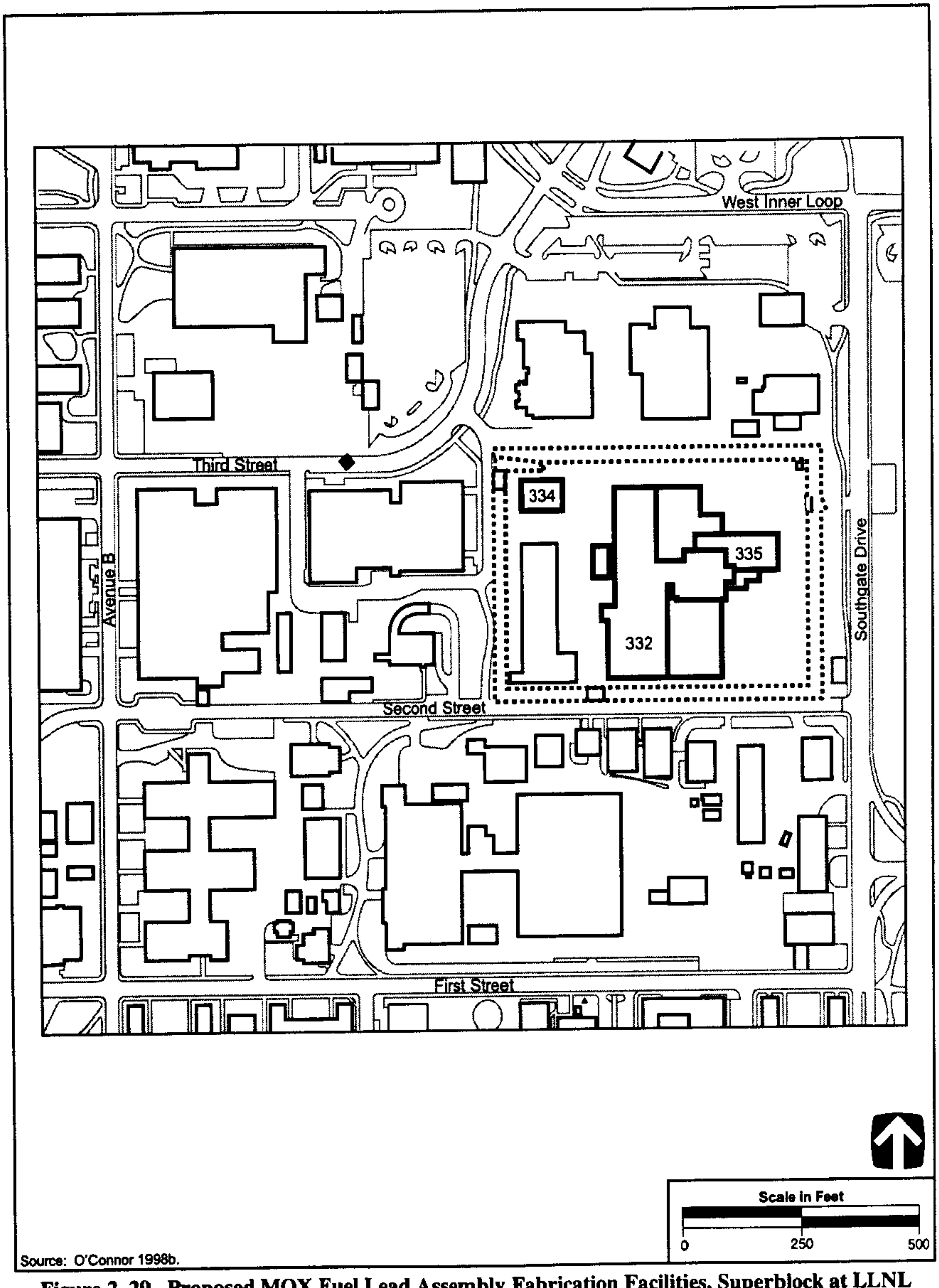


Figure 2–29. Proposed MOX Fuel Lead Assembly Fabrication Facilities, Superblock at LLNL

physical testing. Such tests, standard industry and research activities, would provide information on how the fuel material and the cladding responded to being inside the operating reactor. Postirradiation examination would likely be performed at either ANL–W or ORNL because these facilities have hot cells (special facilities which are heavily shielded and have remote handling equipment for working with highly radioactive materials) and testing equipment that are routinely required for these activities.

2.17.2.6.1 Argonne National Laboratory–West

The Hot Fuel Examination Facility (HFEF) is a hot cell complex for the preparation and examination of irradiated experiments and the characterization and testing of waste forms from conditioning of spent fuel and waste. HFEF is located in a double-fenced compound on the ANL–W site at INEEL (see Figure 2–24). HFEF consists of two adjacent shielded hot cells, a shielded metallographic loading box, an unshielded Hot Repair Area and a Waste Characterization Area. The building is a three-story structure with a basement support area, and has a gross floor area of about 5,200 m^2 (56,000 ft^2).

The HFEF main cell is 21 m (70 ft) long by 9 m (30 ft) wide by 7.5 m (25 ft) high, and has an argon gas atmosphere. The cell is serviced by two electro-mechanical manipulators rated for 340 kg (750 lb) and two 5-ton bridge cranes. There are 15 workstations, each equipped with two master/slave manipulators.

The primary program at HFEF, since October 1994, has been the support of the Experimental Breeder Reactor II (EBR–II) defueling and decommissioning. HFEF was responsible for receiving all the fuel and blanket material from EBR–II and preparing the material for storage in the Radioactive Scrap and Waste Facility (RSWF).

In addition to the handling of the EBR–II fuel, HFEF is the examination facility for both the metal and ceramic waste form experiments from the Fuel Conditioning Facility (FCF). In addition, equipment is being installed and processes tested for the disposal of the plutonium and fission product waste from the conditioning of EBR–II fuel. The testing and characterization of the ceramic waste forms will be performed in HFEF.

HFEF is presently being modified to accept commercial-sized fuel assemblies. All the examination equipment in the cell and the cask handling systems are being modified to handle commercial sized casks and fuel rods for examination. These modification are expected to be complete in mid-1999.

2.17.2.6.2 Oak Ridge National Laboratory

The Irradiated Fuels Examination Laboratory (IFEL), Building 3525, has been used for fuel research and examination. It is part of ORNL approximately 14 km (8 mi) southwest of the city of Oak Ridge, Tennessee. Over a period of three decades, this facility has handled a wide variety of fuels including aluminum clad research reactor fuel, both stainless and zircaloy clad LWR fuel, coated-particle gas cooled reactor fuel, and numerous one of a kind fuel test specimens. In addition, the facility has also done iridium isotope processing and irradiated capsule disassembly.

The IFEL contains a large horseshoe-shaped array of hot cells which are divided into three work areas. The hot cells are constructed of 3-ft thick concrete walls with oil-filled lead glass viewing windows. The inside of surfaces of the cell bank are lined with stainless steel to provide containment of particulate matter and to facilitate decontamination. Special penetrations are provided for the sealed entry of services such as instrument lines, lights, and electrical power. A pair of manipulators are located at each of 15 window stations for remote cell operations and periscopes allow for magnified views of in-cell objects. Heavy objects within each cell bank can be moved by electromechanical manipulators or a 3-ton crane. Fuel materials enter and leave the cells through three shielded transfer stations provided at the rear face of the North cell.

Next Section

2.18 SUMMARY OF IMPACTS OF CONSTRUCTION AND OPERATION OF SURPLUS PLUTONIUM DISPOSITION FACILITIES

This section summarizes the potential impacts associated with the activities necessary to implement DOE's disposition strategy for surplus plutonium. The summary addresses the environmental information to be considered for each of the decisions contemplated as part of this strategy. This information is compiled from the analyses presented in Chapter 4 of this SPD EIS. Section 2.18.1 summarizes impacts related to the surplus plutonium disposition facilities and provides that information by alternative, and within each alternative, by site. Summarized impacts are presented for the No Action Alternative as well as for each of the 23 alternatives that encompass the range of reasonable alternatives for both the 50-t (55-ton) immobilization and the hybrid approaches to plutonium disposition. Section 2.18.2 compares the potential impacts related to implementation of lead assembly fabrication at the five candidate sites. To provide an overview of the impacts associated with full implementation of the MOX fuel approach to disposition, Section 2.18.3 presents an integrated assessment of the potential impacts of the MOX facility, lead assembly fabrication, and use of the MOX fuel in domestic, commercial reactors (based on generic reactor impacts developed in the *Storage and Disposition PEIS*). To facilitate the evaluation of proposed immobilization technologies, the final section compares the impacts associated with the can-in-canister immobilization technology with those described in the PEIS for the ceramic immobilization and vitrification alternatives.

2.18.1 Summary of Impacts by Alternative and Site

Table 2–4 summarizes the potential impacts of the No Action and surplus plutonium disposition facility alternatives on key environmental resource areas. In addition, the amount of land that would be disturbed and the potential impacts from facility accidents and transportation are summarized. Impacts are presented by alternative, and within each alternative, by the affected site. For the No Action Alternative, sites that currently store surplus plutonium are included in the table.

Impacts on air quality are expected to be low for all alternatives. Table 2–4 provides the incremental criteria pollutant concentrations from surplus plutonium disposition operations for each alternative. In all cases, the incremental concentrations would contribute less than 1 percent of the applicable regulatory standard. Concentrations for total site air emissions, which also factor in the amount associated with the No Action Alternative,[25] would be no more than 19 percent of the applicable regulatory standard, with the highest occurring in the alternatives that would have the immobilization facility located at SRS. That particular value represents projected sulfur dioxide concentrations as a percent of the annual National Ambient Air Quality Standards (NAAQS); the corresponding value for the No Action Alternative is also 19 percent, demonstrating that the increment associated with plutonium disposition facilities would be very small.[26]

Expected waste generation is estimated for TRU waste, LLW, mixed LLW, hazardous waste, and nonhazardous waste from construction activities and 10 years of expected facility operation. As shown in Chapter 4 of the SPD EIS, impacts associated with management of hazardous and nonhazardous wastes would be minor and would not tend to be a discriminator among alternatives.

TRU waste generation would range from 1,440 m^3 (1,884 yd^3) to 1,740 m^3 (2,276 yd^3), and LLW generation would range from 1,400 m^3 (1,831 yd^3) to 3,040 m^3 (3,976 yd^3). The largest amounts of TRU waste and LLW would be generated by the hybrid alternatives that include immobilization at SRS in existing facilities

[25] As indicated in Appendix G, the No Action Alternative projects air emissions to the year 2005, when plutonium disposition facility operations under the disposition alternatives would begin, and includes emissions from existing and other planned facilities.

[26] This conclusion assumes that activity levels under the No Action Alternative remain the same beyond 2005.

(Alternatives 3B, 5B, 6C, 6D, 7B, and 9B). Mixed waste generation would range from 20 m^3 (26 yd^3) for immobilizing all 50 t (55 tons) (Alternatives 11A, 11B, 12A, 12B, 12C, and 12D) to 40 m^3 (52 yd^3) for each of the hybrid alternatives.

Impacts on the waste management infrastructure from implementing alternatives for surplus plutonium disposition are expected to be minor. At Pantex, a maximum of 640 m^3 (837 yd^3) of TRU waste would be generated under Alternatives 9A, 9B, or 10. Because TRU waste is not routinely generated and stored at Pantex, TRU waste storage space would be designated within the pit conversion and MOX facilities. Current schedules for shipment of TRU waste to WIPP near Carlsbad, New Mexico, would accommodate shipment of TRU waste from surplus plutonium disposition facilities.

Although the surplus plutonium disposition facilities are still in the early stages of engineering and design, the program would integrate pollution prevention practices that include waste stream minimization, source reduction and recycling, and DOE procurement processes that preferentially procure products made from recycled materials. The surplus plutonium disposition facility designs would minimize the size of radiologically controlled areas, thereby minimizing the generation of radioactive waste. To the extent practicable, the DOE facilities would not use solvents regulated by the Resource Conservation and Recovery Act (RCRA), thereby minimizing the amount of hazardous and mixed waste generated. Wastewater would be recycled to the extent possible to minimize effluent discharge.

The employment column summarizes the number of direct jobs that would be generated by the proposed facilities under each alternative. All the action alternatives would generate employment opportunities at the facilities. Expected annual peak construction employment ranges from 339 workers (Alternative 11A) to 1,408 workers (Alternative 5A).[27] Annual employment during operation would range from 671 workers (Alternatives 12A and 12C) to 1,022 workers (Alternatives 3B, 5B, 6C, 6D, and 9B).

Potential effects on human health from facility construction, 10 years of operation, postulated facility accidents and intersite transportation of radioactive materials are also summarized in Table 2–4. Doses to workers from 10 years of routine operation of all the surplus plutonium disposition facilities would result in up to 2.3 latent cancer facilities (LCFs) for the hybrid alternatives (under Alternatives 4A, 4B, 5B, 6C, 6D, 9B, and 10), and approximately 1.6 LCFs for the 50-t (55-ton) immobilization alternatives (under Alternatives 11A, 11B, 12B, and 12D). No LCFs would be expected to occur in the general population during routine operations. Under the No Action Alternative, continued storage of the surplus plutonium would not result in any LCFs to the general population during routine operations. Collective doses to workers from routine operations at all sites would be expected to result in approximately 2 LCFs.

Table 2–4 presents the results of the analysis of the most severe design basis accident scenario. For alternatives including immobilization at SRS in an existing facility (Building 221–F) (under Alternatives 3B, 5B, 6C, 6D, 7B, 9B,12B, and 12D), the design basis earthquake results in the greatest health effects in the general population. For all other alternatives except the No Action Alternative, a design basis fire in the pit conversion facility resulting in a tritium release would result in the most severe consequences. However, neither accident would be expected to result in LCFs in the general population. For the No Action Alternative, a primary containment vessel penetration would result in the most severe consequences, which would also not be expected to result in LCFs in the general population.

[27] These values represent the combined peak annual construction workforce at each site. Peak construction employment under Alternative 11A is composed of the 339 construction workers at Hanford in 2003. Peak construction employment under Alternative 5A is composed of the 452 construction workers at Pantex in 2002 and the 956 construction workers at SRS in 2003.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions, on the other hand, could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality were to occur, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the criticality. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Materials transportation is analyzed to determine potential radiological and nonradiological impacts from routine and accident conditions. These results are summarized in Table 2–4. Transportation includes the movement of surplus plutonium from storage and among the proposed disposition facilities; depleted uranium hexafluoride from, for example, Portsmouth to the representative conversion facility; uranium dioxide from the representative conversion facility to the immobilization and MOX facilities; recovered HEU from the pit conversion facility to the Oak Ridge Reservation; recovered pit parts from the pit conversion facility to LANL; MOX fuel to domestic, commercial reactors; and both spent nuclear fuel resulting from the use of MOX fuel in a reactor and the immobilized plutonium to a geologic repository. For all alternatives, no traffic fatalities from nonradiological accidents or LCFs from radiological exposures or vehicle emissions would be expected.

Table 2–4 also provides the total land area that would be disturbed at each site for each alternative. Land disturbance relates directly to impacts on ecological resources, cultural resources, geology and soils, and land use and visual resources. The amount of land that would be disturbed for the hybrid alternatives would range from 15 hectares (37 acres) in Alternative 2, to 31 hectares (77 acres) in Alternatives 5A and 9A. Because these land areas are in or adjacent to previously disturbed areas and represent a very small percent of the land available at the candidate sites, the impacts on geology and soils, land use, and visual resources would be minor. Land disturbance associated with immobilizing approximately 50 t (55 tons) of surplus plutonium would range from 4.6 hectares (11 acres) in Alternative 11A, to 21 hectares (52 acres) in Alternative 12C. No major impact is anticipated for any threatened or endangered species because none have been observed near the candidate sites. Cultural resource impacts would be minor because construction of facilities would be in mostly disturbed or developed areas. If all three plutonium disposition facilities were constructed at SRS in new buildings (Alternative 3A), however, the construction area would be near a previously identified archaeological site. Determination of potential impacts and mitigation actions would be made through consultations with the South Carolina State Historic Preservation Officer (SCSHPO) in compliance with the *Programmatic Memorandum of Agreement* among DOE, the SCSHPO, and the Advisory Council on Historic Preservation.

Impacts were also assessed on water availability and quality and infrastructure including requirements for roads, electricity, and fuel. These evaluations indicated that all impacts would be minor. No significant effects on the general population are expected to result from routine operations or transportation. Generally, no LCFs would be expected to occur in the event of a design basis accident. For alternatives that include immobilization at Building 221–F, a design basis earthquake would be expected to result in 0.43 to 0.53 LCF among the general population. Depending on the weather conditions prevailing at the time of the earthquake, the expected impact could occur among any member of the general population residing within 80 km (50 mi) of the accident site. However, the probability of occurrence of a design basis earthquake is unlikely. None of the alternatives were found to pose a significant risk (when probability is considered) to the general population, nor would implementation of any of the alternatives result in a significant risk of disproportionately high and adverse impacts to low-income or minority groups within the general population.

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 1: No Action							
Hanford	No change	No change	No change	None	Dose Public: 4.7×10^{-2} Workers: 46 LCFs Public: 1.2×10^{-3} Workers: 0.92	Primary containment vessel penetration: 1.3×10^{-3} LCFs	None
INEEL	No change	No change	No change	None	Dose Public: 7.6×10^{-5} Workers: 1.5 LCFs Public: 1.9×10^{-6} Workers: 2.9×10^{-2}	Primary containment vessel penetration: 5.1×10^{-4} LCFs	None
Pantex	No change	No change	No change	None	Dose Public: 6.3×10^{-6} Workers: 3 LCFs Public: 1.6×10^{-7} Workers: 6.0×10^{-2}	Primary containment vessel penetration: 4.4×10^{-4} LCFs	None
SRS	No change	No change	No change	None	Dose Public: 2.9×10^{-4} Workers: 7.5 LCFs Public: 7.2×10^{-6} Workers: 0.15	Primary containment vessel penetration: 1.4×10^{-3} LCFs	None

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
LANL	No change	No change	No change	None	Dose Public: 2.7 Workers: 12.5 LCFs Public: 6.8×10^{-2} Workers: 0.25	None	None
RFETS	No change	No change	No change	None	Dose Public: 0.10 Workers: 25 LCFs Public: 2.5×10^{-3} Workers: 0.50	None	None
Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford							
Hanford	CO: 0.53 NO_2: 0.046 PM_{10}: 0.0025 SO_2: 0.0022	TRU: 1,590 LLW: 1,540 MLLW: 40	Construction: 847 Operations: 1,014	15	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.0 Workers: 561 LCFs Public: 3.5×10^{-2} Workers: 2.2	Tritium release at pit conversion facility: 7.3×10^{-2} LCFs	LCFs: 5.8×10^{-2} Traffic fatalities: 7.2×10^{-2} Kilometers traveled: 6.7M

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 3A: Pit Conversion, Immobilization, and MOX in New Construction at SRS							
SRS	CO: 0.339 NO_2: 0.0409 PM_{10}: 0.00261 SO_2: 0.0779	TRU: 1,590 LLW: 1,540 MLLW: 40	Construction: 1,212 Operations: 996	31	Construction (workforce) Dose: 3.9 LCFs: 1.6×10^{-3} Operations Dose Public: 1.6 Workers: 541 LCFs Public: 8.2×10^{-3} Workers: 2.2	Tritium release at pit conversion facility: 3.3×10^{-2} LCFs	LCFs: 8.7×10^{-2} Traffic fatalities: 7.3×10^{-2} Kilometers traveled: 6.8M
Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS							
SRS	CO: 0.339 NO_2: 0.0409 PM_{10}: 0.00261 SO_2: 0.0779	TRU: 1,740 LLW: 3,040 MLLW: 40	Construction: 1,164 Operations: 1,022	26	Construction (workforce) Dose 7.2 LCFs: 2.9×10^{-3} Operations Dose Public: 1.6 Workers: 561 LCFs Public: 8.2×10^{-3} Workers: 2.2	Design basis earthquake at immobilization facility: 0.53 LCFs	LCFs: 8.7×10^{-2} Traffic fatalities: 7.3×10^{-2} Kilometers traveled: 6.8M

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10	Construction: 452 Operations: 400	4.9	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 5.8×10^{-2} Traffic fatalities: 6.8×10^{-2} Kilometers traveled: 6.2M
Hanford	CO: 0.386 NO_2: 0.0294 PM_{10}: 0.00209 SO_2: 0.00194	TRU: 1,410 LLW: 940 MLLW: 30	Construction: 776 Operations: 614	13	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.12 Workers: 369 LCFs Public: 5.9×10^{-4} Workers: 1.5	Nuclear criticality at MOX facility: 2.7×10^{-3} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10	Construction: 452 Operations: 400	4.9	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 5.8×10^{-2} Traffic fatalities: 6.8×10^{-2} Kilometers traveled: 6.2M
Hanford	CO: 0.0386 NO_2: 0.0294 PM_{10}: 0.00209 SO_2: 0.00194	TRU: 1,410 LLW: 940 MLLW: 30	Construction: 630 Operations: 614	12	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 5.9×10^{-2} Workers: 369 LCFs Public: 3.0×10^{-4} Workers: 1.5	Nuclear criticality at MOX or immobilization facility: 2.7×10^{-3} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10	Construction: 452 Operations: 400	4.9	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 8.8×10^{-2} Traffic fatalities: 7.3×10^{-2} Kilometers traveled: 6.8M
SRS	CO: 0.25 NO_2: 0.0183 PM_{10}: 0.00121 SO_2: 0.0471	TRU: 1,410 LLW: 940 MLLW: 30	Construction: 956 Operations: 596	27	Construction (workforce) Dose: 2.6 LCFs: 1.0×10^{-3} Operations Dose Public: 3.1×10^{-2} Workers: 349 LCFs Public: 1.6×10^{-4} Workers: 1.4	Nuclear criticality at MOX facility: 1.1×10^{-3} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 5B: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF and MOX in New Construction at SRS							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10	Construction: 452 Operations: 400	4.9	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 8.8×10^{-2} Traffic fatalities: 7.3×10^{-2} Kilometers traveled: 6.8M
SRS	CO: 0.25 NO_2: 0.0183 PM_{10}: 0.00121 SO_2: 0.0471	TRU: 1,560 LLW: 2,440 MLLW: 30	Construction: 908 Operations: 622	22	Construction (workforce) Dose: 5.9 LCFs: 2.4×10^{-3} Operations Dose Public: 3.1×10^{-2} Workers: 369 LCFs Public: 1.6×10^{-4} Workers: 1.5	Design basis earthquake at immobilization facility: 0.53 LCFs	

Table 2–4. *Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site*

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
					Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS		
Hanford	CO: 0.247 NO_2: 0.031 PM_{10}: 0.00143 SO_2: 0.00123	TRU: 640 LLW: 940 MLLW: 30	Construction: 579 Operations: 750	13	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.0 Workers: 367 LCFs Public: 3.5×10^{-2} Workers: 1.5	Tritium release at pit conversion facility: 7.3×10^{-2} LCFs	LCFs: 9.0×10^{-2} Traffic fatalities: 8.9×10^{-2} Kilometers traveled: 7.9M
SRS	CO: 0.141 NO_2: 0.0093 PM_{10}: 0.000697 SO_2: 0.0165	TRU: 950 LLW: 600 MLLW: 10	Construction: 448 Operations: 246	16	Construction (workforce) Dose: 1.4 LCFs: 5.6×10^{-4} Operations Dose Public: 2.3×10^{-3} Workers: 174 LCFs Public: 1.2×10^{-5} Workers: 0.70	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
			Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS				
Hanford	CO: 0.247 NO_2: 0.031 PM_{10}: 0.00143 SO_2: 0.00123	TRU: 640 LLW: 940 MLLW: 30	Construction: 433 Operations: 750	13	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.0 Workers: 367 LCFs Public: 3.4×10^{-2} Workers: 1.5	Tritium release at pit conversion facility: 7.3×10^{-2} LCFs	LCFs: 9.0×10^{-2} Traffic fatalities: 8.9×10^{-2} Kilometers traveled: 7.9M
SRS	CO: 0.141 NO_2: 0.0093 PM_{10}: 0.000697 SO_2: 0.0165	TRU: 950 LLW: 600 MLLW: 10	Construction: 448 Operations: 246	16	Construction (workforce) Dose: 1.4 LCFs: 5.6×10^{-4} Operations Dose Public: 2.3×10^{-3} Workers: 174 LCFs Public: 1.2×10^{-5} Workers: 0.70	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
			Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS				
Hanford	CO: 0.247 NO_2: 0.031 PM_{10}: 0.00143 SO_2: 0.00123	TRU: 640 LLW: 940 MLLW: 30	Construction: 579 Operations: 750	13	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.0 Workers: 367 LCFs Public: 3.5×10^{-2} Workers: 1.5	Tritium release at pit conversion facility: 7.3×10^{-2} LCFs	LCFs: 9.0×10^{-2} Traffic fatalities: 8.9×10^{-2} Kilometers traveled: 7.9M
SRS	CO: 0.148 NO_2: 0.00968 PM_{10}: 0.000724 SO_2: 0.0166	TRU: 1,100 LLW: 2,100 MLLW: 10	Construction: 400 Operations: 272	11	Construction (workforce) Dose: 4.7 LCFs: 1.9×10^{-3} Operations Dose Public: 2.3×10^{-3} Workers: 194 LCFs Public: 1.2×10^{-5} Workers: 0.77	Design basis earthquake at immobilization facility: 0.53 LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 6D: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in Building 221-F and DWPF at SRS							
Hanford	CO: 0.247 NO_2: 0.031 PM_{10}: 0.00143 SO_2: 0.00123	TRU: 640 LLW: 940 MLLW: 30	Construction: 433 Operations: 750	13	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.0 Workers: 367 LCFs Public: 3.4×10^{-2} Workers: 1.5	Tritium release at pit conversion facility: 7.3×10^{-2} LCFs	LCFs: 9.0×10^{-2} Traffic fatalities: 8.9×10^{-2} Kilometers traveled: 7.9M
SRS	CO: 0.148 NO_2: 0.00968 PM_{10}: 0.000724 SO_2: 0.0166	TRU: 1,100 LLW: 2,100 MLLW: 10	Construction: 400 Operations: 272	11	Construction (workforce) Dose: 4.7 LCFs: 1.9×10^{-3} Operations Dose Public: 2.3×10^{-3} Workers:194 LCFs Public:1.2×10^{-5} Workers:0.77	Design basis earthquake at immobilization facility: 0.53 LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
			Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS				
INEEL	CO: 0.703 NO_2: 0.141 PM_{10}: 0.00798 SO_2: 0.305	TRU: 640 LLW: 940 MLLW: 30	Construction: 600 Operations: 708	13	Construction (workforce) Dose: 2.0 LCFs: 7.7×10^{-4} Operations Dose Public: 2.2 Workers: 345 LCFs Public: 1.1×10^{-2} Workers: 1.4	Tritium release at pit conversion facility: 2.9×10^{-3} LCFs	LCFs: 8.9×10^{-2} Traffic fatalities: 8.4×10^{-2} Kilometers traveled: 7.4M
SRS	CO: 0.141 NO_2: 0.0093 PM_{10}: 0.000697 SO_2: 0.0165	TRU: 950 LLW: 600 MLLW: 10	Construction: 448 Operations: 246	16	Construction (workforce) Dose: 1.4 LCFs: 5.6×10^{-4} Operations Dose Public: 2.3×10^{-3} Workers: 174 LCFs Public: 1.2×10^{-5} Workers: 0.70	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 7B: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in Building 221–F and DWPF at SRS							
INEEL	CO: 0.703 NO_2: 0.141 PM_{10}: 0.00798 SO_2: 0.305	TRU: 640 LLW: 940 MLLW: 30	Construction: 600 Operations: 708	13	Construction (workforce) Dose: 2.0 LCFs: 7.7×10^{-4} Operations Dose Public: 2.2 Workers: 345 LCFs Public: 1.1×10^{-2} Workers: 1.4	Tritium release at pit conversion facility: 2.9×10^{-3} LCFs	LCFs: 8.9×10^{-2} Traffic fatalities: 8.4×10^{-2} Kilometers traveled: 7.4M
SRS	CO: 0.141 NO_2: 0.0093 PM_{10}: 0.000697 SO_2: 0.0165	TRU: 1,100 LLW: 2,100 MLLW: 10	Construction: 400 Operations: 272	11	Construction (workforce) Dose: 4.7 LCFs: 1.9×10^{-3} Operations Dose Public: 2.3×10^{-3} Workers: 194 LCFs Public: 1.2×10^{-5} Workers: 0.77	Design basis earthquake at immobilization facility: 0.53 LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford							
INEEL	CO: 0.703 NO_2: 0.141 PM_{10}: 0.00798 SO_2: 0.305	TRU: 640 LLW: 940 MLLW: 30	Construction: 600 Operations: 708	13	Construction (workforce) Dose: 2.0 LCFs: 7.7×10^{-4} Operations Dose Public: 2.2 Workers: 345 LCFs Public: 1.1×10^{-2} Workers: 1.4	Tritium release at pit conversion facility: 2.9×10^{-3} LCFs	LCFs: 5.8×10^{-2} Traffic fatalities: 7.0×10^{-2} Kilometers traveled: 6.2M
Hanford	CO: 0.283 NO_2: 0.015 PM_{10}: 0.00108 SO_2: 0.001	TRU: 950 LLW: 600 MLLW: 10	Construction: 268 Operations: 264	2.1	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.8×10^{-3} Workers: 194 LCFs Public: 3.9×10^{-5} Workers: 0.77	Nuclear criticality at immobilization facility: 2.7×10^{-3} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS							
Pantex	CO: 0.687 NO_2: 0.0725 PM_{10}: 0.00514 SO_2: 0.00264	TRU: 640 LLW: 940 MLLW: 30	Construction: 783 Operations: 750	16	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.59 Workers: 367 LCFs Public: 3.0×10^{-3} Workers: 1.5	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 8.2×10^{-2} Traffic fatalities: 6.1×10^{-2} Kilometers traveled: 5.9M
SRS	CO: 0.141 NO_2: 0.0093 PM_{10}: 0.000697 SO_2: 0.0165	TRU: 950 LLW: 600 MLLW: 10	Construction: 448 Operations: 246	16	Construction (workforce) Dose: 1.4 LCFs: 5.6×10^{-4} Operations Dose Public: 2.3×10^{-3} Workers: 174 LCFs Public: 1.2×10^{-5} Workers: 0.70	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 9B: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS							
Pantex	CO: 0.687 NO_2: 0.0725 PM_{10}: 0.00514 SO_2: 0.00264	TRU: 640 LLW: 940 MLLW: 30	Construction: 783 Operations: 750	16	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.59 Workers: 367 LCFs Public: 3.0×10^{-3} Workers: 1.5	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 8.2×10^{-2} Traffic fatalities: 6.1×10^{-2} Kilometers traveled: 5.9M
SRS	CO: 0.148 NO_2: 0.00968 PM_{10}: 0.000724 SO_2: 0.0166	TRU: 1,100 LLW: 2,100 MLLW: 10	Construction: 400 Operations: 272	11	Construction (workforce) Dose: 4.7 LCFs: 1.9×10^{-3} Operations Dose Public: 2.3×10^{-3} Workers: 194 LCFs Public: 1.2×10^{-5} Workers: 0.77	Design basis earthquake at immobilization facility: 0.53 LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 10: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford							
Pantex	CO: 0.687 NO_2: 0.0725 PM_{10}: 0.00514 SO_2: 0.00264	TRU: 640 LLW: 940 MLLW: 30	Construction: 783 Operations: 750	16	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.59 Workers: 367 LCFs Public: 3.0×10^{-3} Workers: 1.5	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 5.1×10^{-2} Traffic fatalities: 5.3×10^{-2} Kilometers traveled: 4.8M
Hanford	CO: 0.283 NO_2: 0.015 PM_{10}: 0.00108 SO_2: 0.001	TRU: 950 LLW: 600 MLLW: 10	Construction: 268 Operations: 264	2.1	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 7.8×10^{-3} Workers: 194 LCFs Public: 3.9×10^{-5} Workers: 0.77	Nuclear criticality at immobilization facility: 2.7×10^{-3} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
			Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford (No MOX)				
Hanford	CO: 0.772 NO_2: 0.0316 PM_{10}: 0.00149 SO_2: 0.00128	TRU: 1,440 LLW: 1,400 MLLW: 20	Construction: 339 Operations: 704	4.6	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 6.9 Workers: 410 LCFs Public: 3.4×10^{-2} Workers: 1.6	Tritium release at pit conversion facility: 7.3×10^{-2} LCFs	LCFs: 6.6×10^{-2} Traffic fatalities: 5.1×10^{-2} Kilometers traveled: 3.4M

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
			Alternative 11B: Pit Conversion in New Construction at Pantex and Immobilization in FMEF and HLWVF at Hanford (No MOX)				
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10	Construction: 452 Operations: 400	4.9	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 6.6×10^{-2} Traffic fatalities: 4.8×10^{-2} Kilometers traveled: 2.8M
Hanford	CO: 0.628 NO_2: 0.015 PM_{10}: 0.00108 SO_2: 0.001	TRU: 1,260 LLW: 800 MLLW: 10	Construction: 268 Operations: 304	2.1	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 1.6×10^{-2} Workers: 218 LCFs Public: 8.0×10^{-5} Workers: 0.87	Nuclear criticality at immobilization facility: 2.7×10^{-3} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS (No MOX)							
SRS	CO: 0.389 NO_2: 0.0318 PM_{10}: 0.00209 SO_2: 0.0473	TRU: 1,440 LLW: 1,400 MLLW: 20	Construction: 729 Operations: 671	20	Construction (workforce) Dose: 2.7 LCFs: 1.1×10^{-3} Operations Dose Public: 1.6 Workers: 385 LCFs Public: 8.0×10^{-3} Workers: 1.5	Tritium release at pit conversion facility: 3.3×10^{-2} LCFs	LCFs: 0.13 Traffic fatalities: 7.4×10^{-2} Kilometers traveled: 4.1M

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 12B: Pit Conversion in New Construction and Immobilization in Building 221-F and DWPF at SRS (No MOX)							
SRS	CO: 0.389 NO_2: 0.0318 PM_{10}: 0.00209 SO_2: 0.0473	TRU: 1,590 LLW: 2,900 MLLW: 20	Construction: 665 Operations: 712	16	Construction (workforce) Dose: 6.0 LCFs: 2.4×10^{-3} Operations Dose Public: 1.6 Workers: 410 LCFs Public: 8.0×10^{-3} Workers: 1.6	Design basis earthquake at immobilization facility: 0.49 LCFs	LCFs: 0.13 Traffic fatalities: 7.4×10^{-2} Kilometers traveled: 4.1M

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 12C: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS (No MOX)							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10	Construction: 452 Operations: 400	4.9	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 0.13 Traffic fatalities: 7.4×10^{-2} Kilometers traveled: 4.2M
SRS	CO: 0.299 NO_2: 0.0093 PM_{10}: 0.000697 SO_2: 0.0166	TRU: 1,260 LLW: 800 MLLW: 10	Construction: 448 Operations: 271	16	Construction (workforce) Dose: 1.4 LCFs: 5.6×10^{-4} Operations Dose Public: 4.9×10^{-3} Workers: 193 LCFs Public: 2.5×10^{-5} Workers: 0.77	Nuclear criticality at immobilization facility: 8.0×10^{-4} LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

Candidate Site	Air Quality[a] (incremental pollutant concenrations in $\mu g/m^3$)	Waste Management[b] (m^3)	Employment[c] (direct)	Land Disturbance[d] (ha)	Human Health Risk[e] (dose in person-rem)	Facility Accidents[f]	Transportation[g]
Alternative 12D: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS (No MOX)							
Pantex	CO: 0.381 NO_2: 0.0374 PM_{10}: 0.00215 SO_2: 0.00064	TRU: 180 LLW: 600 MLLW: 10	Construction: 452 Operations: 400	4.9	Construction (workforce) Dose: 0 LCFs: 0 Operations Dose Public: 0.58 Workers: 192 LCFs Public: 2.9×10^{-3} Workers: 0.77	Tritium release at pit conversion facility: 1.2×10^{-2} LCFs	LCFs: 0.13 Traffic fatalities: 7.4×10^{-2} Kilometers traveled: 4.2M
SRS	CO: 0.31 NO_2: 0.00968 PM_{10}: 0.000724 SO_2: 0.0166	TRU: 1,410 LLW: 2,300 MLLW: 10	Construction: 400 Operations: 312	11	Construction (workforce) Dose: 4.7 LCFs: 1.9×10^{-3} Operations Dose Public: 4.9×10^{-3} Workers: 218 LCFs Public: 2.5×10^{-5} Workers: 0.87	Design basis earthquake at immobilization facility: 0.49 LCFs	

Table 2–4. Summary of Impacts of Construction and Operation of Surplus Plutonium Disposition Facilities by Alternative and Site

[a] Values represent the incremental criteria pollutant concentrations associated with surplus plutonium disposition operations for the annual averaging period for nitrogen dioxide (NO_2), particulate matter with an aerodynamic diameter smaller than or equal to 10 microns (PM_{10}), and sulfur dioxide (SO_2), and for the 8-hour averaging period for carbon monoxide.

[b] Values are based on a construction period of approximately 3 years and 10 years of operation.

[c] Values are for the peak year of construction and for the annual operation of all facilities for each alternative.

[d] Values represent the total land disturbance at each site from construction and operations.

[e] Values for Alternative 1 represent impacts over 50 years of operation under No Action. Those for the remaining alternatives are for the period of construction and 10 years of operation. Public dose values represent the annual radiological dose (in person-rem) to the population within 80 km (50 mi) of the facility location for the year 2030 under Alternative 1, or for 2010 under Alternatives 2 through 12. Worker dose values represent the total radiological dose to involved workers at the facility (in person-rem/year). Public LCFs represent the 50-year LCFs estimated to occur in the population within 80 km (50 mi) for the year 2030 under Alternative 1, or the 10-year LCFs estimated to occur for the year 2010 under Alternatives 2 through 12. Worker LCFs represent the associated 50-year or 10-year LCFs estimated to occur in the involved workforce.

[f] The most severe of the design basis accidents (based on 95 percent meteorological conditions) is used to obtain the population LCF.

[g] For alternatives that involve more than one site, the transportation impacts for the entire alternative are shown in the first site listed in the alternative. LCFs are from the radiological exposure associated with incident-free operation, radiological accidents, and fatalities expected as a result of vehicle emissions. Traffic fatalities are from nonradiological vehicle accidents.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility; LCF, latent cancer fatality; LLW, low-level waste; MLLW, mixed low-level waste; TRU, transuranic.

Next Section

2.18.2 Summary of Lead Assembly Fabrication Impacts

The impacts on key resources from fabrication of lead assemblies at the five candidate sites (ANL–W, Hanford, LLNL, LANL, and SRS) evaluated in Section 4.27 are summarized in Table 2–5. These areas include waste management, human health risk during normal operations, facility accidents, and transportation. The transportation analysis includes the shipment of plutonium dioxide from LANL to the candidate site; depleted uranium hexafluoride from the representative DOE storage site at the Portsmouth Gaseous Diffusion Plant to the representative conversion facility in Wilmington, North Carolina; uranium dioxide from the conversion facility to the lead assembly fabrication facility; MOX fuel rods from the lead assembly facility to a domestic commercial reactor for irradiation; and irradiated fuel rods from the reactor to a postirradiation examination facility. Total distance traveled, in kilometers, is provided for each proposed fabrication site. Because facility modification activities would occur inside existing buildings (i.e., no new buildings would be constructed and no additional land would be disturbed), there should be little increase in air pollutants; land disturbances would be minimal; and the number of construction workers would be low. Little or no impacts are expected on any other resources areas.

There are no appreciable differences in environmental impacts among the five candidate sites. There would be little difference in the volume of waste generated at any of the sites. The small differences in TRU waste and LLW would be due to wastes generated during modification of contaminated areas of existing buildings at ANL–W and LANL. In addition, less than 5 m^3 (6.5 ft^3) of hazardous waste would be generated during facility modification and lead assembly fabrication. The total amount of nonhazardous waste generated, primarily sanitary wastewater, would range from 8,700 to 13,500 m^3 (11,380 to 17,658 yd^3). No LCFs for either workers or the general public would be expected to result from fabrication of lead assemblies at any of the proposed locations during routine operations. Impacts from facility accidents also show that no LCFs would be expected in the general population at any site from the postulated worst-case design basis accident. Comparison of transportation impacts shows little differences among the sites, with no expected traffic fatalities or LCFs.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions, on the other hand, could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality were to occur, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the criticality. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

If DOE were to decide to immobilize all 50 t (55 tons) of surplus plutonium, no lead assembly activities would be required. If DOE decided to pursue the MOX option, but not fabricate lead assemblies, such activities would not occur at the five sites. Under both of these scenarios, current operations would continue at the sites and the environmental conditions would remain at baseline levels. (See Chapter 3 for a description of the current environmental conditions at the sites.)

Table 2–5. Summary of Impacts of Lead Assembly Fabrication at the Candidate Sites

Candidate Site	Waste Management[a] (m^3)	Human Health Risk[b] (dose in person-rem)	Facility Accidents[c]	Transportation[d]
ANL–W	Total TRU waste: 132 Total LLW: 736 Total MLLW: 4	Dose Public: 0.011 Workers: 28 LCFs Public: 5.5×10^{-6} Workers: 0.011	Nuclear criticality LCFs: 1.6×10^{-4}	Radiological LCFs: 8.9×10^{-3} Traffic fatalities: 9.2×10^{-4} Kilometers traveled: 80,000
Hanford	Total TRU waste: 132 Total LLW: 700 Total MLLW: 4	Dose Public: 0.025 Workers: 28 LCFs Public: 1.2×10^{-5} Workers: 0.011	Nuclear criticality LCFs: 2.7×10^{-3}	Radiological LCFs: 9.0×10^{-3} Traffic fatalities: 1.0×10^{-3} Kilometers traveled: 89,000
LLNL	Total TRU waste: 132 Total LLW: 700 Total MLLW: 4	Dose Public: 1.1 Workers: 28 LCFs Public: 5.5×10^{-4} Workers: 0.011	Nuclear criticality LCFs: 3.1×10^{-2}	Radiological LCFs: 9.2×10^{-3} Traffic fatalities: 9.1×10^{-4} Kilometers traveled: 73,000
LANL	Total TRU waste: 137 Total LLW: 705 Total MLLW: 4	Dose Public: 0.025 Workers: 28 LCFs Public: 1.2×10^{-5} Workers: 0.011	Nuclear criticality LCFs: 3.2×10^{-3}	Radiological LCFs: 8.9×10^{-3} Traffic fatalities: 6.7×10^{-4} Kilometers traveled: 55,000
SRS	Total TRU waste: 132 Total LLW: 700 Total MLLW: 4	Dose Public: 6.6×10^{-3} Workers: 28 LCFs Public: 3.3×10^{-6} Workers: 0.011	Nuclear criticality LCFs: 6.5×10^{-4}	Radiological LCFs: 9.0×10^{-3} Traffic fatalities: 7.3×10^{-4} Kilometers traveled: 84,000

[a] Totals for 2-year modification and 3-year operation of lead assembly facility.
[b] Annual dose for public residing within 80 km (50 mi) of the candidate site. Worker dose is the same at all five facilities because estimated number of workers and estimated dose to worker does not vary by site. Estimated dose to public varies based on projected population within 80 km (50 mi) of candidate site.
[c] The most severe of the design basis accidents is listed.
[d] LCFs are from the radiological exposure associated with incident-free operation and radiological accidents; traffic fatalities, from nonradiological traffic accidents.
Key: LCF, latent cancer fatality; LLW, low-level waste; MLLW, mixed-low-level waste; TRU, transuranic.

2.18.3 MOX Fuel Integrated Impacts

The impacts from implementing the MOX fuel fabrication alternatives would not be limited to those associated with the MOX fuel fabrication facility, but would also include impacts from lead assembly fabrication, irradiation and postirradiation examination; and the use of a reactor or reactors for irradiation of the MOX fuel assemblies. Any new construction would occur at existing DOE sites. MOX-related operations at all sites would be compatible with, or similar to, activities already occurring at those locations.

Tables 2–6 through 2–11 describe the potential impacts of implementation of the MOX alternatives, from fabrication of the MOX fuel assemblies and lead assemblies to irradiation of the assemblies in domestic, commercial nuclear power reactors, and the transportation for all radioactive material movements. While these impacts would be cumulative over the life of the campaign, they would not all be concurrent. The MOX facility and lead assembly facility data are those reported in Chapter 4 of this SPD EIS. The reactor site data used in this section are those presented in Section 4.3.5.2 of the *Storage and Disposition PEIS* for generic light water reactors, and summarized in Section 4.28 of this SPD EIS.[28]

Air emissions, presented in Table 2–6, would result primarily from building heating and vehicular emissions. The MOX fuel fabrication process would contribute various hydrocarbon emissions, an estimated 1 t/yr (1.1 ton/yr). These were analyzed as ethylene glycol, a toxic air pollutant used in the MOX fuel fabrication process. There are no nonradiological emissions from these facilities that are regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAP). As discussed in Section 4.32, radiological NESHAP emissions would be monitored and maintained as part of the total site limit of 10 mrem/yr from all sources. Releases of criteria pollutants are provided as a range, with the lowest emissions at Hanford, where electricity is the method of heating, and highest at INEEL, where coal-fired boilers produce steam for heating and travel distances for personnel result in vehicular emissions double those estimated for other candidate sites. Lead assembly fabrication is a relatively small effort that is not expected to measurably increase air emissions at any of the candidate sites. The *Storage and Disposition PEIS* states that criteria, toxic, and hazardous pollutant emissions are not related to the type of fuel being used in a light water reactor (LWR).[29] Rather, emission of these pollutants from an LWR would be related to ancillary processes at the site such as operation of diesel generators, periodic testing of emergency diesel generators, and facility operations. Thus, there would be no incremental difference in the air emissions from a reactor using MOX fuel.

Table 2–6. Potential Impacts on Air Quality of MOX Fuel Fabrication and Irradiation

Criteria Pollutant	MOX Fuel Facility (kg/yr)	Lead Assembly Fabrication (kg/yr)	Reactor Operation Increment (kg/yr)	Total MOX Fuel Increment (kg/yr)
Carbon monoxide	35K to 82K	NA	0	35K to 82K
Nitrogen dioxide	11K to 32K	NA	0	11K to 32K
PM_{10}	32K to 60K	NA	0	32K to 60K
Sulfur dioxide	0.1K to 61K	NA	0	0.1K to 61K
Volatile organic compounds	4K to 10K	NA	0	4K to 10K
Total suspended particulates[a]	31K to 34K	NA	0	31K to 34K
Toxics[b]	1K	NA	0	1K

[a] Total suspended particulates assumed to be same as PM_{10}.
[b] Toxics may be emitted as ethylene glycol.

TRU waste and LLW would be generated during operation of both the lead assembly and full-scale MOX facilities (see Table 2–7). The amount of waste generated would be process-specific, and would not vary appreciably by site. Lead assembly fabrication would result in a total of about 800 m^3 (1046 ft^3) of this waste. The larger amount of waste generated on an annual basis by lead assembly fabrication, as compared to full-scale fabrication, would be attributed to operational differences between fabricating MOX fuel on a laboratory rather than commercial scale. Similarly, activities such as material recycle may not be implemented to as great an extent on the smaller scale.

[28] As discussed in Section 2.1.3, DOE has begun the procurement process for a potential contract for MOX fuel fabrication and irradiation services, which will identify specific reactor sites. Reactor-specific environmental information will be included in the SPD Final EIS.

[29] Light water reactor is the type of reactor used in the United States for power production. The domestic, commercial nuclear reactors referred to in this SPD EIS are LWRs

Table 2–7. Potential Impacts on Waste Generation of MOX Fuel Fabrication and Irradiation

Waste Type	MOX Fuel Facility (m^3)	Lead Assembly Fabrication (m^3)	Reactor Operation Increment	Total MOX Fuel Increment[a] (m^3)
TRU waste	460	132	0	592
Low-level waste	340	700	0	1,040
Mixed LLW	20	4	0	24
Hazardous	10	0	0	10
Nonhazardous				
Liquid[b]	250K	6.4K	0	256K
Solid	1.5K	5.2K	0	6.7K

[a] Total contribution of MOX effort; based on total lead assembly activities and 10 years of MOX fuel fabrication.
[b] Primary contributor is sanitary use, not process-related activities.

According to the *Storage and Disposition PEIS*, more spent fuel could be generated as a result of the proposed disposition of surplus plutonium as MOX fuel. The analysis in the *Storage and Disposition PEIS* assumes that the MOX assemblies would be removed from the reactor as soon as the fuel had been irradiated enough to meet the Spent Fuel Standard[30] rather than being left in the reactor for the maximum length of time. The *Storage and Disposition PEIS* indicates that even so, there would be sufficient space at the reactor sites (in either the spent fuel pools or dry storage) to store the additional spent fuel until it could be sent to a geologic repository pursuant to the NWPA.

Existing infrastructure would be adequate to support the MOX fuel alternatives, although it has been estimated that 1 km (0.62 mi) of new roads would be needed for the MOX facility (see Table 2–8). Consumption of coal, natural gas and electricity vary greatly from site to site, for both the MOX and the lead assembly fabrication facilities, depending on the type of fuel used for heating. For example, electricity needed for MOX fuel fabrication would be 12,000 MWh/yr at all sites but Hanford. Hanford, which is estimated to use twice the electricity of the other sites (24,000 MWh/yr), uses electricity to heat its buildings. INEEL and SRS use coal for heating, and Pantex, natural gas.

Table 2–8. Potential Impacts on Infrastructure of MOX Fuel Fabrication and Irradiation

Requirement	MOX Fuel Facility	Lead Assembly Fabrication	Reactor Operation Increment
Electricity (MWh/yr)	12K to 24K	0.7K to 1.2K	0
Water (l/yr)	43M	1.6M	0
Fuel			
Oil (l/yr)	43K	12K to 61K	0
Natural gas (m^3/yr)	0 to 920K	0 to 55K	0
Coal (t/yr)	0.7K to 1.6K	0 to 0.06K	0
Transportation			
Roads (km)	1.0 to 2.0	NA	0
Rail (km)	0	NA	0

Key: NA, not applicable.

[30] The Spent Fuel Standard was identified by the National Academy of Sciences and modified by DOE. To meet the Spent Fuel Standard, surplus weapons-usable plutonium should be made as inaccessible and unattractive for weapons use as the much larger and growing quantity of plutonium that exists in spent nuclear fuel from commercial power reactors.

Table 2–9 compiles information about expected radiological impacts on workers during routine operation. The impacts on workers at the MOX and lead assembly fabrication facilities are based on an average annual dose rate of 500 mrem/yr. This is an administrative limit that has been set in accordance with as low as is reasonably achievable (ALARA) principles. This exposure over the life of the MOX campaign (10 years for the MOX facility and 3 years for lead assembly fabrication) would result in an increased risk of fatal cancer of 2×10^{-3} per worker for 10 years of exposure at the MOX facility, and 6×10^{-4} at the lead assembly site. The corresponding number of LCFs for MOX facility workers and lead assembly workers from the MOX campaign would be 0.70 and 0.033, respectively. The *Storage and Disposition PEIS* estimates that the incremental dose to workers at a light water reactor using MOX fuel would be 1.3 to 2.7 mrem/yr more than if uranium-only fuel were used. This exposure over the life of the MOX campaign (the *Storage and Disposition PEIS* assumes 11 years to disposition) would result in an increased risk of fatal cancer of 5.8×10^{-6} to 1.2×10^{-5} over that for a uranium-only core. The corresponding number of LCFs among reactor workers from the MOX campaign would be 7.1×10^{-3}.

Table 2–9. Potential Radiological Impacts on Workers of MOX Fuel Fabrication and Irradiation

Impact	MOX Fuel Facility (over 10 years)	Lead Assembly Fabrication (over 3 years)	Reactor Operation Increment (over 11 years)
Average worker dose (mrem/yr)	500	500	1.3 to 2.7
Fatal cancer risk	2.0×10^{-3}	6.0×10^{-4}	5.8×10^{-6} to 1.2×10^{-5}
Total dose (person-rem/yr)	175	28	1.6
Latent fatal cancer	0.70	0.033	7.1×10^{-3}

The potential radiological impacts on the general population from routine operation would be very small. Table 2–10 shows that from routine operations annual doses from the MOX facility to the maximally exposed individual (MEI) range from 3.1×10^{-4} to 5.5×10^{-3} mrem/yr (Alternatives 3B and 10, respectively), which translates to an increased risk of fatal cancer of 1.6×10^{-9} to 2.8×10^{-8} for 10 years of exposure. The lowest dose would be received from SRS; the highest, Pantex. However, the population around Pantex would receive the lowest total population dose, and the lowest annual dose to the average individual. Estimated results at Hanford (Alternative 4A) would be at the high end of the range for both of these parameters, 1.1×10^{-1} person-rem/yr and 2.8×10^{-4} mrem/yr, respectively. The annual dose to the average individual would still be extremely small, and would result in only a 1.4×10^{-9} increased risk of fatal cancer for 10 years of exposure. Offsite dose to the MEI resulting from lead assembly fabrication ranges from a low at SRS of 5.5×10^{-5} to 6.4×10^{-2} mrem/yr at LLNL. The associated risk of fatal cancer would be extremely low for the same MEI, ranging from 8.4×10^{-11} to 9.6×10^{-8}. Annual doses to the average individual at SRS and LLNL would be 8.8×10^{-6} and 1.4×10^{-4} mrem, respectively; risk of LCFs to the same individuals would be 1.3×10^{-11} and 2.1×10^{-10}. The *Storage and Disposition PEIS* estimates that the incremental dose to the general public from normal operations associated with the disposition of MOX fuel at a generic LWR would not be signficantly different than operations with a uranium core (see Table 2–10).

Table 2–10. Potential Radiological Impacts on the Public of MOX Fuel Fabrication and Irradiation

Impact	MOX Fuel Facility (over 10 years)	Lead Assembly Fabrication (over 3 years)	Reactor Operation Increment (over 11 years)
Annual dose to MEI (mrem)	3.1×10^{-4} to 5.5×10^{-3}	5.5×10^{-5} to 6.4×10^{-2}	-1.1×10^{-2} to 0.020
Fatal cancer risk	1.6×10^{-9} to 2.8×10^{-8}	8.4×10^{-11} to 9.6×10^{-8}	-6.2×10^{-8} to 1.1×10^{-7}
Annual population dose (person-rem)	1×10^{-2} to 1.1×10^{-1}	6×10^{-3} to 1.1	-4.6×10^{-2} to 2.0×10^{-1}
Fatal cancers	5.0×10^{-5} to 5.5×10^{-4}	9.9×10^{-6} to 1.7×10^{-3}	-2.5×10^{-3} to 1.1×10^{-4}
Annual dose to average ind. (mrem)	3.3×10^{-5} to 2.8×10^{-4}	8.8×10^{-6} to 1.4×10^{-4}	-1.8×10^{-4} to 1.0×10^{-4}
Fatal cancer risk	1.7×10^{-10} to 1.4×10^{-9}	1.3×10^{-11} to 2.1×10^{-10}	-9.7×10^{-10} to 5.8×10^{-10}

Transportation impacts are summarized in Table 2–11, and include radiological dose to the crew and the general population, nonradiological emissions from vehicle operation, potential traffic accident fatalities, and LCFs resulting from an accident involving a breach of containment and release of radioactive materials. Shipments analyzed include all those listed in Table 2–3 for the MOX and lead assembly facilities. The analysis shows that no traffic fatalities or LCFs would be expected from either routine transportation activities or accidents.

Table 2–11. Potential Overland Transportation Risks of MOX Fuel Fabrication and Irradiation

Impact	MOX Fuel Facility	Lead Assembly Fabrication	Total MOX Fuel Increment
Routine radiological			
Crew(LCFs)	1.0×10^{-4} to 3.2×10^{-4}	5.9×10^{-4}	6.8×10^{-4} to 9.1×10^{-4}
Public (LCFs)	5.2×10^{-4} to 2.3×10^{-3}	5.1×10^{-3} to 5.2×10^{-3}	5.6×10^{-3} to 7.5×10^{-3}
Routine nonradiological, emissions (LCFs)	8.9×10^{-3} to 9.6×10^{-3}	1.5×10^{-4} to 3.4×10^{-4}	9.0×10^{-3} to 9.9×10^{-3}
Accidental, traffic (fatalities)	3.1×10^{-2} to 4.1×10^{-2}	6.7×10^{-4} to 1.0×10^{-3}	3.2×10^{-2} to 4.2×10^{-2}
Accidental, radiological (LCFs)	6.5×10^{-3} to 6.6×10^{-3}	3.1×10^{-3} to 3.4×10^{-3}	9.6×10^{-3} to 1.0×10^{-2}

Key: LCFs, latent cancer fatalities.

Accidents are unplanned events which would be different for each type of facility needed to implement the MOX approach. The accidents analyzed for the disposition facilities are presented in detail in Appendix K, and the consequences summarized by alternative in Chapter 4 (Sections 4.3 through 4.19 for Alternatives 2 through 10, respectively, and Section 4.27 for the lead assembly alternatives). The design basis accident with the most severe consequences postulated for the MOX facility is a criticality. This accident would result in an estimated dose at a distance of 1 km (0.62 mi) from the facility of from 0.03 rem at Hanford to 0.12 rem at INEEL. This same accident would result in doses at the site boundaries ranging from 2.4×10^{-3} rem at INEEL to 9.3×10^{-3} rem at Pantex. Population doses and LCFs within 80 km (50 mi) would range from 1.1×10^{-1} person-rem and 5.4×10^{-5} LCF at INEEL to 7.6 person-rem and 3.7×10^{-3} LCF at Hanford.

The *Storage and Disposition PEIS* evaluates the potential impacts from a set of postulated highly unlikely accidents with potentially severe consequences at a domestic, commercial power reactor using both uranium-only and MOX cores. In this evaluation, the *Storage and Disposition PEIS* cites a report by the National Academy of Sciences (NAS), *Management and Disposition of Excess Weapons Plutonium Reactor-Related Options* (NAS 1995). This NAS report indicates that the potential influences on safety of the use of MOX fuel in LWRs were extensively studied in the United States in the 1970s in the *Final Generic Environmental Impact Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors*, NUREG-0002 (NRC 1976). Regarding effects of MOX fuel on accident probabilities, the NAS report states, "... no important overall adverse impact of MOX use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than low enriched uranium (LEU) fuel" (NAS 1995:352). Regarding the effects of MOX fuel on accident consequences, the report states, "... it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by no more than 10 to 20 percent. The influence on the consequences of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all" (NAS 1995:355).

In the *Storage and Disposition PEIS*, the incremental effects of using MOX fuel in a commercial reactor in place of LEU fuel were derived from a quantitative analysis of several highly unlikely severe accident scenarios for MOX and LEU fuel. The analysis considers severe accidents where sufficient damage could occur to cause the release of plutonium or uranium. The consequences of these accident releases were found to be in the range of plus 8 to minus 7 percent,[31] compared with LEU fuel, depending on the accident release scenario. This analysis was based on existing commercial LWR probabilistic risk assessments of severe accidents, and the release scenarios were modeled assuming large population distributions near the LWRs and meteorological conditions for dispersal that lead to large doses, which are not necessarily reflective of specific or actual site conditions.

As part of its Request for Proposals, DOE requested information about specific LWRs that the offerors are proposing for irradiation of the MOX fuel. Available reactor-specific information will be included in the SPD Final EIS.

2.18.4 Comparison of Immobilization Technology Impacts

To provide a basis for evaluating alternative immobilization forms and technologies, the environmental impacts associated with operating the ceramic and glass can-in-canister immobilization facilities evaluated in this SPD EIS were compared with the corresponding environmental impacts associated with operating the homogenous ceramic immobilization and vitrification facilities evaluated in the *Storage and Disposition PEIS* (DOE 1996a).

Section 4.29 presents the comparable impacts for key environmental resources (e.g., air quality, waste management, human health risk, and resource requirements) at Hanford and SRS for the homogenous ceramic immobilization/vitrification facilities and the can-in-canister immobilization facilities. Impacts associated with facility accidents, intersite transportation, and environmental justice are also discussed. The results of the comparative analysis are summarized here.

The comparison of impacts is based on immobilizing the full 50 t (55 tons) of surplus plutonium. The *Storage and Disposition PEIS* impact analyses are based on operating facilities that would convert the plutonium into an oxide in one new facility and immobilize it into a homogenous ceramic or glass form in another new facility. Impacts for a plutonium conversion facility are evaluated and itemized separately from the impacts for a ceramic immobilization or vitrification facility. In contrast, this SPD EIS considers the use of both new and existing facilities, and is based on a collocated plutonium conversion and immobilization capability. To compare the impacts, it was therefore necessary to combine the separate *Storage and Disposition PEIS* impact values, as appropriate, to establish a suitable standard of comparison.

Generally, air quality impacts associated with the ceramic or glass can-in-canister technologies would be lower or about the same as those evaluated in the *Storage and Disposition PEIS* for ceramic immobilization or vitrification. With the exception of sulfur dioxide in the ceramic can-in-canister process, all criteria pollutant emissions associated with either can-in-canister technology would be much lower. In terms of differences between the can-in-canister immobilized forms, pollutant levels attributed to the ceramic process would be slightly higher than those for the glass process, although both would be much lower than the regulatory limits.

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[31] Accidents severe enough to cause a release of plutonium involve combinations of events that are highly unlikely. Estimates and analyses presented in the *Storage and Disposition PEIS* indicate a range of postulated LCFs of 1.3×10^2 to 7.3×10^3 (in the population within 80 km (50 mi) of the release point) with attendant risks of LCFs over 11 years of reactor operation of 0.012 and 0.010, respectively (and risks of LCFs over 17 years of reactor operation of 0.018 and 0.016, respectively). One of the accidents analyzed had a higher risk of LCFs, 0.098 over 11 years (0.15 over 17 years), but the number of postulated LCFs (5.9×10^3) falls within the stated range of LCFs.

Potential volumes of each waste type resulting from operation of the ceramic or glass can-in-canister technologies would be considerably less than the waste volumes expected from either ceramic immobilization or vitrification technology evaluated in the *Storage and Disposition PEIS*. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in TRU waste volumes of 126 m^3/yr (165 yd^3/yr), compared to the 647 m^3/yr (846 yd^3/yr) of TRU waste estimated in the *Storage and Disposition PEIS* from operation of the homogenous ceramic immobilization facility. Factors contributing to the reduced waste levels associated with the can-in-canister technology would include the use of dry-feed preparation techniques, coordination with existing HLW vitrification operations and the need for a smaller operating work force. Waste volumes would not be expected to differ appreciably between the ceramic and glass can-in-canister processes.

Section 4.29 also presents the potential radiological exposure and cancer risk to the public and involved workers from normal operation of the immobilization facilities. The potential risks to the public associated with either can-in-canister technology would be about the same as the homogeneous technologies at Hanford, but lower at SRS. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in population doses of 1.6×10^{-2} or 4.9×10^{-3} person-rem/yr, respectively, compared to the population doses of 8.4×10^{-3} (at Hanford) or 6.6×10^{-2} (at SRS) person-rem/year resulting from operation of the homogenous ceramic immobilization facility evaluated in the *Storage and Disposition PEIS*. These variations may be attributable to the incorporation of updated source terms, meteorology, population distribution, and other modeling variables in the analysis of the can-in-canister technologies. A comparison between the ceramic and glass can-in-canister technologies indicates operation of the ceramic process would result in slightly higher potential offsite impacts, regardless of whether it is located at Hanford or SRS. For example, the dose associated with operation of the can-in-canister facility at Hanford would result in a population dose of 1.6×10^{-2} person-rem/yr using the ceramic process and 1.5×10^{-2} person-rem/yr using the glass process; the same facility at SRS would result in a population dose of 4.9×10^{-3} person-rem/yr using the ceramic process, and a dose of 4.5×10^{-3} person-rem/yr using the glass process.

The estimated average worker dose and associated cancer risk for the can-in-canister technologies are slightly higher than estimated in the *Storage and Disposition PEIS* for the homogenous technologies. Although the estimated average dose to an individual involved worker is higher for the can-in-canister approaches than for the homogenous approaches (e.g., 750 mrem/yr versus 512 mrem/yr), the total dose to all involved workers would be lower from either can-in-canister technology (ranging from 193 to 218 person-rem/yr) than from either homogenous technology (ranging from 243 to 253 person-rem/yr) because fewer workers would be required. Potential radiological impacts on involved workers are not expected to differ appreciably between the ceramic and glass can-in-canister processes.

Although some potential hazardous chemical impacts were determined for the homogenous ceramic immobilization/vitrification technologies evaluated in the *Storage and Disposition PEIS*, none are expected for either the ceramic or glass can-in-canister technology because no hazardous chemical emissions would occur from operations.

Because of substantial differences between the *Storage and Disposoition PEIS* and the SPD EIS in terms of the specific accident scenarios and supporting assumptions used in the determination of facility accident impacts, no basis for appropriately comparing between homogenous technology and can-in-canister technology accidents is available. However, comparison between the ceramic and glass can-in-canister processes indicates slightly higher impacts would be associated with the ceramic process. For example, a design basis earthquake at Hanford would result in 9.6×10^{-5} LCF in the general population using the ceramic process, and 8.4×10^{-5} LCF using the glass process. Similarly, a design basis earthquake in a new facility at SRS would result in 3.6×10^{-5} LCF in the general population using a ceramic process, and 3.1×10^{-5} LCF using a glass process.

In terms of resource requirements, operation of the can-in-canister technologies would require substantially lower amounts of electricity, fuel, land area, and water than would the homogenous technologies evaluated in the *Storage and Disposition PEIS*. Fewer workers would be required to operate the can-in-canister technologies, which in turn would result in lower socioeconomic impacts. Resource requirements differ between the ceramic and glass can-in-canister processes in two areas: water requirements would be greater to support the ceramic process at Hanford (i.e., the ceramic process would require 44 million l/yr (12 million gal/yr), compared to 41 million l/yr (11 million gal/yr) for the glass process) and electricity requirements would be greater to support the ceramic process at either site (i.e., the ceramic process would require 16,000 or 14,000 MWh/yr at Hanford or SRS, respectively, compared to the 15,000 or 13,000 MWh/yr, respectively, required for the glass process).

The *Storage and Disposition PEIS* analysis assumes that canisters of plutonium immobilized with radionuclides would be transported to a Federal geologic repository via rail. This SPD EIS analysis, however, conservatively assumes that the immobilized canisters would be shipped by truck from the immobilization site to the repository, with one canister being transported per truck shipment. The ceramic and glass can-in-canister technologies would result in fewer total potential fatalities from intersite transportation than would the homogenous ceramic immobilization/vitrification technologies evaluated in the *Storage and Disposition PEIS*. Because the ceramic can-in-canister process would produce fewer canisters, it would result in somewhat lower routine and accidental transportation impacts than the glass can-in-canister process.

Evaluations of both the homogenous ceramic immobilization/vitrification technologies and can-in-canister technologies included routine facility operations and transportation as well as accidents. Generally, no LCFs would be expected to occur for normal operations or in the event of a design basis accident. For alternatives that include immobilization at Building 221–F, a design basis earthquake would be expected to result in 0.43 LCF to 0.53 LCF among the general population. Depending on the weather conditions prevailing at the time of the earthquake, the expected impact could occur among any member of the general population residing within 80 km (50 mi) of the accident site. However, the probability of occurrence of a design basis earthquake is unlikely. Therefore, implementation of homogenous ceramic immobilization/vitrification technologies or can-in-canister technologies would pose no significant risk to the general population, nor would implementation of these technologies result in a significant risk of disproportionately high and adverse impacts on low-income or minority groups within the general population.

2.19 REFERENCES

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, Richland Operations Office, Richland, WA, August.

DOE (U.S. Department of Energy), 1997a, *Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, 62 FR 3014, Office of the Federal Register, Washington, DC, January 14.

DOE (U.S. Department of Energy), 1997b, *Surplus Plutonium Disposition Environmental Impact Statement*, Notice of Intent, 62 FR 28009, Office of the Federal Register, Washington, DC, May 22.

NAS (National Academy of Sciences), 1995, *Management and Disposition of Excess Weapons Plutonium Reactor-Related Option*, National Academy Press, Washington, DC.

NRC (U.S. Nuclear Regulatory Commission), 1976, *Final Generic Environmental Impact Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors*, NUREG-0002, National Technical Information Service, Springfield, VA, August.

O'Connor, D.G., et al., 1998a, *ANL-W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13478, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998b, *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13480, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998c, *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13481, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G. et al., 1998d, *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13482, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998e, *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13483, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

UC (Regents of the University of California), 1997, *Immobilization Technology Down-Section Radiation Barrier Approach*, UCRL-ID-127320, Lawrence Livermore National Laboratory, Livermore, CA, May 23.

UC (Regents of the University of California), 1998a, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Hanford Site*, LA-UR-97-2907, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998b, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Idaho National Engineering and Environmental Laboratory,* LA-UR-97-2908, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998c, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Pantex Plant,* LA-UR-97-2909, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998d, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Savannah River Site,* LA-UR-97-2910, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998e, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford,* UCRL-ID-128275, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998f, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Hanford,* UCRL-ID-128276, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998g, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site,* UCRL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998h, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Savannah River Site,* UCRL-ID-128272, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998i, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in New Facilities at Savannah River Site,* UCRL-ID-128273, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998j, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Savannah River Site,* UCRL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998k, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Hanford Site,* LA-UR-97-2064, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998l, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Idaho National Engineering and Environmental Laboratory,* LA-UR-97-2065, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998m, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Pantex Plant,* LA-UR-97-2067, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998n, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Savannah River Site*, LA-UR-97-2066, Los Alamos National Laboratory, Los Alamos, NM.

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Chapter 3
Affected Environment

3.1 APPROACH TO DEFINING THE AFFECTED ENVIRONMENT

In accordance with the Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations (CEQ 1986) on preparing an environmental impact statement (EIS), the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." The affected environment descriptions presented in this chapter provide the context for understanding the environmental consequences described in Chapter 4. As such, they serve as a baseline from which any environmental changes that may be brought about by implementing the proposed action and alternatives can be identified and evaluated. For this surplus plutonium disposition (SPD) EIS, the baseline conditions are the existing conditions.

Selected Characteristics of the Candidate Sites for Surplus Plutonium Disposition Facilities

		Population			Dose per Year[a]	
Site	Area (km^2)	Health Risk ROI[a]	Socioecon ROI	Site Work Force	MEI (mrem)	Population (person-rem)
Hanford	1,450	380,000	179,949	12,882	0.0074	0.20
INEEL	2,390	121,500	213,547	8,291	0.031	0.24
Pantex	60	275,000	212,729	2,944	0.000088	0.0021
SRS	800	620,100	453,778	15,032	0.20	8.6

[a] For 1996.

Key: MEI, maximally exposed individual; ROI, region of influence.

The candidate sites for surplus plutonium disposition facilities are the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), the Pantex Plant (Pantex), and the Savannah River Site (SRS). As described in Chapter 2, areas within the boundaries of the sites that are potential locations for the surplus plutonium disposition facilities include the 200 East and 400 Areas at Hanford, the Idaho Nuclear Technology and Engineering Center (INTEC)[1] at INEEL, Zone 4 at Pantex, and F- and S-Areas at SRS. The resources that are described for the candidate sites are air quality and noise, waste management, socioeconomics, human health risk, environmental justice, geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and infrastructure.

Candidate sites for mixed oxide (MOX) fuel lead assembly fabrication are described in Section 3.6. These sites are Hanford, INEEL (at Argonne National Laboratory–West [ANL–W]), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), and SRS. These additional sites are evaluated for related plutonium disposition activities only; therefore, they are not described in detail. Sites that would supply uranium oxide and sites that would perform postirradiation examination of MOX fuel lead assemblies are not described in this section because these activities are routinely performed at these locations, would be conducted in existing buildings with existing personnel, and would not be expected to result in additional impacts at these sites. See Figure 2–1 for the location of these sites.

The U.S. Department of Energy (DOE) evaluated the environmental impacts of the surplus plutonium disposition alternatives within defined regions of influence (ROI) at each of the four candidate sites and along transportation routes. The ROIs are specific to the type of effect evaluated and encompass geographic areas within which any significant impact would be expected to occur. For example, human health risks to the

[1] Formerly known as the Idaho Chemical Processing Plant (ICPP).

general public from exposure to airborne contaminant emissions were assessed for an area within an 80 km (50 mi) radius of the proposed facilities. The human health risks of shipping materials among sites were evaluated for populations living along the roadways linking the DOE sites. Economic effects such as job and income growth were evaluated within a socioeconomic ROI that includes the county in which the site is located and nearby counties in which a substantial portion of the site's workforce reside. Brief descriptions of the ROIs are given in Table 3–1. More detailed descriptions of the ROI and the methods used to evaluate impacts are presented in Appendix F.

Table 3–1. General Regions of Influence for the Affected Environment

Environmental Feature	Region of Influence
Air quality and noise	The site and nearby offsite areas within local air quality control regions and the transportation corridors between the sites
Waste management	Waste management facilities on the site
Socioeconomics	The counties where at least 90 percent of site employees reside
Human health risk	The site and nearby offsite areas (within 80 km of the site and the transportation corridors between the sites) where worker and general population radiation, radionuclide, and hazardous chemical exposures may occur
Environmental justice	The minority and low-income populations within 80 km of the site and along the transportation corridors between the sites
Geology and soils	Geologic and soil resources within the site and nearby offsite areas
Water resources	Onsite and adjacent surface water bodies and groundwater
Ecological resources	The site and adjacent areas where ecological communities exist including nonsensitive and sensitive habitats and species
Cultural and paleontological resources	The area within the site and adjacent to the site boundary
Land use and visual resources	The site and the areas immediately adjacent to the site
Infrastructure	Power, fuel supply, water supply, and road systems on the site

At each of the four candidate sites, baseline conditions for each environmental resource area were determined from information provided in previous environmental studies, relevant laws and regulations, and other government reports and databases. More detailed information on the affected environment at the candidate sites can be found in annual site environmental reports and site NEPA documents.

For More Detailed Information on Environmental Conditions at the Candidate Sites for Surplus Plutonium Disposition Facilities[a]

Draft Hanford Remedial Action EIS and Comprehensive Land Use Plan, 1996

DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Final EIS, 1995

Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components, 1996

SRS Waste Management Final EIS, 1995

[a] Also consult annual site environmental reports.

3.2 HANFORD

Hanford, established in 1943 as one of the three original Manhattan Project sites, is in Washington State just north of Richland (Figure 2–2). Hanford was a U.S. Government nuclear materials production site that included nuclear reactor operation, storage and reprocessing of spent nuclear fuel, and management of radioactive and dangerous wastes. Present Hanford programs are diversified and include management of radioactive wastes, research and development (R&D) for advanced reactors, renewable energy technologies, waste disposal technologies and contamination cleanup, and plutonium stabilization and storage (DOE 1996a:3-20).

Hanford is owned and used primarily by DOE, but portions of it are owned, leased, or administered by other government agencies. Public access is limited to travel on the Route 4 and Route 10 access roads as far as the Wye Barricade, State Routes 24 and 240, and the Columbia River. By restricting access to the site, the public is buffered from the areas formerly used for production of nuclear materials and currently used for waste storage and disposal. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly vacant land with widely scattered facilities. The entire Hanford Site has been designated a National Environmental Research Park (DOE 1996a:3-20).

Hanford includes extensive production, service, research, and development areas. Onsite programmatic and general purpose facilities total approximately 799,000 m^2 (8.6 million ft^2) of space. Fifty-one percent (408,000 m^2 [4.4 million ft^2]) is general purpose space, including offices, laboratories, shops, warehouses, and other support facilities. The remaining 392,000 m^2 (4.2 million ft^2) of space are programmatic facilities comprising processing, evaporation, filtration, waste recovery, waste treatment, waste storage facilities, and R&D laboratories. More than half of the general purpose and programmatic facilities are more than 30 years old. Facilities designed to perform previous missions are being evaluated for reuse in the cleanup mission. The existing facilities are grouped into the following numbered operational areas (DOE 1996a:3-20, 3-21).

- The 100 Areas, in the northern part of the site on the southern shore of the Columbia River, are the site of eight retired plutonium production reactors and the dual-purpose N Reactor, all of which have been permanently shut down since 1991. The 100 Areas cover about 1,100 ha (2,720 acres).

- The 200 West and 200 East Areas are in the center of the site and are about 8 and 11 km (5 and 6.8 mi), respectively, south of the Columbia River. Historically, these areas have been used for fuel reprocessing; plutonium processing, fabrication, and storage; and waste management and disposal activities. The 200 Areas cover about 1,600 ha (3,950 acres).

- The 300 Area is in the southern part of the site, just north of the city of Richland. A few of the facilities continue to support nuclear and nonnuclear R&D to include the Pacific Northwest National Laboratory (PNNL). Many of the facilities in the 300 Area are in the process of being deactivated. This area covers 150 ha (370 acres).

- The 400 Area, about 8 km (5 mi) northwest of the 300 Area, is the location of the recently shut down Fast Flux Test Facility (FFTF) and Fuels and Materials Examination Facility (FMEF). FFTF is an advanced liquid-metal-cooled research reactor that was used in the testing of breeder reactor systems. The six-level process building (427 Building) is the main structure of FMEF and encloses about 17,000 m^2 (183,000 ft^2) of operating area. FMEF also consists of several connected buildings. This building has never been operated and is free of contamination. The exterior walls are reinforced concrete, and the cell walls are constructed of high-density concrete. The facility was designed and constructed for spent fuel examination and was subsequently partially converted for MOX fuel fabrication.

- The 600 Area comprises the remainder of Hanford, which includes most of the undisturbed land and support facilities and infrastructure (e.g., roads, railroads, telecommunications, water treatment and distribution, electrical transmission lines and substations, fire and ambulance, and access control facilities, borrow pits, and a landfill).

- The 700 Area is the administrative center in downtown Richland and consists of government-owned buildings (e.g., the Federal Building).

- The 1100 and 3000 Areas are support areas in north Richland. The 1100 Area includes support services such as general stores and transportation maintenance. The 3000 Area is being vacated but still contains some administrative and support facilities.

In addition, there are DOE-leased facilities and DOE contractor-owned facilities that support Hanford operations. These facilities are on private land south of the 300 Area and outside of the 1100 and 3000 Areas (DOE 1996a:3-21).

DOE Activities. The Hanford mission is to clean up the site, provide scientific and technological excellence to meet global needs, and partner the economic diversification of the region. Current DOE activities that support Hanford's mission are shown in Table 3–2. In the area of waste management, Hanford has embarked on a long-range cleanup program in compliance with the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) and applicable Federal, State, and local laws. DOE has set a goal of cleaning up Hanford's waste sites and bringing its facilities into compliance with Federal, State, and local environmental laws by the year 2028. In addition, as part of the cleanup mission, DOE has the responsibility to safely store, handle, and stabilize plutonium materials and spent fuel (DOE 1996a:3-21, 3-22).

Table 3–2. Current Missions at Hanford

Mission	Description	Sponsor
Waste management	Store defense wastes and handle, store, and dispose of radioactive, hazardous, mixed, or sanitary wastes from current operations	Assistant Secretary for Environmental Management
Environmental restoration	Restore approximately 1,100 inactive radioactive, hazardous, and mixed waste sites and about 100 surplus facilities	Assistant Secretary for Environmental Management
Research and development	Conduct research in the fields of energy, health, safety, environmental sciences, molecular sciences, environmental restoration and waste management R&D, and national security activities	Various DOE Program Managers
Technology development	Develop new technologies for environmental restoration and waste management, including site characterization and assessment methods, and waste minimization	Various DOE Program Managers

Source: DOE 1996a:3-22.

Non-DOE Activities. In addition to the DOE mission-related activities, Hanford has some unique and diverse assets and non-DOE missions that include the following (DOE 1996a:3-22):

- The Fitzner-Eberhardt Arid Lands Ecology Reserve, 31,100 ha (76,800 acres), established in 1967, managed by the U.S. Fish and Wildlife Service (USFWS) for DOE as a habitat and wildlife reserve and nature research center (Sandberg 1998a).

- The area north of the Columbia River, managed in part by the Washington State Department of Wildlife as the Wahluke Slope Wildlife Recreation Area and in part by the USFWS as the Saddle Mountain National Wildlife Refuge.
- The Washington Nuclear Plant-2 (WNP-2), 1,100-MWe reactor operated by the Washington Public Power Supply System (WPPSS) and also the partially completed WNP-1 reactor.
- The Laser Interferometer Gravitational-Wave Observatory, operated by the National Science Foundation as one of two widely separated installations (within the United States) that are operated in unison as a single gravitational-wave observatory.
- The Hanford Meteorological Station and towers.
- An observatory and radio telescope facilities on Rattlesnake Mountain.
- The U.S. Ecology commercial low-level radioactive waste disposal site on State-leased lands south of the 200 Areas near the center of Hanford.

3.2.1 Air Quality and Noise

3.2.1.1 Air Quality

Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

3.2.1.1.1 General Site Description

The climate at Hanford and the surrounding region is characterized as that of a semiarid steppe. The humidity is low, and winters are mild. The average annual temperature is 11.8 °C (53.3 °F); average monthly temperatures range from a minimum of -1.5 °C (29.3 °F) in January to a maximum of 24.7 °C (76.5 °F) in July. The average annual precipitation is 16 cm (6.3 in). Prevailing winds at the Hanford Meteorological Station are from the west-northwest. The average annual windspeed is 3.4 m/s (7.6 mph) (DOE 1996a:3-29). Additional information related to meteorology and climatology at Hanford is presented in Appendix F of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition Final PEIS)* (DOE 1996a:F-2–F-5) and in the *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Neitzel 1996).

Most of Hanford is within the South-Central Washington Intrastate Air Quality Control Region (AQCR) #230, but a small portion of the site is in the Eastern Washington-Northern Idaho Interstate AQCR #62. None of the areas within Hanford and its surrounding counties are designated as nonattainment areas with respect to National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (EPA 1997b). Applicable NAAQS and Washington State ambient air quality standards are presented in Table 3–3.

There are no prevention of significant deterioration (PSD) Class I areas within 100 km (62 mi) of Hanford. Hanford operates under a PSD permit issued in 1980 that limits emissions of nitrogen dioxide from the Plutonium-Uranium Extraction (PUREX) and Uranium Trioxide Plants in the 200 Area (DOE 1996a:3-29). These facilities have not been operated since 1994 and have been deactivated and transferred to the

Table 3–3. Comparison of Ambient Air Concentrations From Hanford Sources With Most Stringent Applicable Standards or Guidelines, 1994

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	Concentration ($\mu g/m^3$)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	0.7
	1 hour	40,000[b]	2.6
Nitrogen dioxide	Annual	100[b]	0.2
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50[b]	0.01
	24 hours	150[b]	0.1
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	50[d]	0.8
	24 hours	260[d]	6.6
	3 hours	1,300[b]	22.9
	1 hour	1,000[f]	47.9
	1 hour	700[f,g]	47.9
Other regulated pollutants			
Gaseous fluoride	30 days	0.84[f]	(i)
	7 days	1.7[f]	(i)
	24 hours	2.9[f]	(i)
	12 hours	3.7[f]	(i)
	8 months (Mar-Oct)	0.50[f]	(i)
Total suspended particulates	Annual	60[f]	0.01
	24 hours	150[f]	0.1
Hazardous and other toxic compounds			
Benzene	24 hours	0.12[h]	(i)
Ethylene glycol	24 hours	420[h]	(i)

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (EPA 1997b), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is ≤ 1. The 1-hr ozone standard applies only to nonattainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 $\mu g/m^3$. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standard is ≤ 1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and State standard.

[c] Federal standard.

[d] Not directly emitted or monitored by the site.

[e] No data is available with which to assess $PM_{2.5}$ concentrations.

[f] State standard.

[g] Not to be exceeded more than twice in any 7 consecutive days.

[h] State's risk-based acceptable source impact levels.

[i] No sources identified at the site.

Note: NAAQS also include standards for lead. No sources of lead emissions have been identified at the site. Emissions of other air pollutants not listed here have been identified at Hanford, but are not associated with any alternatives evaluated. These other air pollutants are quantified in the *Storage and Disposition Final PEIS* (DOE 1996a). EPA recently revised ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 $\mu g/m^3$ (0.12 ppm) to an 8-hr concentration of 157 $\mu g/m^3$ (0.08 ppm). During a transition period while States are developing State implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in nonattainment areas (EPA 1997c:38855). For particulate matter, the current PM_{10} annual standard is retained, and two $PM_{2.5}$ (particulate matter with an aerodynamic diameter less than or equal to 2.5 μm) standards are added. These standards are set at a 15-$\mu g/m^3$ 3-year annual arithmetic mean based on community-oriented monitors and a 65-$\mu g/m^3$ 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr PM_{10} standard is based on the 99th percentile of 24-hr concentrations. The existing PM_{10} standards will continue to apply in the interim period (EPA 1997d:38652).
Source: DOE 1996a:3-30; EPA 1997b; WDEC 1994.

DOE Office of Environmental Restoration for continued surveillance and maintenance awaiting eventual decommissioning.

Ambient air quality near the Hanford boundary is currently monitored for particulate matter. Particulate concentrations can reach rather high levels in eastern Washington because of extreme natural events (dust storms, volcanic eruptions, and large brush fires [DOE 1996b:4-46–4-50]). The 24-hr PM_{10} (particulate matter with an aerodynamic diameter less than or equal to 10 μm) standard was exceeded in 1993 at Columbia Center in Kennewick, about 10 km (6.2 mi) southeast of Hanford, likely as a result of windblown dust. Ambient air quality at Hanford is discussed in more detail in the *Hanford Site 1995 Environmental Report* (Dirkes and Hanf 1996:56, 61, 62, 95–108). Routine monitoring of most nonradiological pollutants is not conducted at the site. Monitoring of nitrogen oxides and total suspended particulates at Hanford has been discontinued as a result of phasing out programs for which the monitoring was required. Carbon monoxide, sulfur dioxide, and nitrogen dioxide have been monitored periodically in communities and commercial areas southeast of Hanford. In 1995, air samples of semivolatile organic compounds were collected on the site and at an offsite location, and the results are discussed in the annual environmental report (Dirkes and Hanf 1996:95–108). All concentrations of these compounds were below the applicable risk-based concentrations.

The primary sources of air pollutants at Hanford include process emissions, vehicular emissions, and construction activities. Table 3–3 presents the existing ambient air pollutant concentrations at the site boundary attributable to sources at Hanford. These concentrations are based on emissions for the year 1994. The emissions were modeled using meteorological data from 1989–1990 (DOE 1996a:3-30). Only those pollutants that would be emitted by any of the surplus plutonium disposition alternatives are presented. With the exception of particulate matter, as discussed previously, the concentrations of these pollutants—concentrations from Hanford combined with those from background (non-Hanford) sources—are in compliance with the ambient air quality standards. All coal-fired steam generation facilities have been shut down at Hanford. The conversion to oil, natural gas, and electric energy sources was completed in 1998. This will result in a significant reduction in air pollutant emissions from the site. Detailed information on emissions of other pollutants at Hanford is discussed in the *Hanford Site NEPA Characterization* (Neitzel 1996:4.28–4.32, 6.12).

3.2.1.1.2 Proposed Facility Locations

Prevailing winds in the 200 Areas (Hanford Meteorological Station) are from the west-northwest (Neitzel 1996:4.3, 4.6; Hoitink and Burk 1996:2.10). The 200 East Area has emissions of various air pollutants from oil-fired steam generation and releases of various toxic pollutants from tank farms, waste processing, and laboratories. Emissions from these sources are quantified in the *Tank Waste Remediation System EIS* (DOE 1996c:G-35–G-111).

Prevailing winds in the 400 Area are from the south-southwest, with a secondary maximum from the northwest (Neitzel 1996:4.6; Hoitink and Burk 1996:2.10). The 400 Area has no nonradioactive air pollutant emission sources of concern (Neitzel 1996:4.30).

3.2.1.2 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.2.1.2.1 General Site Description

Major noise sources within Hanford include various facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Data from two noise surveys indicate that background noise levels (measured as the 24-hr equivalent sound level) at Hanford range from 30 to 60.5 decibel A-weighted (dBA) (DOE 1996a:3-29). The 24-hr background sound level in undeveloped areas at Hanford ranges from 24 to 36 dBA, except when high winds elevate sound levels (Neitzel 1996:4.127). The primary source of noise at the site and nearby residences is traffic. Most Hanford industrial facilities are far enough from the site boundary that noise levels from these sources at the boundary are not measurable or are barely distinguishable from background noise levels (DOE 1996a:3-29). Hanford is currently in compliance with the State noise regulations (DOE 1996a:3-29–3-31). Noise sources, existing noise levels at Hanford, and noise standards are described in the *Storage and Disposition Final PEIS* (DOE 1996a:3-29–3-31, F-31, F-32) and in the *Hanford Site NEPA Characterization* (Neitzel 1996:4.125–4.130).

The potential impact of traffic noise resulting from Hanford activities was evaluated for a draft EIS addressing the siting of the proposed New Production Reactor. Estimates were made of baseline traffic noise along two major access routes: State Route 24, leading from the Hanford Site west to Yakima, and State Route 240, south of the site and west of Richland, where it handles maximum traffic volume. Modeled traffic noise levels (equivalent sound level [1-hr]) at 15 m (50 ft) from State Route 24 and State Route 240 for both peak and offpeak periods were 62 and 70 dBA, respectively (Neitzel 1996:4.127, 4.130). These traffic noise levels were projections based on employment levels about 30 percent higher than actual levels at Hanford in 1997. About 9 percent of Hanford's employees commute by vanpool or bus (Mecca 1997a). Existing traffic noise levels may be different as a result of changes in site employment and ride-sharing activities.

The U.S. Environmental Protection Agency (EPA) guidelines for environmental noise protection recommend an average day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (DOT 1995). It is expected that for most residences near Hanford, the day-night average sound level is less than 65 dBA and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

3.2.1.2.2 Proposed Facility Locations

No distinguishing noise characteristics have been identified at either the 200 East Area or the 400 Area. Both are far enough from the site boundary—the 200 East Area is 12.6 km (7.8 mi) and the 400 Area is 6.1 km (3.8 mi) away—that noise levels from the facilities at the boundary are not measurable or are barely distinguishable from background levels.

3.2.2 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders.

3.2.2.1 Waste Inventories and Activities

Hanford manages the following types of waste: high-level waste (HLW), transuranic (TRU), mixed TRU, low-level waste (LLW), mixed LLW, hazardous, and nonhazardous. HLW would not be generated by surplus plutonium disposition activities at Hanford, and thus is not discussed further. Waste generation rates and the inventory of stored waste from activities at Hanford are provided in Table 3–4. Table 3–5 summarizes the Hanford waste management capabilities. More detailed descriptions of the waste management system capabilities at Hanford are included in the *Storage and Disposition Final PEIS* (DOE 1996a:3-61, E-12).

Table 3–4. Waste Generation Rates and Inventories at Hanford

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact handled	450	11,450
Remotely handled	72	273
LLW	3,902	0
Mixed LLW		
RCRA	840	8,170
TSCA	7	103
Hazardous	560	NA[b]
Nonhazardous		
Liquid	200,000	NA[b]
Solid	43,000	NA[b]

[a] Includes mixed TRU waste.
[b] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
Key: LLW, low-level waste; NA, not applicable; RCRA, Resource Conservation and Recovery Act; TRU, transuranic; TSCA, Toxic Substances Control Act.
Source: DOE 1996d:15, 16, except hazardous and nonhazardous solid wastes (DOE 1996a:3-62, E-19), and nonhazardous liquid wastes (Teal 1997).

EPA placed Hanford on the National Priorities List on November 3, 1989. In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), DOE entered into a Tri-Party Agreement with EPA and the State of Washington to govern the environmental compliance and cleanup of Hanford. That agreement meets the legal requirements specified under the Federal Facility Compliance Act (FFCA). An aggressive environmental restoration program is under way using priorities established in the Tri-Party Agreement (DOE 1996a:3-61). More information on regulatory requirements for waste disposal is provided in Chapter 5.

3.2.2.2 Transuranic and Mixed Transuranic Waste

All currently generated contact-handled TRU waste is being placed in above-grade storage buildings at the Hanford Central Waste Complex and the TRU Waste Storage and Assay Facility (DOE 1996a:3-64). TRU waste will be maintained in storage until shipped to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, for disposal, beginning in 1999 (DOE 1997a:17). The new Waste Receiving and Processing Facility has the capability to process retrieved suspect TRU waste and certify newly generated and stored TRU waste for shipment to WIPP (Dirkes and Hanf 1996:10). Treatment of TRU waste will be provided in the future at the Stabilization Facility and Thermal Treatment Facility. TRU waste will be treated to meet WIPP waste acceptance criteria, packaged in accordance with DOE and U.S. Department of Transportation (DOT) requirements, and transported to WIPP for disposal (DOE 1996a:3-144). Mixed TRU wastes are included in

Table 3–5. Waste Management Capabilities at Hanford

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment Facility (m^3/yr except as otherwise specified)								
242-A Evaporator, m^3/day	265	Online	X	X	X	X		
Waste Receiving and Processing Facility	1,820	Online	X	X	X	X		
Stabilization Facility Contract	1,860	Planned for 1999	X	X		X		
Thermal Treatment Facility Contract	5,135	Planned for 2001	X	X		X		
Grout Treatment Facility	15,000	Online				X		
Shielded Analytical Lab Waste Treatment Unit, kg/hr	4	Online				X		
Maintenance & Storage Facility, batch/yr	26	Online				X		
200 Area Effluent Treatment Facility, m^3/min	0.57	Online			X	X		
200 East Area Sanitary Wastewater Treatment Facility	120,000	Online						X
Storage Facility (m^3)								
Central Waste Complex	16,800	Online	X	X	X	X		
TRU Waste Storage and Assay Facility	416	Standby	X	X	X	X		
305-B Storage Facility	20	Online			X	X	X	
B-Plant Canyon Waste Pile	5	Online			X			
B-Plant Container Storage	51	Online				X		
PUREX Tunnel 1	4,141	Online			X	X		
PUREX Tunnel 2	19,528	Online			X	X		
PUREX Canyon Waste Pile	432	Online				X		
200 Area Liquid Effluent Retention Facility	59,000	Online			X	X		
4843 Alkali Metal Storage Facility	95	Standby				X	X	
Disposal Facility (m^3 except as otherwise specified)								
Grout Vaults	230,000	Online			X			
LLW Burial Ground	1,740,000	Online			X			
Radioactive Mixed Waste Disposal Facility	14,200	Standby			X	X		
200 Area Treated Effluent Disposal Facility, m^3/min	13	Online						X
WPPSS Sewage Treatment Facility	235,000	Online						X

Key: Haz, hazardous; LLW, low-level waste; PUREX, Plutonium-Uranium Extraction (Plant); TRU, transuranic; WPPSS, Washington Public Power Supply System.
Source: Kovacs 1997; Rhoderick 1998; Sandberg 1998a; Teal 1997.

the TRU waste category because these wastes are expected to go to WIPP for ultimate disposal (DOE 1996a:3-64).

Next Section

3.2.2.3 Low-Level Waste

Solid LLW is compacted and sent to the LLW Burial Ground in the 200 West Area for disposal in trenches. Additional LLW is received from offsite generators and disposed of at the LLW Burial Ground. LLW resulting from the tank waste remediation system waste pretreatment program will be vitrified; as a contingency, the Grout Facility will be maintained in standby condition. The vitrified LLW will be disposed of on the site in the 200 Area under the tank waste remediation system program (DOE 1996a:3-64).

U.S. Ecology operates a licensed commercial LLW Burial Ground on a site southwest of the 200 East Area that is leased to the State of Washington. The facility is not a DOE facility and is not considered part of DOE's Hanford operations (DOE 1996a:E-17).

3.2.2.4 Mixed Low-Level Waste

One of the existing treatment facilities for mixed LLW is the 242-A Evaporator in the 200 East Area, which reduces the volume of these wastes and removes cesium via ion exchange (DOE 1996a:3-64). The process condensate from the evaporator is temporarily stored in the Liquid Effluent Retention Facility until it is treated in the Liquid Effluent Treatment Facility. The Liquid Effluent Retention Facility consists of three Resource Conservation and Recovery Act (RCRA)-compliant surface impoundments for storing process condensate from the 242-A Evaporator. This facility provides equalization of the flow and pH to the Liquid Effluent Treatment Facility. The Liquid Effluent Treatment Facility provides ultraviolet light/peroxide destruction of organic compounds, reverse osmosis to remove dissolved solids, and ion exchange to remove the last traces of contaminants. Discharge of the treated effluent is via a dedicated pipeline to an underground drain field. The effluent treatment process produces a mixed LLW sludge that is concentrated, dried, packaged in 208-l (55-gal) drums, and transferred to the Central Waste Complex. This secondary waste is stored prior to treatment (if necessary) and disposal in the Mixed Waste Trench (Dirkes and Hanf 1996:10, 45, 46). In a recent modification to the Tri-Party Agreement, DOE has agreed to begin designing a vitrification facility to treat liquid mixed LLW (DOE 1996a:E-17; E-18).

The Waste Receiving and Processing Facility, near the Central Waste Complex in the 200 West Area, eventually will provide size reduction, decontamination, condensation, melting, amalgamation, incineration, ash stabilization, and shipping for Hanford mixed waste. The Waste Receiving and Processing Facility is being constructed in two phases: module 1 and module 2 (2A and 2B) and is designed to process 6,800 drums of waste annually (Dirkes and Hanf 1996:40). Module 1 will be designed to prepare retrieved and stored TRU waste and will be operational in 1999. Module 2A is designed to process LLW, TRU waste, mixed LLW, and mixed TRU waste, and is operational. Module 2B, if authorized, will be designed to process LLW, TRU waste, mixed LLW, and mixed TRU waste with a dose rate greater than 200 mrem/hr. Module 2B has an undetermined startup date (DOE 1996a:E-18).

The Radioactive Mixed Waste Disposal Facilities are in the Hanford LLW Burial Ground and are designated as 218-W-5, Trench 31, and Trench 34. The facilities consist of rectangular trenches with approximate dimensions of 76 by 30 m (250 by 100 ft). These facilities are RCRA compliant, with double liners and leachate collection and removal systems (Dirkes and Hanf 1996:40).

3.2.2.5 Hazardous Waste

There are no treatment facilities for hazardous waste at Hanford; therefore, the wastes are accumulated in satellite storage areas (for less than 90 days) or at interim RCRA-permitted facilities such as the 305-B Waste Storage Facility. The common practice for newly generated hazardous waste is to ship it off the site by truck using DOT-approved transporters for treatment, recycling, recovery, and disposal at RCRA-permitted facilities (DOE 1996a:3-65, E-18; Sandberg 1998a).

3.2.2.6 Nonhazardous Waste

Sanitary wastewater is discharged to onsite treatment facilities such as septic tanks, subsurface soil adsorption systems, and wastewater treatment plants. These facilities treat an average of 600,000 l/day (159,000 gal/day) of sewage (DOE 1996a:E-19).

The 200 Area Treated Effluent Disposal Facility industrial sewer collects the treated wastewater streams from various plants in the 200 Areas and disposes of the clean effluent at two 2-ha (5-acre) ponds permitted by the State of Washington (DOE 1996a:E-19). The design capacity of the facility is approximately 8,700 l/min (2,300 gal/min), although the discharge permit presently limits the average monthly flow to about 2,400 l/min (640 gal/min) (Dirkes and Hanf 1996:46).

Nonhazardous solid wastes include construction debris, office trash, cafeteria wastes, furniture and appliances, nonradioactive friable asbestos, powerhouse ash, and nonradioactive/nonhazardous demolition debris. Until 1997, nonhazardous solid wastes were disposed of in the 600 Area central landfill. Under an agreement between DOE and the city of Richland, most of the site's nonregulated and nonradioactive solid wastes are now sent to the Richland Sanitary Landfill for disposal (DOE 1996a:3-65, E-19). The Richland Sanitary Landfill is at the southern edge of the Hanford Site boundary. Nonradioactive friable asbestos and medical waste are shipped off the site for disposal (Dirkes and Hanf 1996:83; Sandberg 1998a).

3.2.2.7 Waste Minimization

The Hanford Site Pollution Prevention Program is a comprehensive and continual effort to systematically reduce the quantity and toxicity of hazardous, radioactive, mixed, and sanitary wastes; conserve resources and energy; reduce hazardous substance use; and prevent or minimize pollutant releases to all environmental media from all operations and site cleanup activities. In accordance with sound environmental management, preventing pollution through source reduction is the first priority in the Hanford Site Pollution Prevention Program, and the second priority is environmentally safe recycling. For instance, Hanford pollution prevention efforts in 1995 helped to prevent the generation of approximately 2,900 m^3 (3,790 yd^3) of radioactive mixed waste, 207 t (228 tons) of RCRA waste, 30,000 m^3 (39,200 yd^3) of process wastewater, and 4,400 t (4,850 tons) of sanitary waste. Also during 1995, Hanford recycled approximately 632 t (697 tons) of office paper, 20 t (22 tons) of cardboard, 3,600 t (3,970 tons) of ferrous metal, 215 t (237 tons) of nonferrous metal, 57 t (63 tons) of lead, 16 t (18 tons) of solid chemicals, and 78,000 l (20,600 gal) of liquid chemicals. In addition, Hanford's new centralized recycling center collects aerosol cans, fluorescent light ballasts, fluorescent light tubes, and lead acid batteries (Dirkes and Hanf 1996:44, 45).

3.2.2.8 Preferred Alternatives From the WM PEIS

Preferred alternatives from the Waste Management (WM) PEIS (DOE 1997b:summary, 95) are shown in Table 3–6 for the four waste types analyzed in this SPD EIS. A decision on the future management of these wastes could result in the construction of new waste management facilities at Hanford and the closure of other facilities. Decisions on the various waste types are expected to be announced in a series of records of decision (RODs) to be issued on this WM PEIS. In fact, the TRU waste ROD was issued on January 20, 1998 (DOE 1998a). The ROD states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ." More detailed information and DOE's alternatives for the future configuration of waste management facilities at Hanford is presented in the WM PEIS and the TRU waste ROD.

Table 3–6. Preferred Alternatives From the WM PEIS

Waste Type	Preferred Action
TRU and mixed TRU	DOE prefers onsite treatment and storage of Hanford's TRU waste pending disposal at WIPP[a].
LLW	DOE prefers to treat Hanford's LLW on the site. Hanford could be selected as one of the regional disposal sites for LLW.
Mixed LLW	DOE prefers regionalized treatment at Hanford. This includes the onsite treatment of Hanford's wastes and could include treatment of some mixed LLW generated at other sites. Hanford could be selected as one of the regional disposal sites for mixed LLW.
Hazardous	DOE prefers to continue to use commercial facilities for hazardous waste treatment.

[a] ROD for the TRU waste (DOE 1998a) states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ."
Key: LLW, low-level waste; ROD, record of decision; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.
Source: DOE 1997b:summary, 95.

3.2.3 Socioeconomics

Statistics for employment and regional economy are presented for the regional economic area (REA) as defined in Appendix F.9, which encompasses nine counties surrounding Hanford in Washington. Statistics for population, housing, community services, and local transportation are presented for the ROI, a two-county area in which 91 percent of all Hanford employees reside as shown in Table 3–7. In 1997, Hanford employed about 12,882 persons (about 3.8 percent of the REA civilian labor force) (Mecca 1997b).

Table 3–7. Distribution of Employees by Place of Residence in the Hanford Region of Influence, 1997

County	Number of Employees	Total Site Employment (Percent)
Benton	10,563	82
Franklin	1,159	9
ROI total	11,722	91

Source: Mecca 1997b.

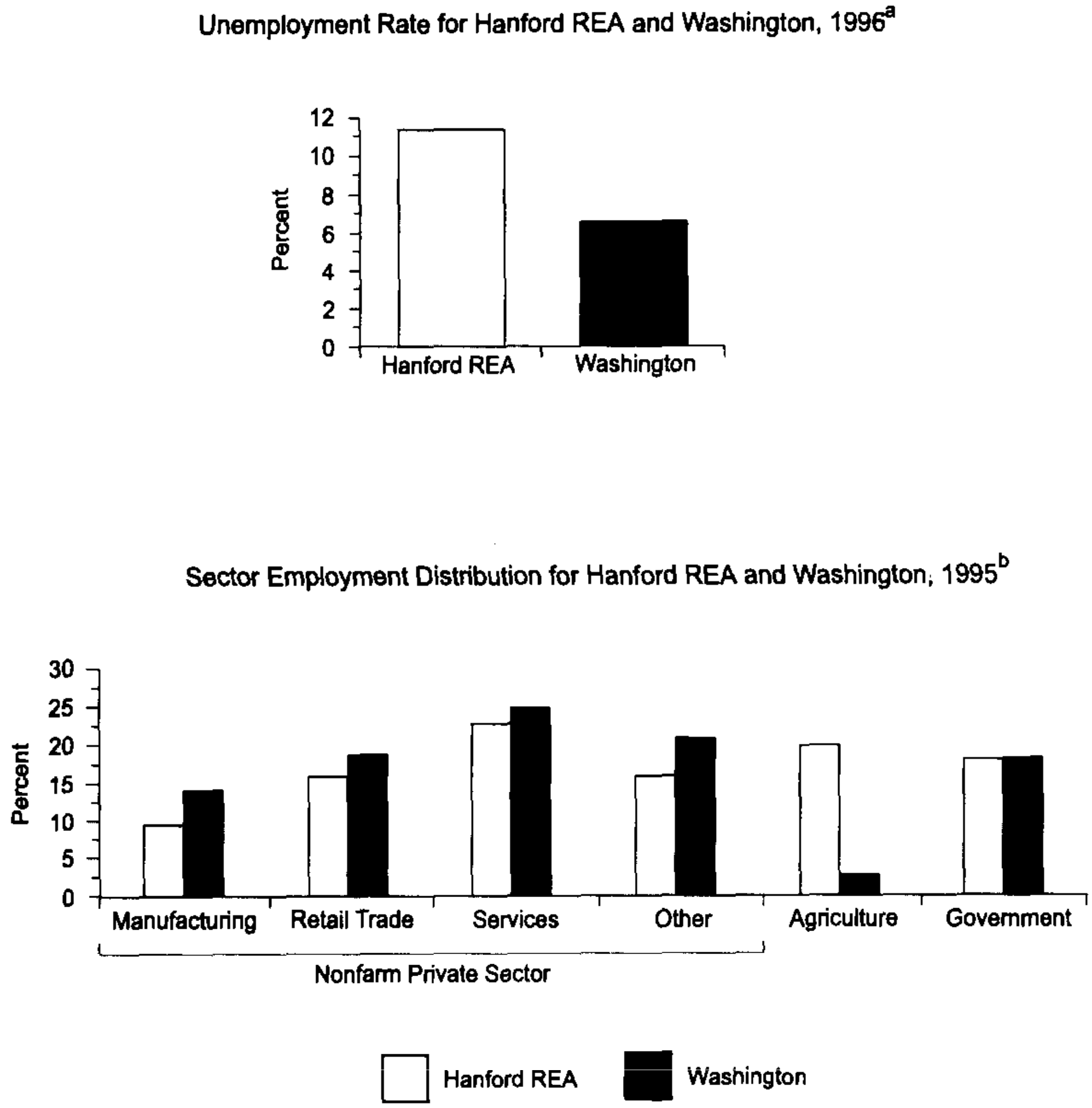
3.2.3.1 Regional Economic Characteristics

Selected employment and regional economy statistics for the Hanford REA and Washington are summarized in Figure 3–1. Between 1990 and 1996, the civilian labor force in the REA increased 34.6 percent to 342,941. In 1996, the unemployment rate in the REA was 11.1 percent, significantly higher than the rate of 6.5 percent in Washington State (DOL 1997a).

In 1995, service activities represented the largest sector of employment in the REA (22.3 percent). This was followed by agriculture (19.6 percent) and government (17.4 percent). Overall, the State total for these employment sectors was 25.0 percent, 3.7 percent, and 18.0 percent, respectively (DOL 1997b).

3.2.3.2 Population and Housing

In 1996, the ROI population totaled 179,949. Between 1990 and 1996, the ROI population increased 18.9 percent compared with the 12.9 percent increase experienced in Washington (DOC 1997). Between 1980 and 1990, the number of housing units in the ROI increased by about 4.6 percent, compared with a 20.3 percent increase in Washington. The total number of housing units within the ROI for 1990 was 58,541 (DOC 1994). The 1990 homeowner vacancy rates for the ROI was 1.4 percent compared with the State's rate



[a]DOL 1997a.
[b]DOL 1997b.

REA Regional economic area

Figure 3–1. Employment and Local Economy for the Hanford Regional Economic Area and the State of Washington

of 1.3 percent. The ROI renter vacancy rate was 5.5 percent compared with 5.8 percent for the State (DOC 1990a). Population and housing trends in the ROI and Washington are summarized in Figure 3–2.

3.2.3.3 Community Services

3.2.3.3.1 Education

Ten school districts provide public education in the Hanford ROI. As shown in Figure 3–3, school districts in 1997 were operating at capacities ranging from 65 to 100 percent. In 1997, the student-to-teacher ratio in the ROI averaged 16:1 (Nemeth 1997a). In 1990, the average student-to-teacher ratio for Washington was 11.4:1 (DOC 1990b; 1994).

3.2.3.3.2 Public Safety

In 1997, a total of 281 sworn police officers were serving the ROI. The ROI average officer-to-population ratio was 1.6 officers per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 1.7 police officers per 1,000 persons (DOC 1990b). In 1997, 616 paid and volunteer firefighters provided fire protection services in the Hanford ROI. The average firefighter-to-population ratio in 1997 in the ROI was 3.4 firefighters per 1,000 persons. This compares with the 1990 State average of 1 firefighter per 1,000 persons (DOC 1990b). Figure 3–4 displays the ratio of sworn police officers and firefighters to population for the two counties in the Hanford ROI.

3.2.3.3.3 Health Care

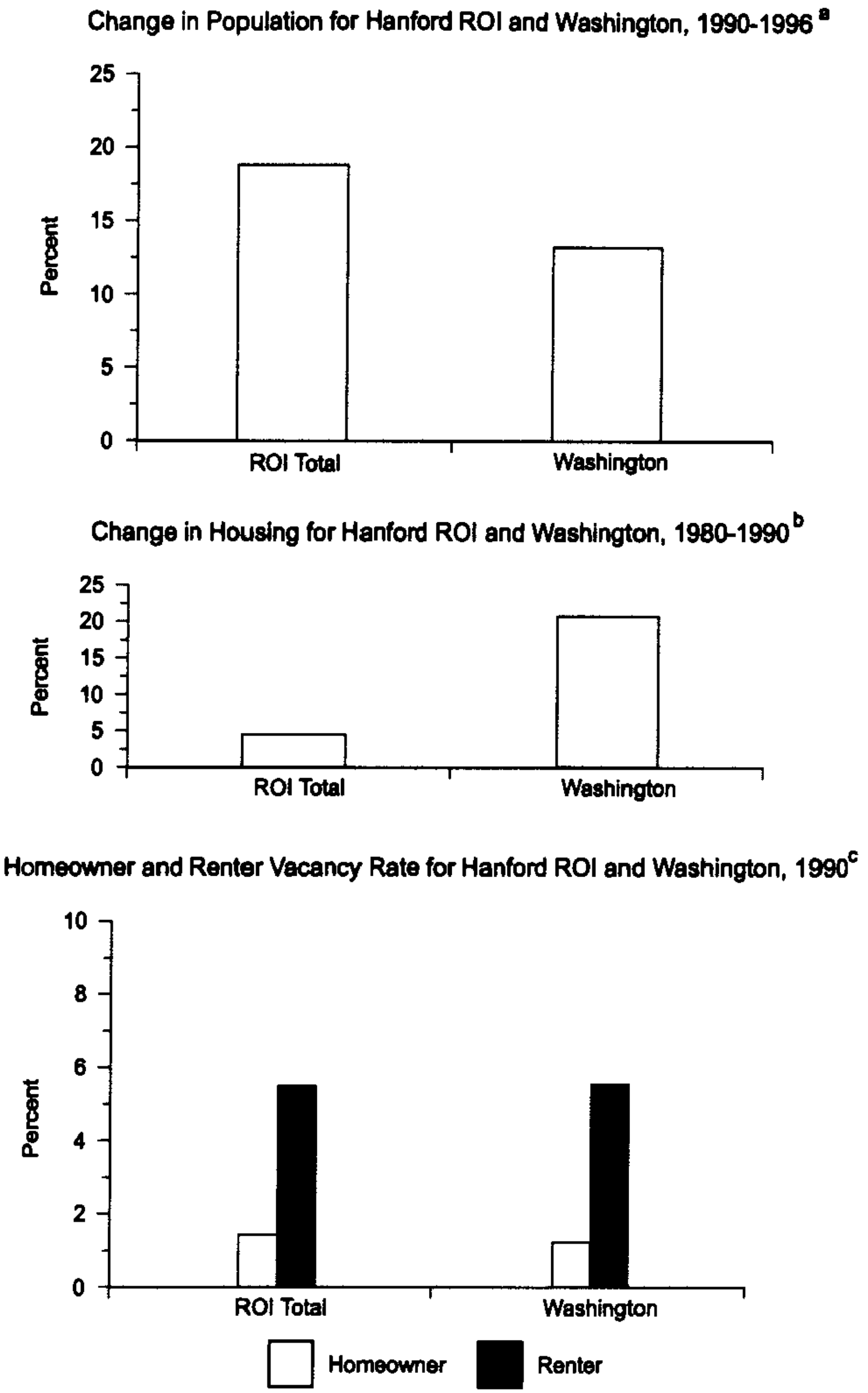
In 1996, a total of 257 physicians served the ROI. The average physician-to-population ratio in the ROI was 1.4 physicians per 1,000 persons compared with the 1996 State average of 3.7 per 1,000 persons (Randolph 1997). In 1997, there were four hospitals serving the ROI. The hospital bed-to-population ratio averaged 2.1 beds per 1,000 persons (Nemeth 1997c). This compares with a State 1991 average of 2.4 beds per 1,000 persons (DOC 1996:128). Figure 3–4 displays the ratio of physicians-to-population and hospital bed-to-population for the two counties in the Hanford ROI.

3.2.3.4 Local Transportation

Vehicular access to Hanford is provided by State Routes 240, 243, 24, and Stevens Drive. State Route 240 connects to the Richland bypass highway, which interconnects with I–182. State Route 243 exits the site's northwestern boundary and serves as a primary link between the site and I–90. State Route 24 enters the site from the west and continues eastward across the northernmost portion of the site and intersects State Route 26 about 16 km (10 mi) east of the site boundary. Stevens Drive out of north Richland is the favored route to Hanford (see Figure 2–2).

One current road improvement project that could affect vehicular access to Hanford is repaving and signal work at the intersection of State Route 240 and Stevens Drive. Two projects, currently in the planning stage, could affect vehicular access to Hanford in the future: a realignment of State Route 240 from Stevens Drive to State Route 224 and the paving of asphalt overlay of State Route 224 from West Richland to State Route 240 in the year 2000 (MacNeil 1997). However, an improvement project on Grosscup Road would provide relief of congestion due to State Route 224 paving activities.

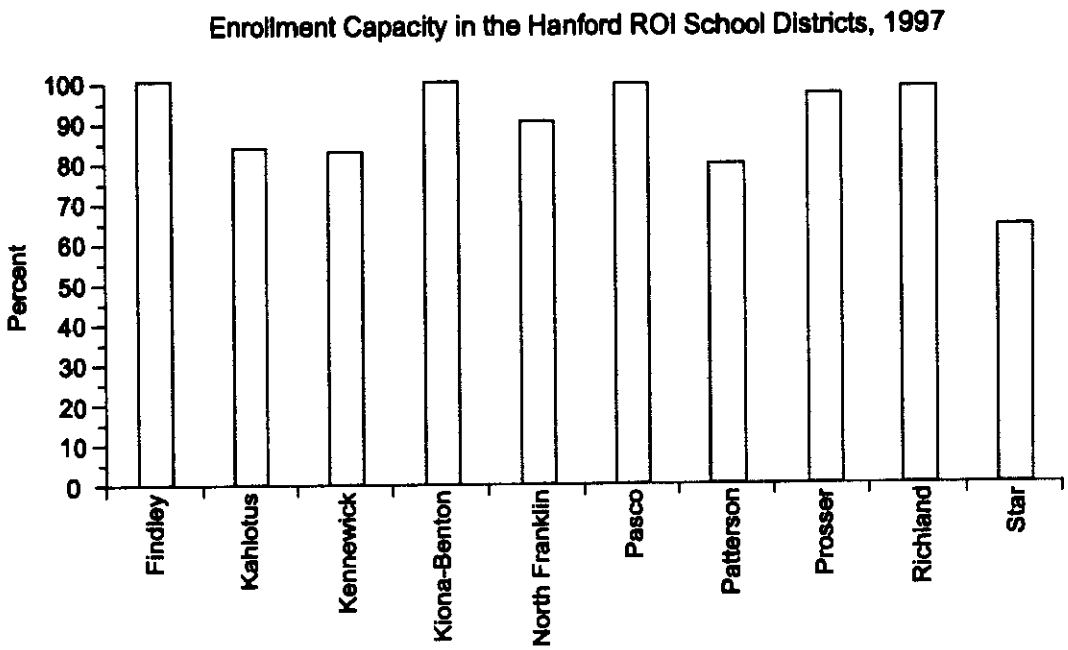
The local intercity transit system, Ben Franklin Transit, supplies bus service between the Tri-Cities and Hanford. Both private interests and Ben Franklin Transit provide vanpooling opportunities in the ROI.

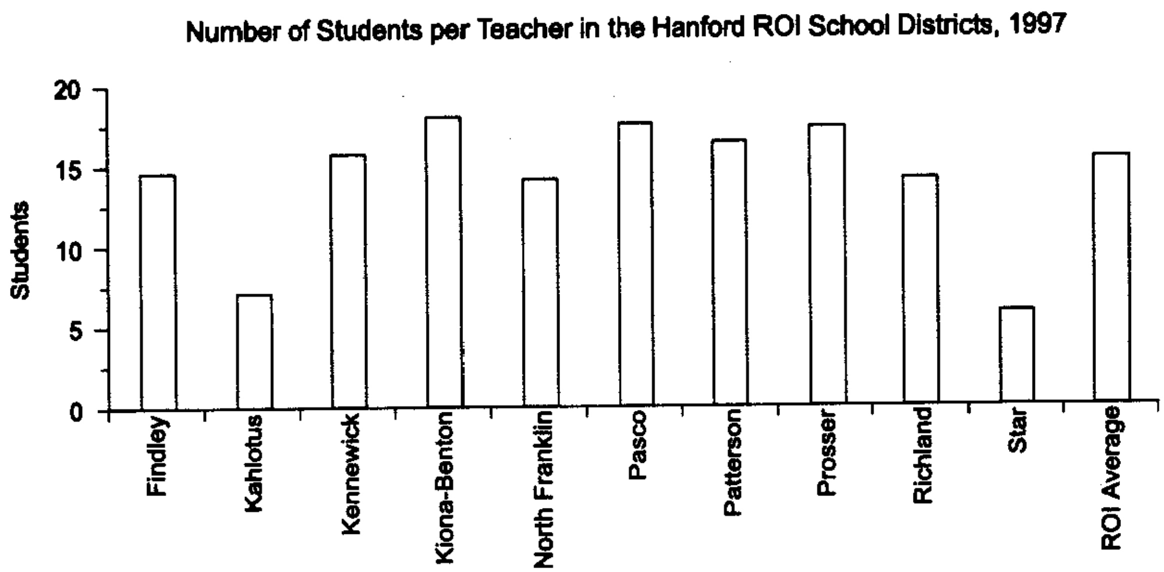


[a] DOC 1997.
[b] DOC 1994.
[c] DOC 1990a.

ROI Region of Influence

Figure 3–2. Population and Housing for the Hanford Region of Influence and the State of Washington

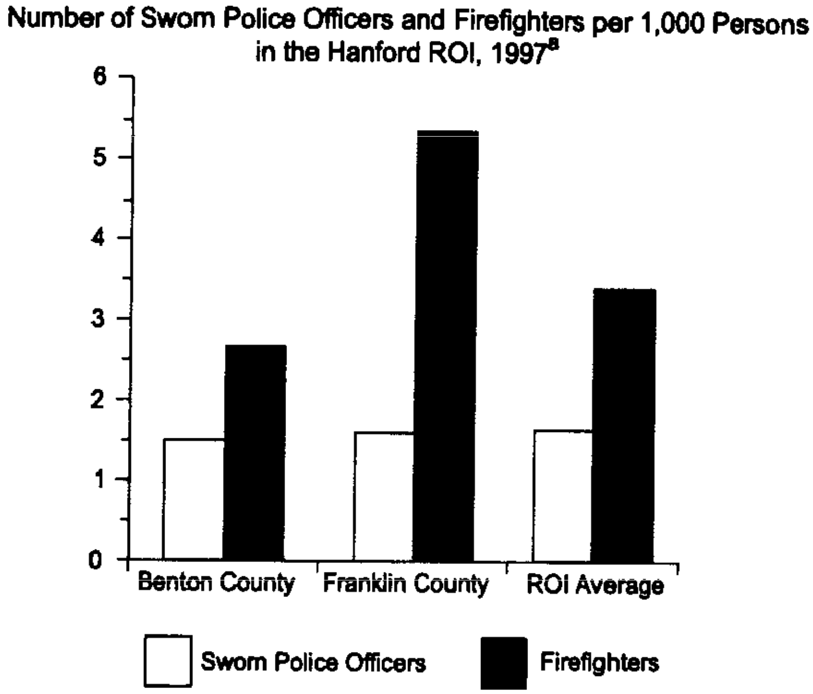


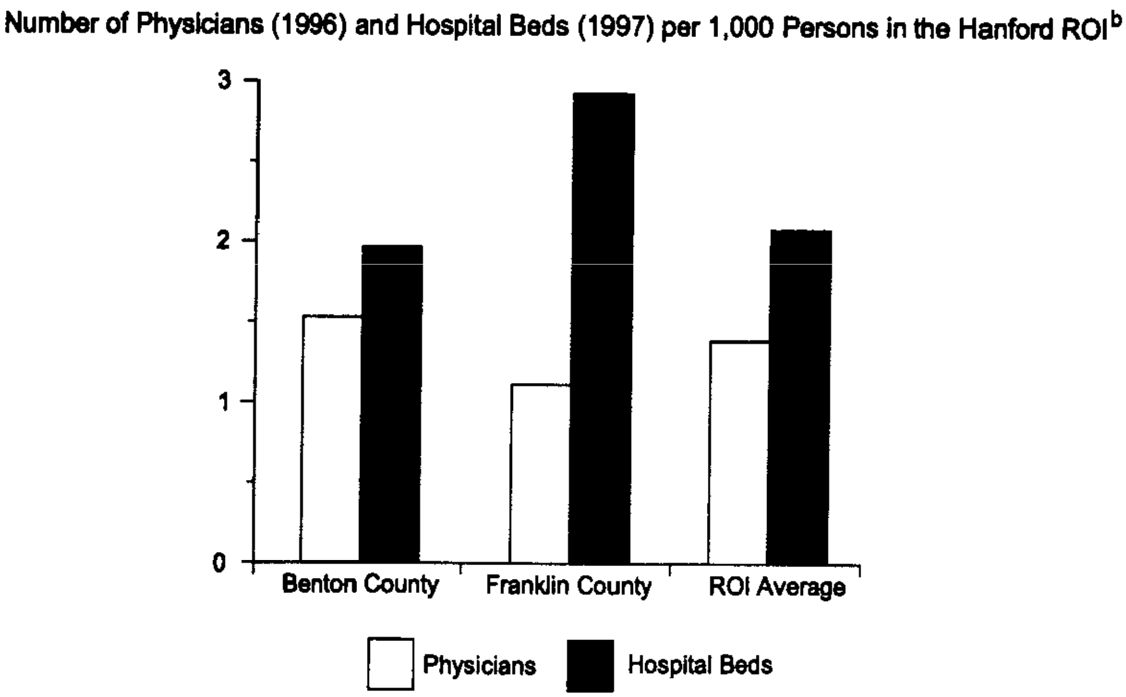


Source: Nemeth 1997a.

ROI Region of influence

Figure 3–3. School District Characteristics for the Hanford Region of Influence





[a] Nemeth 1997b.
[b] Nemeth 1997c; Randolph 1997.

ROI Region of Influence

Figure 3–4. Public Safety and Health Care Characteristics for the Hanford Region of Influence

Onsite rail transport is provided by a short-line railroad that connects with the Union Pacific line just south of the Yakima River. The Union Pacific line interchanges with the Washington Central and Burlington Northern and Santa Fe at the city of Kennewick. There is no passenger rail service at Hanford (see Section 3.2.11.1.1 for more information).

In the ROI, the Columbia River is used as an inland waterway for barge transportation from the Pacific Ocean. The Port of Benton provides a barge slip where shipments arriving at Hanford may be off-loaded.

Tri-Cities Airport, near the city of Pasco, provides jet air passenger and cargo service by both national and local carriers. Numerous smaller private airports are located throughout the ROI (DOE 1996a).

3.2.4 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.2.4.1 Radiation Exposure and Risk

3.2.4.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of Hanford are shown in Table 3–8. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to Hanford operations.

Table 3–8. Sources of Radiation Exposure to Individuals in the Hanford Vicinity Unrelated to Hanford Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation[a]	
Cosmic radiation	30
External terrestrial radiation	30
Internal terrestrial radiation	40
Radon in homes (inhaled)	200[b]
Other background radiation[c]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	365

[a] Dirkes and Hanf 1997:264.
[b] An average for the United States.
[c] NCRP 1987:11, 40, 53.

Releases of radionuclides to the environment from Hanford operations provide another source of radiation exposure to individuals in the vicinity of Hanford. Types and quantities of radionuclides released from Hanford operations in 1996 are listed in the *Hanford Site Environmental Report for Calendar Year 1996* (Dirkes and Hanf 1997:65–71). Doses to the public resulting from these releases are presented in Table 3–9. These doses fall within radiological limits per DOE Order 5400.5 (DOE 1993a:II-1–II-5) and are much lower than those of background radiation.

Table 3–9. Radiation Doses to the Public From Normal Hanford Operations in 1996 (Total Effective Dose Equivalent)

	Atmospheric Releases[a]		Liquid Releases		Total	
Members of the Public	**Standard[b]**	**Actual**	**Standard[b]**	**Actual**	**Standard[b]**	**Actual**
Maximally exposed individual (mrem)	10	4.6×10^{-3}	4	2.8×10^{-3}[(c)]	100	7.4×10^{-3}
Population within 80 km (person-rem)[d]	None	0.13	None	0.072	100	0.20
Average individual within 80 km (mrem)[e]	None	3.4×10^{-4}	None	1.9×10^{-4}	None	5.3×10^{-4}

[a] Includes direct radiation dose from surface deposits of radioactive material.
[b] The standards for individuals are given in DOE Order 5400.5 (DOE 1993a:II-1–II-5). As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4 mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, as published in 58 FR 16268 (DOE 1993b:para. 834.7). If the potential total dose exceeds the 100 person-rem value, it is required that the contractor operating the facility notify DOE.
[c] Includes the drinking water dose.
[d] About 380,000 in 1996.
[e] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Source: Dirkes and Hanf 1997:chap. 5.

Using a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Hanford operations in 1996 is estimated to be 3.7×10^{-9}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Hanford operations is less than 4 in 1 billion. (It takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

According to the same risk estimator, 1×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of Hanford from normal operations in 1996. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The 1995 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Famighetti 1998:964). Based on this mortality rate, the number of fatal cancers expected during 1996 from all causes in the population living within 80 km (50 mi) of Hanford was 760. This expected number of fatal cancers is much higher than the 1×10^{-4} fatal cancers estimated from Hanford operations in 1996.

Hanford workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. Table 3–10 presents the average dose to the individual worker and the cumulative dose to all workers at Hanford from operations in 1996. These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995a:para. 835.202). According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers[2] (Appendix F.10), the number of projected fatal cancers among Hanford workers from normal operations in 1996 is 0.11.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Hanford Site Environmental Report for Calendar Year 1996* (Dirkes and Hanf 1997). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) are also presented in that report.

[2] The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 3–10. Radiation Doses to Workers From Normal Hanford Operations in 1996 (Total Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average radiation worker (mrem)	None[b]	19
Total workers (person-rem)[c]	None	266

[a] The radiological limit for an individual worker is 5,000 mrem/yr. However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

[c] About 14,000 (badged) in 1996.

Source: DOE 1995a:para. 835.202; Lyon 1997.

3.2.4.1.2 Proposed Facility Locations

External radiation doses have been measured in the 200 and 400 Areas. In 1996, the annual doses in the 200 and 400 Areas were roughly the same, about 85 mrem. This is 10 mrem higher than the value measured at the offsite control locations. The concentration of plutonium 239/240 in air in the 200 Area in 1996 was about 1×10^{-5} picocurie (pCi)/m^3. Although this was about one hundred times higher than the value at the control location, it was still very small. No measurements of plutonium concentrations in air were reported for the 400 Area (Dirkes and Hanf 1997:75, 76, 124, 185, 186).

3.2.4.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Section 3.2.1.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emissions and National Pollutant Discharge Elimination System [NPDES] permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur via inhalation of air containing hazardous chemicals released to the atmosphere during normal Hanford operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those via the inhalation pathway.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.2.1. The baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information on estimating the health impacts of hazardous chemicals is presented in Appendix F.10.

Exposure pathways to Hanford workers during normal operations may include the inhalation of contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. They are also protected by adherence to Occupational Safety and Health Administration (OSHA) and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals used in the operational processes ensures that these standards are not exceeded. Additionally, DOE requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, workplace conditions at Hanford are substantially better than required by standards.

3.2.4.3 Health Effects Studies

Three epidemiological studies and a feasibility study have been conducted on communities around Hanford to determine whether there are excess cancers in the general population. One study found no excess cancers but identified an elevated rate of neural tube defects in progeny. This elevated rate was not attributed to parental employment at Hanford. A second study suggested that neural tube defects were associated with cumulative radiation exposure, and showed other defects statistically associated with parental employment at Hanford, but not with parental radiation exposure. The third study did not show any cancer risk associated with living near the facility.

Many epidemiological studies have been carried out on the Hanford workers over the years. The studies have consistently shown a statistically significant elevated risk of death from multiple myeloma associated with radiation exposure among Hanford male workers. The elevated risk was observed only among workers exposed to 10 rads (~10 rem) or more. Other studies have also identified an elevated risk of death from pancreatic cancers, but a recent reanalysis did not conclude there was an elevated risk. Studies of female Hanford workers have shown an elevated risk of deaths from musculoskeletal system and connective tissue conditions. For a more detailed description of the studies reviewed and their findings, and for a discussion of the epidemiologic surveillance program implemented by DOE to monitor the health of current workers, refer to Appendix M.4.2 of the *Storage and Disposition Final PEIS* (DOE 1996a:M-224–M-230).

3.2.4.4 Accident History

Prior to 1997, there were 128 nuclear-process-related incidents with some degree of safety significance at Hanford over its period of operation. These do not include less-significant instances of radioactivity release or contamination during normal operations, which have been the subject of other reviews. The 128 incidents fall into three significant categories, based on the seriousness of the actual or potential consequences.

Fifteen of the incidents were Category 1, indicating that serious injury, radiation release or exposure above limits, substantial actual plant damage, or a significant challenge to safety resulted. Forty-six events were Category 2, less severe than Category 1, but involving significant cost or a less significant threat to safety. The remaining 67 incidents were Category 3, causing minor radiation exposure or monetary cost, or involving a violation of operating standards without a serious threat to safety (Sandberg 1993:1).

On May 14, 1997, a chemical explosion occurred at the Hanford Plutonium Reclamation Plant in a room where nonradioactive bulk chemicals were mixed for the now-discontinued plutonium recovery process. The reclamation plant was designed to concentrate liquid feeds, dissolve and process solid material, and perform solvent-extraction recovery of plutonium from aqueous streams. Eight workers outside the plant at the time of the explosion complained of various symptoms, including headaches, light-headedness, and a strange metallic taste. All eight workers were transported to a nearby medical center, where they were examined and released. A small fire protection water line ruptured during the explosion, resulting in the release of water from the building. No one was injured and no radioactive materials were released to the environment. The explosion caused significant localized damage to the facility.

3.2.4.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, preparedness, and response.

Accordingly, the DOE Richland Operations Office has developed and maintains a comprehensive set of emergency preparedness plans and procedures for Hanford to support onsite and offsite emergency management actions in the event of an accident. The DOE Richland Operations Office also provides technical assistance to other Federal agencies and to State and local governments. Hanford contractors are responsible for ensuring that emergency plans and procedures are prepared and maintained for all facilities, operations, and activities under their jurisdiction, and for directing implementation of those plans and procedures during emergency conditions. The DOE Richland Operations Office, contractor, and State and local government plans are fully coordinated and integrated. Emergency control centers have been established by the DOE Richland Operations Office and its contractors for the principal work areas to provide oversight and support to emergency response actions within those areas.

Following the May 1997 explosion at Hanford (discussed previously), a review of the emergency management response indicated that multiple programs and systems failed in the hours following the accident. In a letter to Secretarial Offices, Secretary of Energy Federico Peña identified actions to be taken at all DOE sites to implement lessons learned from the emergency response (Peña 1997). The actions involve the following elements:

1. Improve training for facility and site emergency personnel
2. Ensure that equipment and qualified personnel are ready for the wide variety of potential radiological and chemical hazards
3. Improve coordination with local medical communities
4. Have in place comprehensive procedures to attend to personnel who are potentially affected by an accident

3.2.5 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. In the case of Hanford, the potentially affected area includes parts of Washington and Oregon.

The potentially affected area around the 200 East Area is defined by a circle with an 80-km (50-mi) radius centered at the planned HLW vitrification facility (lat. 46°33'03.64" N, long. 119°30'13.95" W). The total population residing within that area in 1990 was 329,576. The proportion of the population that was considered minority was 26.8 percent. The potentially affected area surrounding the 400 Area is defined by a circle with an 80-km (50-mi) radius centered at FMEF (lat. 46°26'07" N, long. 119°21'55" W). The total population residing within that area in 1990 was 270,387, and the proportion of the population deemed minority was 25.4 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and the percentages for the States of Washington and Oregon were 13.2 and 9.2, respectively (DOC 1992).

Figure 3–5 illustrates the racial and ethnic composition of the minority population in the potentially affected area around the 200 East Area. At the time of the 1990 census, Hispanics were the largest minority group within the potentially affected area, constituting 22.1 percent of the total population. Native Americans contributed about 2 percent, and Asians, about 1.4 percent. Blacks made up about 1.2 percent of the population (DOC 1992).

As for the racial and ethnic composition of the minority population in the potentially affected area around the 400 Area, Hispanics were the largest minority group, constituting 21.7 percent of the total population during the 1990 census. Asians contributed about 1.4 percent, and Native Americans, about 1.3 percent. Blacks were about 1 percent of the population (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 62,615 persons (19.0 percent of the total population) residing within the potentially affected area around the 200 East Area reported incomes below that threshold. The data also show that 45,820 persons (16.9 percent of the total population) residing within the potentially affected area around the 400 Area reported incomes below the poverty threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that the figures for Washington and Oregon were 10.9 and 12.4 percent, respectively.

3.2.6 Geology and Soils

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

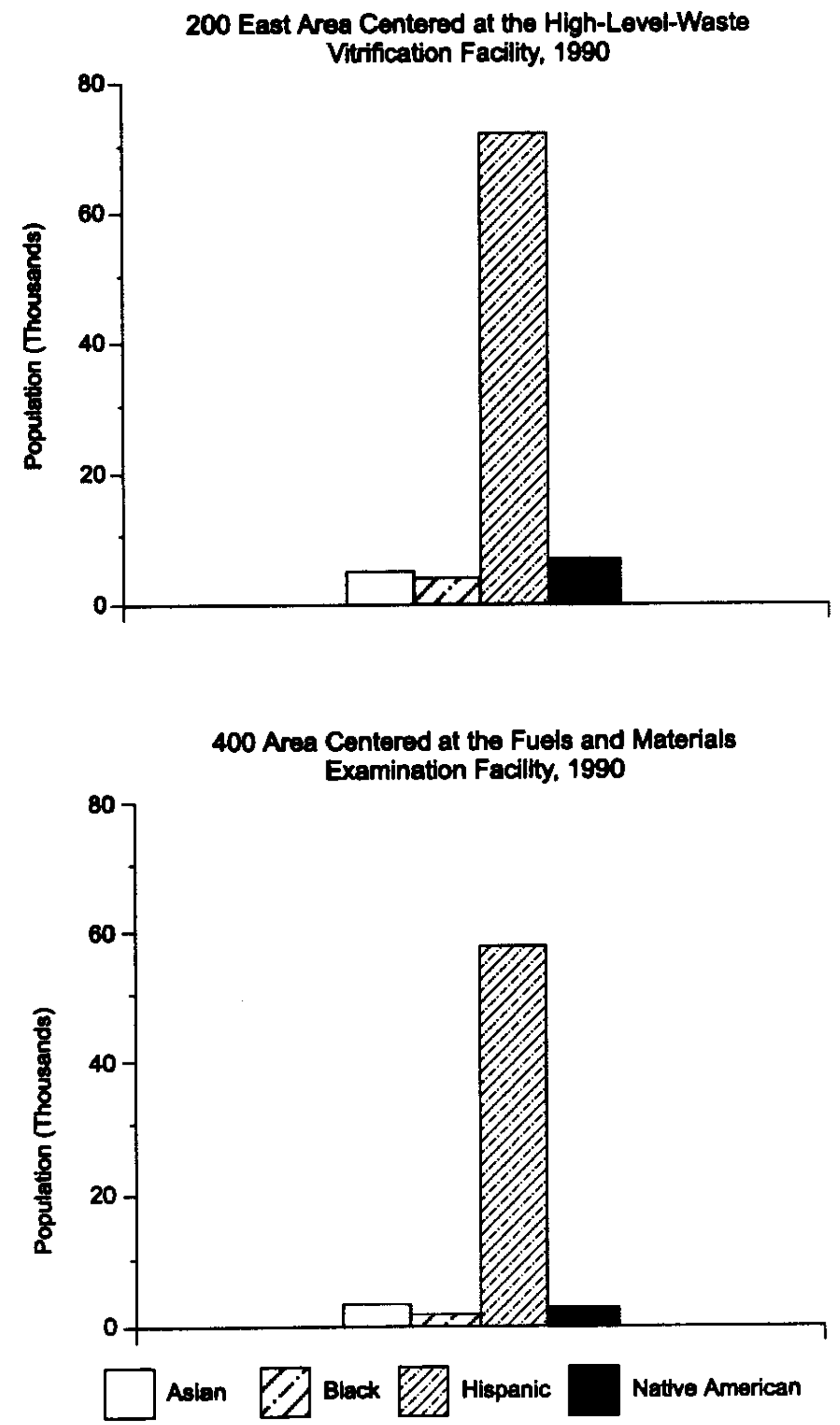
3.2.6.1 General Site Description

The rocks beneath Hanford consist of Miocene-age and younger rocks that overlay older Cenozoic sedimentary and volcanic basement rocks. The major geologic units underlying Hanford are, in ascending order: subbasalt (basement) rocks, the Columbia River Basalt Group, the Ellensburg Formation, the Ringold Formation, the Plio-Pleistocene unit, early "Palouse" soil, and the Hanford Formation (DOE 1996a:3-38).

Basalt outcrops are exposed on ridges at Gable Mountain, Gable Butte, and the Saddle Mountains in the northern part of Hanford, and on Rattlesnake Hills and Yakima Ridge, overlapping the western and southwestern edges of Hanford (DOE 1996a:3-38). Other than crushed rock, sand, and gravel, no economically viable geologic resources have been identified at Hanford (DOE 1996c:4-10).

Known faults in the Hanford area include those on Gable Mountain and the Rattlesnake-Wallula alignment. The faults in Central Gable Mountain are considered capable, although there is no observed seismicity on or near Gable Mountain. The Rattlesnake-Wallula alignment is interpreted as possibly being capable because there appear to be active portions of the fault system 56 km (35 mi) southwest of the central part of Hanford. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years (Barghusen and Feit 1995:2.2-13, 2.2-14).

According to the Uniform Building Code, Hanford is in Seismic Zone 2B, meaning that moderate damage could occur as a result of an earthquake. Seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the historical magnitude of these events, is lower than that of other regions in the Pacific Northwest (DOE 1996a:3-38, 3-39). The two largest earthquakes near Hanford occurred in 1918 and 1973; each had an approximate Richter magnitude of 4.5 and a Modified Mercalli Intensity of V. They occurred in the central portion of the Columbia Plateau north of Hanford (Neitzel 1996:4.49). An earthquake with a maximum



Source: DOC 1992.

Figure 3–5. Racial and Ethnic Composition of Minorities Around Hanford

horizontal acceleration of 0.25g is calculated to have an annual probability of occurrence of 1 in 10,000 at Hanford (Barghusen and Feit 1995:2.2-14).

There is some potential for slope failure at Hanford, although only the slopes of Gable Mountain and White Bluffs are steep enough to warrant landslide concern. White Bluffs, east of the Columbia River, poses the greatest concern because of the clay-rich nature of some beds above the river level, the discharge of large quantities of irrigation water into the ground atop the cliffs, the surface incline toward the Columbia River, and the eastward channel migration of the Columbia and its undercutting of the adjacent bluffs. A large landslide along White Bluffs could fill the Columbia River channel and divert water onto Hanford (DOE 1996a:3-40). Calculations of the potential impacts of such a landslide indicate a flood area similar to the probable maximum flood (Neitzel 1996:4.58–4.61).

Several major volcanoes are in the Cascade Range west of Hanford, including Mount Adams, 164 km (102 mi) from Hanford, and Mount St. Helens, 218 km (135 mi) west-southwest of the site (DOE 1996a:3-40). Ashfalls from at least three Cascade volcanoes have blanketed the central Columbia Plateau since the late Pleistocene epoch. Generally, ashfall layers have not exceeded more than a few centimeters in thickness, with the exception of the Mount Mazama (Crater Lake, Oregon) eruption, when as much as 10 cm (3.9 in) of ash fell over western Washington (Barghusen and Feit 1995:2.2-14).

Fifteen different soil types occur at Hanford. These soils vary from sand to silty and sandy loam. The dominant soil types are the Quincy (Rupert) sand, Burbank loamy sand, Ephrata sandy loam, and the Warden silt loam. No soils at Hanford are currently classified as prime farmlands because there are no current soil surveys, and the only prime farmland soils in the region are irrigated (DOE 1996b:4-15). The soils at Hanford are considered acceptable for standard construction techniques (DOE 1996a:3-40). More detailed descriptions of the geology and the soil conditions at Hanford are included in the *Storage and Disposition Final PEIS* (DOE 1996a:3-38–3-40) and the *Hanford Remedial Action EIS* (DOE 1996b).

3.2.6.2 Proposed Facility Locations

The nearest capable fault to the 200 East Area is about 10 km (6.2 mi) away (Mecca 1997a:6). The predominant soils of the 200 East Area are the Burbank loamy sand and the Ephrata sandy loam, and the soils are not subject to liquefaction or other instabilities (Mecca 1997a:6; Neitzel 1996:4-46).

The nearest capable fault to the 400 Area is about 19 km (12 mi) away (Mecca 1997a:6). The predominant soil type in the 400 Area is the Rupert sand, and the soils are not subject to liquefaction or other instabilities (Mecca 1997a:6; Neitzel 1996:4-46).

3.2.7 Water Resources

3.2.7.1 Surface Water

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

3.2.7.1.1 General Site Description

The major surface water features at Hanford are the Columbia River, the Yakima River, the springs along the Columbia River and on Rattlesnake Mountain, and onsite ponds. Flow of the Columbia River is regulated by several dams upstream and downstream from the site. The nearest dam upstream from Hanford is the Priest Rapids Dam, and the closest downstream dam is the McNary Dam. The Hanford Reach is the portion of the

Columbia River that extends from Priest Rapids Dam to the upstream edge of the pool behind McNary Dam. Because the flows are regulated, flow rates in the Hanford Reach can vary considerably; it is the last remaining free-flowing, nontidal section of the river (DOE 1996a:3-32). The average flow rate at the Priest Rapids Dam is about 3,360 m^3/s (118,600 ft^3/s). About one-third of the Hanford Site drains into the Yakima River, which forms a portion of the southern site boundary (Neitzel 1996:4.53–4.55). The average annual flow rate for the Yakima River is about 104 m^3/s (3,670 ft^3/s). Rattlesnake Springs and Snively Springs are in the southwestern portion of the site and flow into intermittent streams. Flows received by these streams infiltrate rapidly into the surface sediments thereof (DOE 1996a:3-32).

Waters of the Columbia River are used primarily for hydroelectric power, transportation, irrigation and other agricultural purposes, recreation, and municipal domestic water. Hanford uses water from the river for domestic and industrial purposes (DOE 1996a:3-32).

Flooding of the site has occurred along the Columbia River, but chances of recurrence have been greatly reduced by the construction of dams to regulate river flow. No maps of flood-prone areas have been produced by the Federal Emergency Management Agency (FEMA). FEMA produces these maps for areas capable of being developed, and the Hanford Site is not designated for commercial or residential development (DOE 1996b:4-22). However, analyses have been completed to determine the potential for the probable maximum flood. This is determined through hydrologic factors, including the amount of precipitation within the drainage basin, snow melt, and tributary conditions. The probable maximum flood for the Columbia River below the Priest Rapids Dam has been calculated at 39,600 m^3/s (1.4 million ft^3/s). Figure 3–6 shows the elevations of the highest flood of record, the river at normal flow, the 1948 flood, and the probable maximum flood (DOE 1996b:4-23).

Potential flooding due to dam failure has been evaluated by the U.S. Army Corps of Engineers (USACE). Upstream failures could have any number of causes, the magnitude of the resultant flooding depending on the size of the breach in the dam. USACE evaluated various scenarios for failure of the Grand Coulee Dam and assumed flow conditions of about 11,300 m^3/s (400,000 ft^3/s). The worst-case scenario assumed a 50 percent breach in the dam (Figure 3–7). The flood wave from an instantaneous 50 percent breach was calculated to be 595,000 m^3/s (21 million ft^3/s). In addition to the areas affected by the probable maximum flood, the remainder of the 100 Area, the 300 Area, and nearly all of Richland, Washington, would be flooded. Determinations were not made for larger instantaneous breaches in the Grand Coulee Dam, because the 50 percent scenario was believed to be the largest conceivable flow from a natural or manmade breach. It was not considered credible that a structure as large as the Grand Coulee Dam could be 100 percent destroyed instantaneously. The analysis also assumed that the 50 percent breach would occur only as the result of direct explosive detonation, and not because of some natural event such as an earthquake (DOE 1996b:4-24).

The possibility of a landslide resulting in river blockage has also been evaluated for White Bluffs. Calculations were made for a landslide volume of 765,000 m^3 (1 million yd^3) with a concurrent flow of about 17,000 m^3/s (600,000 ft^3/s) in the river, which is the 200-year flood. This combination resulted in a flood wave crest elevation of 122 m (400 ft) above mean sea level, similar to that from the 50 percent breach of the Grand Coulee Dam (DOE 1996b:4-24).

The Hanford Reach has been classified Class A: excellent drinking water, a recreation area, and wildlife habitat (DOE 1996a:3-32; Dirkes and Hanf 1996:113). The river currently meets applicable drinking water and water quality standards. No federally designated Wild and Scenic Rivers exist on Hanford, although consideration is being given to so designating the Hanford Reach (Barghusen and Feit 1995:2.2-17–2.2-19).

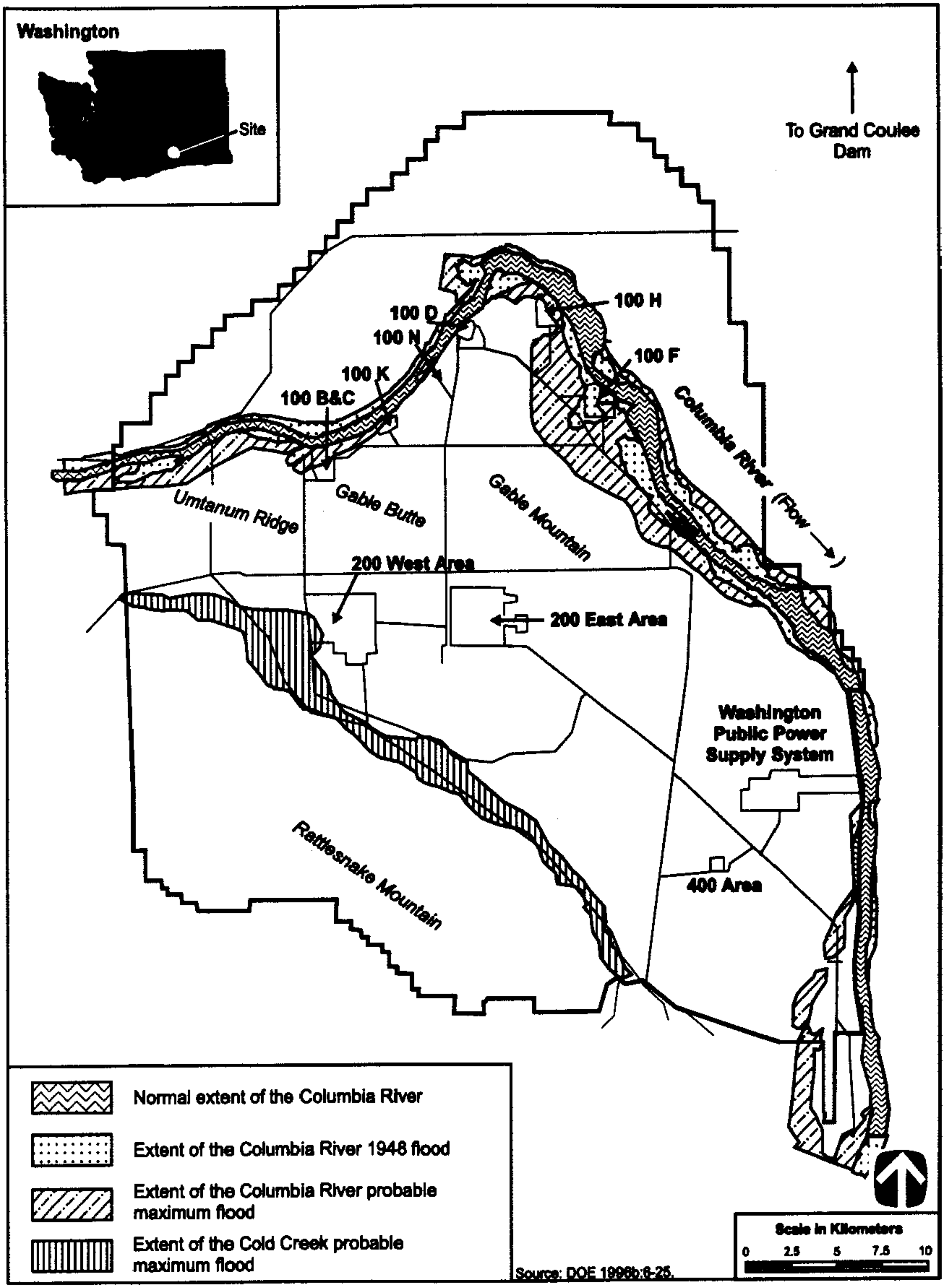


Figure 3–6. Flood Area for the Probable Maximum Flood and Columbia River 1948 Flood

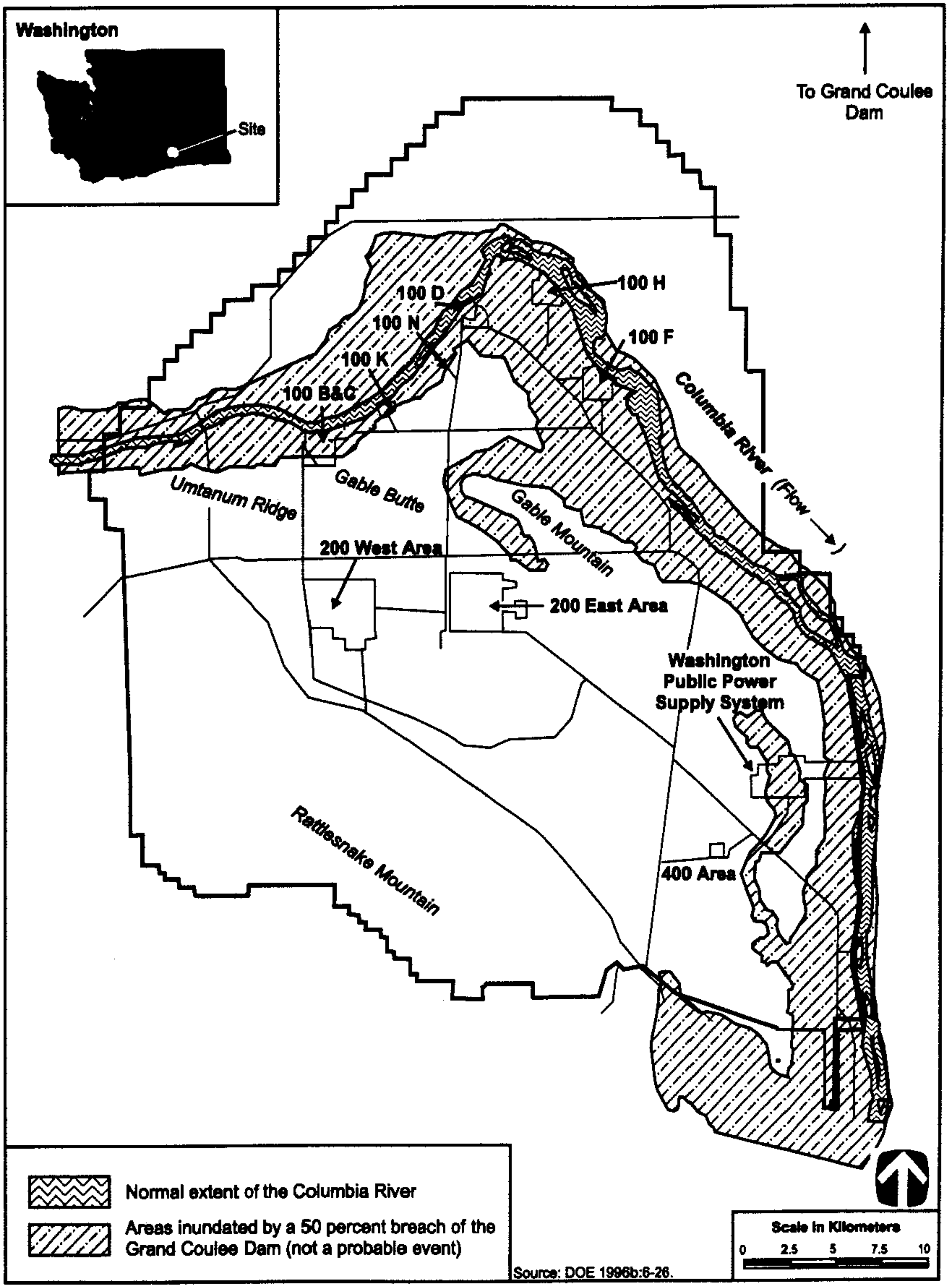


Figure 3–7. Flood Area of a 50 Percent Breach of the Grand Coulee Dam

DOE continues to assert a federally reserved water withdrawal right for the Columbia River. Currently, Hanford withdraws approximately 13.5 billion l/yr (3.6 billion gal/yr) from the Columbia River (DOE 1996a:3-34).

Hanford has six National Pollutant Discharge Elimination System (NPDES)–permitted discharges and two NPDES permits for these discharges. One permit, WA-000374-3, includes five discharges in the 100 and 300 Areas. A request for a minor permit modification to delete two inactive outfalls from the 100 N-Area was submitted to EPA in August 1995. No effluent noncompliance issues were associated with any of these outfalls in 1995 (Dirkes and Hanf 1996:31, 32).

Permit #WA-002592-7 was issued for the 300 Area Treated Effluent Disposal Facility, which had 10 permit exceedances in 1996. This disposal facility was in normal operations and meeting design specifications at the time of these events. All indications suggest that the facility is unable to consistently meet the restrictions of the facility's NPDES permit despite the use of the best available technology (Dirkes and Hanf 1997:36). An application for a permit modification was submitted to the EPA in November 1997. A revised permit is expected to be issued in 1998 (Sandberg 1998b).

Hanford received a general stormwater permit in February 1994. The *Annual Site Compliance Evaluation and the Pollution Prevention Plan* was updated as required by the permit. No noncompliances were associated with this permit in 1995 (Dirkes and Hanf 1996:32).

All radiological contaminant concentrations measured in the Columbia River in 1995 were lower than the DOE-derived concentration guides and Washington State ambient surface water quality criteria (Dirkes and Hanf 1996:114). For nonradiological parameters, applicable standards for Class A–designated surface water were met; however, the minimum detectable concentration of silver exceeded the Washington State toxicity standard. During 1995, there was no evidence of deterioration in water quality attributable to Hanford operations along the Hanford Reach (Dirkes and Hanf 1996:119).

The Columbia River is also the primary discharge area for the unconfined aquifer underlying Hanford. The site conducts sampling of these discharges and refers to them as riverbank springs. Hanford-origin contaminants continued to be detected in riverbank spring water during 1995. The location and extent of the contaminated discharges were consistent with recent groundwater surveys. Tritium; strontium 90; technetium 99; uranium 234, 235, and 238; cadmium; chloroform; chromium; copper; nitrate; trichloroethylene (TCE); and zinc entered the river along the 100 Area shoreline. Tritium; technetium 99; iodine 129; uranium 234, 235, and 238; chromium; nitrate; and zinc entered the river along the portion extending from the old Hanford Townsite to below the 300 Area. All radiological contaminants in these discharges were below DOE-derived concentration guides. With the exception of TCE, the concentrations of all anion and volatile organic compounds measured in riverbank spring water collected from the Hanford shoreline were below Washington State ambient surface water quality criteria. The concentration of TCE exceeded the EPA standard for protection of human health for the consumption of water and organisms in the 100 K-Area riverbank spring (Dirkes and Hanf 1996:124–126, 132).

3.2.7.1.2 Proposed Facility Locations

The water source in the 200 Area is the Hanford export water system that withdraws Columbia River water at the 100 B-Area pumphouse (Mecca 1997a:5, 7). Most of the Hanford Site is supplied with water from this system. Water is withdrawn at a rate of about 36.2 million l/day (9.6 million gal/day). This system provides water to other areas of the site, but since the shutdown of the reactors its primary function is to provide water to the 200 Area (Mecca 1997a:145–147). More detailed information on this water system may be found in Section 3.2.11.

The 200 East Area sits on a plateau about 11 km (6.8 mi) south of the Columbia River (Mecca 1997a:120; Barghusen and Feit 1995:2.2-8). In this area, only the East Powerhouse Ditch and the

216-B-3C Pond are active. The pond was originally excavated in the mid-1950s for disposal of process cooling water and other liquid waste occasionally containing low levels of radionuclides. West Lake, north of the 200 East Area, is predominantly recharged from groundwater. The lake has not received direct effluent discharges from site facilities; it owes its existence to the intersection of the elevated water table with the land surface in the topographically low area south of Gable Mountain and north of the 200 East Area (Neitzel 1996:4.61).

Analyses of maximum flooding scenarios have indicated that the 200 East Area would not be flooded, even in the worst-case scenario of a failure of the Grand Coulee Dam (Neitzel 1996:4.55–4.61; ERDA 1976:1–11). Similar results have been produced by landslide analyses—specifically, analysis of a landslide-induced blockage of the Columbia River at White Bluffs. Such a blockage would cause flooding, but it would not impact the 200 East Area facilities (Neitzel 1996:4-58).

The 400 Area receives its water from three wells that have a total capacity of about 397 million l/yr (105 million gal/yr) (Mecca 1997a:780). Two other wells would provide emergency service if these wells failed, and another, dire emergency service if all other wells failed. Chlorination is the only treatment provided to these wells (Dirkes and Hanf 1996:140).

No specific flooding analyses have been completed for the 400 Area, but analyses have been completed for the site as a whole. According to the sitewide data, the elevation of the ground surface in the 400 Area is about 30 m (100 ft) above that of the maximum calculated flood from a 50 percent breach in the Grand Coulee Dam (Mecca 1997a:4). Also, the 400 Area is above the elevation of the maximum historical flood of 1894 (Neitzel 1996:4.56).

3.2.7.2 Groundwater

Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

3.2.7.2.1 General Site Description

Groundwater under Hanford occurs in confined and unconfined aquifers. The unconfined aquifer lies within the glacioalluvial sands and gravels of the Hanford Formation and the fluvial and lacustrine sediments of the Ringold Formation. Groundwater generally flows eastward across the site; because of local water disposal practices, however, the water table has risen as much as 27 m (89 ft) in the 200 West Area. This has caused groundwater mounding with radial and northward flow components in the 200 Area. Depth to groundwater across the site ranges from 24 to 80 m (79 to 262 ft) (DOE 1996a:3-34).

The unconfined aquifer is recharged mainly from rainfall and runoff from the higher elevation on the western border and from artificial recharge from irrigation and wastewater disposal practices at Hanford. In the vicinity of Hanford, groundwater is discharged along the Columbia River, and some lesser amounts along the Yakima River (DOE 1996a:3-34).

The confined aquifers at Hanford consist of sedimentary interbeds and interflow zones that occur between basalt flows in the Columbia River Basalt Group. Aquifer thickness varies from several centimeters to at least 52 m (171 ft). Recharge of the confined aquifer occurs where the basalt formations are near ground level, and thus surface water is allowed to infiltrate them. Groundwater from the confined aquifers discharges to the Columbia River (DOE 1996a:3-34).

Water use in the Pasco Basin, which includes Hanford, is primarily via surface water diversion; groundwater accounts for less than 10 percent of water use. While most of the water used by Hanford is surface water withdrawn from the Columbia River, some groundwater is used. One of the principal users of groundwater was FFTF, which used about 697,000 l/day (184,000 gal/day) when it operated. The other facilities that use groundwater are the Yakima Barricade and the Patrol Training Academy (Dirkes and Hanf 1996:139–144; Barghusen and Feit 1995:2.2-21–2.2-24). DOE currently asserts an unlimited federally reserved groundwater withdrawal right with respect to the existing Hanford operations and withdraws about 195 million l/yr (52 million gal/yr) (DOE 1996a:3-37).

Groundwater quality beneath portions of the Hanford Site from the 200 Areas north and east to the Columbia River has been affected by past liquid waste disposal practices and as a result of spills and leaks from single-shell radioactive waste storage tanks (Dirkes and Hanf 1997:95). The unconfined aquifer contains radiological and nonradiological contaminants at levels exceeding water quality criteria and standards. Contamination in the confined aquifer is typically limited to areas of exchange with the unconfined aquifer. Tritium and nitrate plumes have moved steadily eastward across the site and seeped into the Columbia River. No aquifers have been designated sole-source aquifers (Barghusen and Feit 1995:2.2-22).

3.2.7.2.2 Proposed Facility Locations

Two major groundwater mounds have been formed in the 200 Area, both in response to wastewater discharges. The first was created by disposal at U Pond in the 200 West Area. This mound has been slowly dissipating since the pond was decommissioned in 1984. The second major mound was created by discharges to B Pond east of the 200 East Area. The water table near B Pond increased to a maximum of about 9 m (30 ft) above preoperational conditions in 1990, and has dropped slightly over the last few years because of the reduced volume of discharges. These mounds have altered the unconfined flow patterns that generally recharge from the west and flow to the east. Water levels in the unconfined aquifer continually change as a result of variations in the volume and location of wastewater discharges. Consequently, the movement of groundwater and its associated constituents has also changed with time (Dirkes and Hanf 1996:185).

The radiological contaminants in two 200 East Area groundwater plumes include cesium 137, cobalt 60, plutonium, strontium 90, technetium 99, and tritium. They are the result of historical reprocessing operations at B Plant. Two pump-and-treat test systems used in treatability testing of these plumes were discontinued in May 1995 after about 5 million l (1.3 million gal) of water were treated. Decisions concerning further actions have been deferred until the data are evaluated. A RCRA Field Investigation/Corrective Measures Study addressing contaminants associated with PUREX Plant discharges is being prepared (Dirkes and Hanf 1996:197–219).

In the 400 Area, groundwater flows to the east. The flow direction at the Nonradioactive Dangerous Waste Landfill and the Solid Waste Landfill, which are nearby, is east-southeast. Because of their rather high permeabilities, Hanford Formation sediments dominate groundwater flows in these areas. Transmissivity of the unconfined aquifer system in the landfill areas is particularly high, because the system is within the main flow channel of the catastrophic floods that deposited the Hanford Formation gravels. In the 400 Area, the Hanford Formation consists mainly of the sand-dominated facies, and the water table is near the point of contact between the Hanford and Ringold Formations. Transmissivity of the aquifer in the 400 Area is an order of magnitude lower than that in the landfill areas (Hartman and Dresel:1997:3.11, 3.12). Water for the 400–Area is supplied by three wells in the unconfined aquifer. Each well has a pumping capacity of 83.3 l/min (22 gal/min). The water is distributed throughout the 400 Area for potable, process, and fire protection use (Dirkes and Hanf 1997:193; Rohl 1994:2-7).

Nitrate is the only significant contaminant attributable to 400 Area operations. Elevated levels have been attributed to the sanitary sewage lagoon, a source of groundwater contamination that should be eliminated by a recently constructed sewage treatment system. Other contamination found in well samples is believed not to emanate from the 400 Area (Hartman and Dresel 1997:6.90).

3.2.8 Ecological Resources

Ecological resources are defined as terrestrial (predominantly land) and aquatic (predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this SPD EIS, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special status species—that is, "nonsensitive" versus "sensitive" habitat.

3.2.8.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

3.2.8.1.1 General Site Description

Hanford is made up of large, undisturbed expanses of shrub-steppe habitat that supports nearly 600 plant species and numerous animal species suited to the region's semiarid environment (DOE 1996d:3-89, 3-90). Present site development consists of clusters of large buildings at widely spaced locations, occupying about 6 percent of the total available area. The remaining site area can be divided into 10 major plant communities (see Figure 3–8). The dominant plants are cheatgrass, big sagebrush, rabbitbrush, and Sandberg's bluegrass, with cheatgrass providing at least half of the total plant coverage. Shrub-steppe is considered a priority habitat by the State of Washington because of its significant value to sensitive wildlife. Trees that were originally planted on farmland to provide windbreaks and shade serve as nesting platforms for several species of birds, including hawks, owls, ravens, magpies, and great blue herons, and as night roosts for wintering bald eagles (DOE 1996a:3-42; DOE 1996b:4-51).

Animal species at Hanford include over 1,000 species of insects, 12 species of amphibians and reptiles, 214 species of birds, 44 species of fish, and 39 species of mammals (Dirkes and Hanf 1997:275). Grasshoppers and darkling beetles are among the more conspicuous groups, and along with other species, are important in the food web of the local birds and mammals. The most abundant reptile is the side-blotched lizard, although short-horned and sagebrush lizards, gopher snakes, yellow-bellied racers, and Pacific rattlesnakes are also seen frequently. The horned lark and western meadowlark are the most abundant nesting birds, but the site also supports populations of chukar partridge, gray partridge, and sage grouse (DOE 1996d:3-90). The Hanford Reach, including several sparsely vegetated islands, provides nesting habitat for the Canadian goose, ring-billed gull, Forster's tern, and great blue heron. Numerous raptors, such as the northern harrier, ferruginous hawk, Swainson's hawk, red-tailed hawk, prairie falcon, American kestrel, and owls, use the site as a refuge, especially during nesting (DOE 1996a:3-42; DOE 1996b:4-56; DOE 1996e:3-90). Mammals on the site are generally small and nocturnal, the Great Basin pocket mouse being the most abundant. Other small mammals include the deer mouse, Townsend ground squirrel, pocket gopher, harvest mouse, Norway rat, sagebrush vole, grasshopper mouse, montane vole, vagrant shrew, Leasts chipmunk, and Merriam's shrew. Larger mammals include the mule deer and elk. Small numbers of bobcats and badgers also inhabit the site. The largest predator, which ranges all across the site, is the coyote. Bat species include the pallid bat, which frequents deserted buildings and is thought to be the most abundant. Other species include the hoary bat, silver-haired bat, California brown bat, little brown bat, Yuma brown bat, and Pacific western big-eared bat (DOE 1996b:4-55; DOE 1996d:3-90).

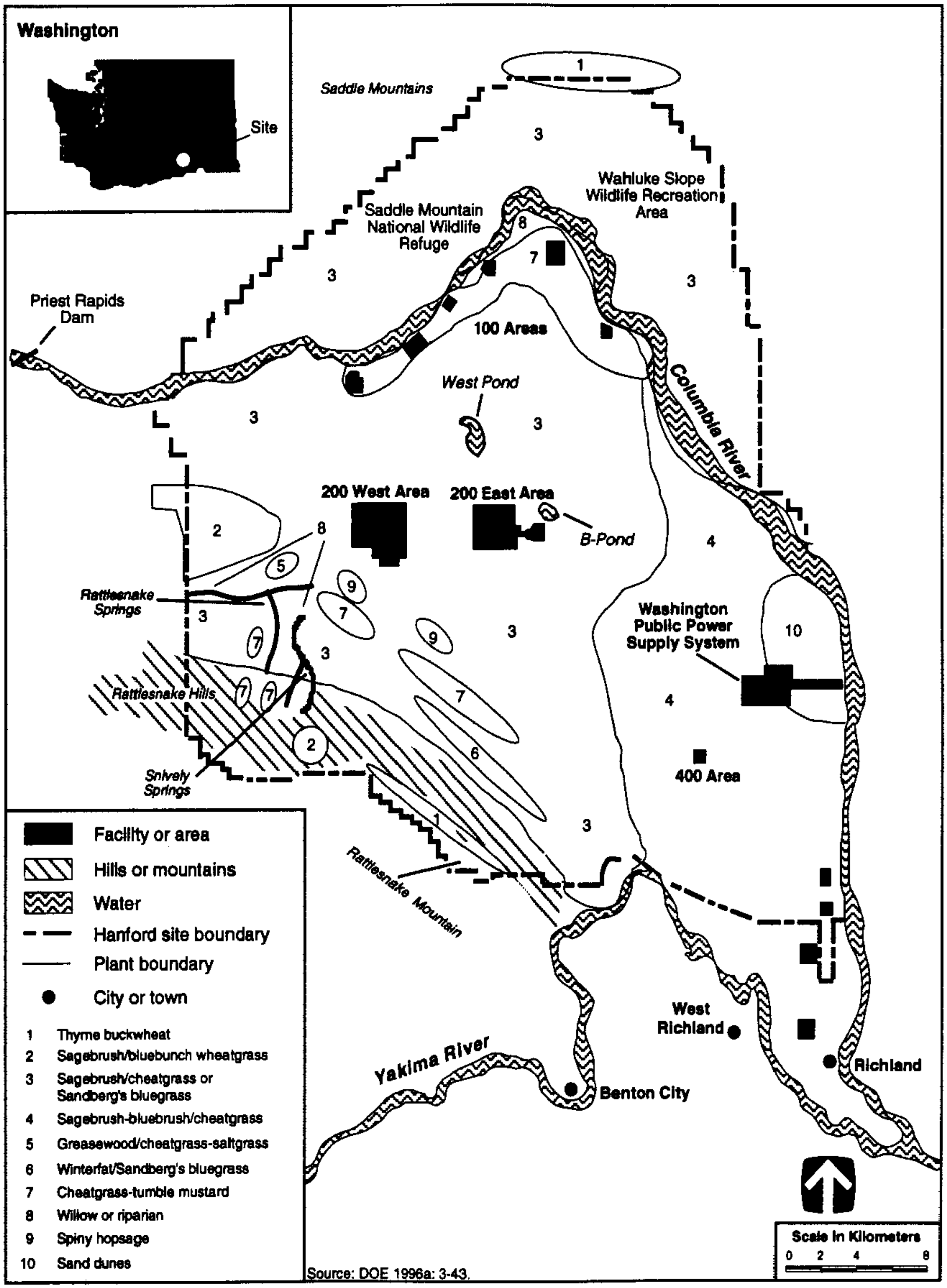


Figure 3–8. Major Plant Communities at Hanford

There are two types of natural aquatic habitats on the Hanford Site. The dominant one, the Columbia River, flows along the northern and eastern edges; the other is the small spring-streams and seeps in the Rattlesnake Hills. Several artificial water bodies, primarily ponds and ditches, have been formed as a result of wastewater disposal practices associated with the operation of reactors and separation facilities. Although they are temporary and will vanish with cessation of activities, all except West Lake form established aquatic ecosystems when present. West Lake is created by a rise in the water table in the 200 Areas, and because it is not fed by surface flow, it is alkaline and has limited plant and animal species (DOE 1996b:4-63).

The Columbia River supports a large and diverse community of plankton, benthic invertebrates, fish, and other aquatic organisms. The Hanford Reach supports transient phytoplankton and zooplankton populations and 44 anadromous and resident species of fish (DOE 1996d:3-90). Of these species, the chinook salmon, sockeye salmon, coho salmon, and steelhead trout use the river as a migration route to upstream spawning areas. Principal resident fish species sought by anglers include whitefish, sturgeon, smallmouth bass, catfish, walleye, and perch. There are also large populations of rough fish present, including carp, shiners, suckers, and squawfish. Small spring-streams, such as Rattlesnake and Snively Springs, support diverse biotic communities and are extremely productive, consisting of dense blooms of watercress and aquatic insects (DOE 1996b:4-63, 4-64). Temporary wastewater ponds and ditches develop riparian communities and are attractive to migrating birds in autumn and spring (DOE 1996e:3-90).

3.2.8.1.2 Proposed Facility Locations

Biological surveys in the 200 East Area and immediately surrounding areas show that approximately 40 percent of the area is big sagebrush and grey rabbitbrush, both native species characteristic of shrub-steppe communities. Roughly 20 percent is Russian thistle, the remainder being either disturbed vegetation or bare gravel (DOE 1996c:4-32). Because of past disturbances and human occupancy in the 200 Areas, wildlife associated with shrub-steppe habitat is somewhat limited (DOE 1996c:S-7). Several animal species may be found in this area. Bird species include the burrowing owl, ferruginous hawk, great blue heron, loggerhead shrike, long-billed curlew, northern harrier, sage sparrow, Swainson's hawk, western meadowlark, vesper sparrow, and horned lark. Potential mammal species include the black-tailed jackrabbit, coyote, Great Basin pocket mouse, house mouse, deer mouse, mule deer, Nuttall's cottontail, raccoon, and badger. Reptiles likely to be seen include the gopher snake, northern Pacific rattlesnake, western yellow-bellied racer, and side-blotched lizard (Mecca 1997b:Poston memo to Teal).

The 400 Area is characterized as postfire shrub-steppe habitat dominated by cheatgrass and small shrubs, including gray and green rabbitbrush. Generally, the same animal species listed above as potentially located in the 200 Area may be found in the 400 Area, with the following exceptions: great blue heron, raccoon, and badger. Species that may be infrequently seen due to limited habitat as a result of fire include loggerhead shrike and sage sparrow (Mecca 1997b:Poston memo to Teal). No surface water flows within 1.6 km (1 mi) of the proposed facility locations in the 200 East and 400 Areas (Mecca 1997b).

3.2.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including designated wetlands) areas of the site that support threatened and endangered, State-protected, and other special status plant and animal species.[3]

[3] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

Next Section

3.2.8.2.1 General Site Description

The primary jurisdictional wetlands on the Hanford Site are found along the Hanford Reach and include the riparian and riverine habitats associated with the river shoreline (DOE 1996b:4-64). The riparian zone varies with seasonal water-level fluctuations and daily variations related to power generation at Priest Rapids Dam, but is known to support extensive stands of willows, grasses, various macrophytes, and other plants. Other large areas of wetlands can be found within the Saddle Mountain National Wildlife Refuge and the Wahluke Slope Wildlife Recreation Area. Wetland habitat in these areas consists of large ponds resulting from irrigation runoff. The ponds support extensive stands of cattails and other emergent aquatic vegetation that are frequently used as nesting sites by waterfowl (DOE 1996a:3-42).

Sixty-five threatened, endangered, and other special status species listed by the Federal Government or the State of Washington may be found in the vicinity of Hanford, as shown in Table 3.2.6–1 of the *Storage and Disposition Final PEIS* (DOE 1996a:3-45).

3.2.8.2.2 Proposed Facility Locations

Riparian habitats are associated with the B Pond Complex near the 200 East Area and a small cooling and wastewater pond in the 400 Area (DOE 1996b:4-64). Wetland plants occurring along the shoreline of B Pond include herbaceous and woody species such as showy milkweed, western goldenrod, three square bulrush, horsetail rush, common cattail, and mulberry. Wildlife species observed include a variety of mammals and waterfowl (DOE 1996c:4-33). Similar representative plants and animals may be found in the 400 Area, with the exception of bulrushes, cattails, horsetails, and mulberry (Mecca 1997a:Poston memo to Teal).

No animals or plants on the Federal list of threatened and endangered species are known to occur on or around the 400 Area and 200 East Area. As indicated in Table 3–11, the State of Washington has classified eight bird, one mammal, four plant, and two reptile species as threatened, endangered, or species of concern. Loggerhead shrike and sage sparrow nest in undisturbed sagebrush habitat. Other bird species of concern that may occur in shrub-steppe habitat are the burrowing owl, ferruginous hawk, golden eagle, long-billed curlew, sage thrasher and Swainson's hawk. The only mammal species is the State-listed endangered pygmy rabbit which have only rarely been observed at Hanford. Pipers daisy has been found at B Pond near the 200 East Area and crouching milkvetch, stalked-pod milkvetch, and squill onion are also found in the vicinity. The reptile species of concern is the desert night snake and striped whipsnake (Dirkes and Hanf 1997:F.1–F.3; DOE 1996a:3-44; DOE 1996c:4-34).

3.2.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. Hanford has a well-documented record of cultural and paleontological resources. The *Hanford Cultural Resources Management Plan*, approved by the State Historic Preservation Officer (Battelle 1989), establishes guidance for the identification, evaluation, recordation, curation, and management of these resources. There are 645 cultural resource sites and isolated finds recorded. Forty-eight archaeological sites and one building are included on the National Register of Historic Places. Nominations have been prepared for several archaeological districts and sites considered to be eligible for listing on the National Register. While many significant cultural resources have been identified, only about 6 percent of Hanford has been surveyed, and few of the known sites have been evaluated for their eligibility for listing on the National Register. Cultural resource reviews are conducted whenever projects are proposed in previously unsurveyed areas. In recent years, reviews have exceeded 500 per year (DOE 1996b:4-68, 4-69).

Table 3–11. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in the Vicinity of 200 East Area and 400 Area

Common Name	Scientific Name	Federal Status	State Status
Birds			
Burrowing owl	*Athene cunicularia*	Species of Concern	Candidate Species
Ferruginous hawk	*Buteo regalis*	Species of Concern	Threatened
Golden eagle	*Aquila chrysaetos*	Not listed	Candidate Species
Loggerhead shrike	*Lanius ladovicianus*	Species of Concern	Candidate Species
Long-billed curlew	*Numenius americanus*	Not listed	Candidate Species
Sage sparrow	*Amphispiza belli*	Not listed	Candidate Species
Sage thrasher	*Oreoscoptes montanus*	Not listed	Candidate Species
Swainson's hawk	*Buteo swainsoni*	Not listed	Candidate Species
Mammals			
Pygmy rabbit	*Brachylagus idahoenis*	Species of Concern	Endangered
Plants			
Crouching milkvetch	*Astragalus succumbens*	Not listed	Monitor Group 3[a]
Piper's daisy	*Erigeron piperianus*	Not listed	Sensitive
Squill onion	*Allium scillioides*	Not listed	Monitor Group 3[a]
Stalked-pod milkvetch	*Astragalus sclerocarpus*	Not listed	Monitor Group 3[a]
Reptiles			
Desert night snake	*Hypsiglena torquata*	Not listed	Monitor Group
Striped whipsnake	*Masticophis taeniatus*	Not listed	Candidate Species

[a] Taxa that are more abundant or less threatened than previously assumed.
Source: Dirkes and Hanf 1997:F.1–F.3; DOE 1996c:4-34.

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

3.2.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.2.9.1.1 General Site Description

Currently, 283 prehistoric sites have been identified, 17 of which contain historic components. Of 48 sites included on the National Register, 2 are individual sites (Hanford Island Site and Paris Site), and the remainder are located in seven archaeological districts. In addition, four other archaeological districts have been nominated or are planned to be nominated for the National Register. A number of sites have been identified along the Middle Columbia River and in inland areas away from the river, but near other water sources. Some evidence of human occupation has been found in the arid lowlands. Sites include remains of numerous pithouse villages, various types of open campsites, graves along the riverbanks, spirit quest monuments (rock cairns), hunting camps, game drive complexes, quarries in mountains and rocky bluffs, hunting and kill sites in lowland stabilized dunes, and small temporary camps near perennial sources of water away from the river (DOE 1996b:4-69, 4-70).

More than 10,000 years of prehistoric human activity in the largely arid environment of the Middle Columbia River region have left extensive archaeological deposits. Archaeological surveys have been conducted at Hanford since 1926; however, little excavation has been conducted at any of the sites. Surveys have included studies of Gable Mountain, Gable Butte, Snively Canyon, Rattlesnake Mountain, Rattlesnake Springs, and a portion of the Basalt Waste Isolation Project Reference Repository location. Most of the surveys have focused on islands and on a 400-m (1,312-ft) wide area on either side of the river. From 1991 through 1995, the 100 Areas were surveyed, and new sites were identified. Excavations have been conducted at several sites on the riverbanks and islands and at two unnamed sites. Test excavations have been conducted at the Wahluke, Vernita Bridge, and Tsulim sites and at other sites in Benton County (DOE 1996a:3-48).

3.2.9.1.2 Proposed Facility Locations

An archaeological survey has been conducted for all undeveloped portions of the 200 East Area and half of the undeveloped portions of the 200 West Area. No prehistoric sites were identified. Because most of the 200 Areas are either developed or disturbed, it is unlikely that they contain intact archaeological deposits. Likewise, most of the 400 Area is disturbed and is unlikely to contain intact prehistoric or historic sites. A cultural resources survey found only 12 ha (30 acres) that were undisturbed, and no sites were identified either within the 400 Area or within 2 km (1.2 mi) of the 400 Area. The *Hanford Cultural Resources Management Plan* provides for survey work before construction and has contingency guidelines for handling the discovery of previously unknown archaeological resources encountered during construction (DOE 1996a:3-48).

3.2.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.2.9.2.1 General Site Description

There are 202 historic archaeological sites and other historic localities recorded at Hanford. Of these sites, 1 is included on the National Register as a historic site, and 56 are listed as archaeological sites. Sites and localities that predate the Hanford era include homesteads, ranches, trash scatters, dumps, gold mine tailings, roads, and townsites, including the Hanford townsite and the East White Bluffs townsite and ferry landing. More recent historic structures include the defense reactors and associated materials-processing facilities that played an important role in the Manhattan Project and the Cold War era (DOE 1996a:3-48, 3-49).

Lewis and Clark were the first European Americans to visit this region, during their 1804 to 1806 expedition. They were followed by fur trappers, military units, and miners. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach, and Chinese gold miners began to work the gravel bars. Cattle ranches opened in the 1880s, and farmers soon followed. Several small thriving towns, including Hanford, White Bluffs, and Ringold, grew up along the riverbanks in the early 20th century. Other ferries were established at Wahluke and Richmond. These towns and nearly all other structures were razed after the U.S. Government acquired the land for the original Hanford Engineer Works in the early 1940s (part of the Manhattan Project). Plutonium produced at the 100 B-Reactor was used in the first nuclear explosion at the White Sands Missile Range in New Mexico, and later in the bomb that destroyed Nagasaki, Japan, to help end World War II. The Hanford 100 B-Reactor is listed on the National Register and is designated a National Mechanical Engineering Landmark, a National Historic Civil Engineering Landmark, and a National Nuclear Engineering Landmark (DOE 1996a:3-48).

3.2.9.2.2 Proposed Facility Locations

Within the 200 Area, the only National Register–evaluated historic site is the old White Bluffs freight road that crosses diagonally through the 200 West Area. The road, which was originally a Native American trail, has been in continuous use as a transportation route since prehistoric times and has played a role in European-American immigration, regional development, agriculture, and the recent Hanford operations. The road has been determined eligible for inclusion on the National Register by the State Historic Preservation Officer, but the segment in the 200 West Area is considered a noncontributing element (i.e., lacking sufficient integrity to be a significant element of the road). A 100-m (328-ft) restricted zone protects the road from uncontrolled disturbance. Buildings in the 200 Area associated with the Manhattan Project and Cold War era have been evaluated for eligibility for nomination to the National Register and are under review by the State Historic Preservation Officer. No known historic resources have been identified in the 400 Area (DOE 1996b:3-49).

3.2.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts.

3.2.9.3.1 General Site Description

In prehistoric and early historic times, the Hanford Reach was heavily populated by Native Americans of various tribal affiliations. The Wanapum and the Chamnapum bands of the Yakima Tribe lived along the Columbia River at what is now Hanford. Some of their descendants still live nearby at Priest Rapids, northwest of Hanford. Palus People, who lived on the lower Snake River, joined the Wanapum and Chamnapum to fish the Hanford Reach, and some inhabited the east bank of the river. Walla Walla and Umatilla People also made periodic visits to fish in the area. These people retain traditional secular and religious ties to the region, and many have knowledge of the ceremonies and lifeways of their culture. The Washani, or Seven Drums religion, which has ancient roots and originated among the Wanapum, is still practiced by many people on the Yakima, Umatilla, Warm Springs, and Nez Perce Reservations. Native plant and animal foods, some of which can be found at Hanford, are used in the ceremonies performed by tribal members (DOE 1996b:4-71).

Consultation is required to identify the traditional cultural properties that are important in maintaining the cultural heritage of Native American tribes. Under separate treaties signed in 1855, the Confederated Tribes and Bands of the Yakima Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation ceded lands to the United States that include the present Hanford Site. Under the treaties, the tribes reserved the right to fish at usual and accustomed places in common with the citizens of the territory, and retained the privilege of hunting, gathering roots and berries, and pasturing horses and cattle upon open, unclaimed land. The Treaty of 1855 with the Nez Perce Tribe includes similar reservations of rights, and the Nez Perce have identified the Hanford Reach as the location of usual and accustomed places for fishing. The Wanapum People are not signatory to any treaty with the United States and are not a federally recognized tribe; however, they live about 8 km (5 mi) west of the Hanford boundary, they were historical residents of Hanford, and their interests in the area have been acknowledged (DOE 1996b:4-71, 4-72).

All these tribes are active participants in decisions regarding Hanford and have expressed concerns about hunting, fishing, pasture rights, and access to plant and animal communities and important sites. Sites sacred to Native Americans at Hanford include remains of prehistoric villages, burial grounds, ceremonial longhouses or lodges, rock art, fishing stations, and vision quest sites. Culturally important localities and geographic features include Rattlesnake Mountain, Gable Mountain, Gable Butte, Goose Egg Hill, Coyote Rapids, and the White Bluffs portion of the Columbia River (DOE 1996a:3-49).

Consultations (see Chapter 5 for discussion) would be initiated with appropriate American Indian Tribal Governments upon publication of this SPD EIS to determine any concerns associated with the actions evaluated in this SPD EIS.

3.2.9.3.2 Proposed Facility Locations

Neither the 200 East Area nor the 400 Area is known to contain any Native American resources.

3.2.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.2.9.4.1 General Site Description

Remains from the Pliocene and Pleistocene Ages have been identified at Hanford. The Upper Ringold Formation dates to the Late Pliocene Age and contains fish, reptile, amphibian, and mammal fossil remains. Late Pleistocene Touchet beds have yielded mammoth bones. These beds are composed of fluvial sediments deposited along ridge slopes that surround Hanford at distances greater than 5 km (3.1 mi) from the 200 and 400 Areas (DOE 1996a:3-49).

3.2.9.4.2 Proposed Facility Locations

No paleontological resources have been reported near the 200 and 400 Areas.

3.2.10 Land Use and Visual Resources

3.2.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

Hanford covers approximately 1,450 km^2 (560 mi^2) of the southeastern part of the State of Washington and extends over parts of Benton, Grant, and Franklin Counties. The site is owned entirely by the Federal Government and is administered and controlled by DOE (DOE 1996a:3-23).

3.2.10.1.1 General Site Description

The Tri-Cities area southeast of Hanford includes residential, commercial, and industrial land use. This area, encompassing the cities of Richland, Kennewick, and Pasco, is the population center closest to Hanford. Additional cities near the southern boundary of Hanford include Benton City, Prosser, and West Richland (DOE 1996b:4-81). Agriculture is a major land use in the remaining areas surrounding Hanford. In 1996, wheat was the largest crop in terms of area planted in Benton, Franklin, and Grant Counties. Alfalfa, apples, asparagus, cherries, corn, grapes, and potatoes are the other major crops in Benton, Franklin, and Grant Counties (DOE 1996b:4-106). Hanford is a Superfund site, listed on the National Priorities List. Public access to most facility areas is restricted.

DOE has designated the entire Hanford Site as a National Environmental Research Park, an outdoor laboratory for ecological research to study the environmental effects of energy development. The Hanford National Environmental Research Park is a shrub-steppe habitat that contains a wide range of semiarid land ecosystems and offers the opportunity to examine linkages between terrestrial, subsurface, and aquatic environments (DOE 1996a:3-23).

Land-use categories at Hanford include reactor operations, waste operations, administrative support, operations support, sensitive areas (including environmentally or culturally important areas), R&D and engineering development, and undeveloped areas. Generalized land uses at Hanford and vicinity are shown in Figure 3–9. Approximately 6 percent of Hanford has been disturbed and is occupied by operational facilities (DOE 1995a:4-1). Hanford contains a variety of widely dispersed facilities, including old reactors, R&D facilities, and various production and processing plants. The largest category of existing Hanford land use is the sensitive areas. Approximately 665 km^2 (257 mi^2), nearly half the site, have been designated as ecological study areas or refuges. Sensitive open-space areas include the Fitzner-Eberhardt Arid Lands Ecology Reserve near Rattlesnake Mountain, and two areas north of the Columbia River: the Saddle Mountain National Wildlife Refuge, administered by USFWS, and the Wahluke Slope Wildlife Recreation Area, managed by the Washington State Department of Fish and Wildlife (DOE 1996b:4-109). Other special status lands in the vicinity include McNary National Wildlife Refuge, administered by USFWS, and the Columbia River Islands Area of Critical Environmental Concern and McCoy Canyon, both administered by the Bureau of Land Management (BLM).

The Fitzner-Eberhardt Arid Lands Ecology Reserve, encompassing approximately 315 km^2 (122 mi^2) in the southwestern portion of Hanford, is managed as a habitat and wildlife reserve and environmental research center by the USFWS (DOE 1996b:4-109, Sandberg 1998a). The Rattlesnake Hills Research Natural Area of the Arid Lands Ecology Reserve remains the largest Research Natural Area in the State of Washington. Because public access to the Arid Lands Ecology Reserve has been restricted since 1943, the shrub-steppe habitat is virtually undisturbed. This geographic area contains a number of small, contaminated sites that were remediated in 1994 and 1995 and have been revegetated (DOE 1996b:4-109).

The Columbia River, which is adjacent to and runs through the Hanford Site, is used for public boating, water skiing, fishing, and hunting of upland game birds and migratory fowl. Public access is allowed on certain islands, while other areas are considered sensitive because of unique habitats and the presence of cultural resources (DOE 1996b:4-109). The area known as the Hanford Reach includes the quarter-mile strip of public land on either side of the last free-flowing, nontidal segment of the Columbia River. In 1988, Congress passed Public Law 100-605, known as the *Comprehensive Conservation Study of the Hanford Reach of the Columbia River*, which required the Secretary of the Interior to prepare a study in consultation with the Secretary of Energy to evaluate outstanding features of the Hanford Reach (DOE 1996b:4-109). The results of this study can be found in the *Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement* (NPS 1994). The study recommends that Congress designate an 80-km (50-mi) segment of the Columbia River extending downstream from below Priest Rapids Dam to near Johnson Island (river mile 346.5 to river mile 396) as a National Wildlife Refuge and Wild and Scenic River.

About 2,400 ha (5,930 acres) or 1.7 percent of the total acreage at Hanford is available for radioactive waste management facilities (DOE 1997b:4-20). Onsite programmatic and general purpose space totals approximately 799,000 m^2 (8.6 million ft^2). Fifty-one percent or approximately 408,000 m^2 (4.4 million ft^2) is general purpose space, including offices, laboratories, shops, warehouses, and other support facilities. The remaining 392,000 m^2 (4.2 million ft^2) of space is devoted to programmatic facilities, including processing, evaporation, filtration, waste recovery, waste treatment, waste storage facilities, and R&D laboratories (Mecca 1997a:120).

The 200 East Area is on the Central Plateau. This areas occupies about 11 km^2 (4.2 mi^2) and is dedicated to fuel reprocessing, waste-processing management, and disposal activities. Waste operations and operations support

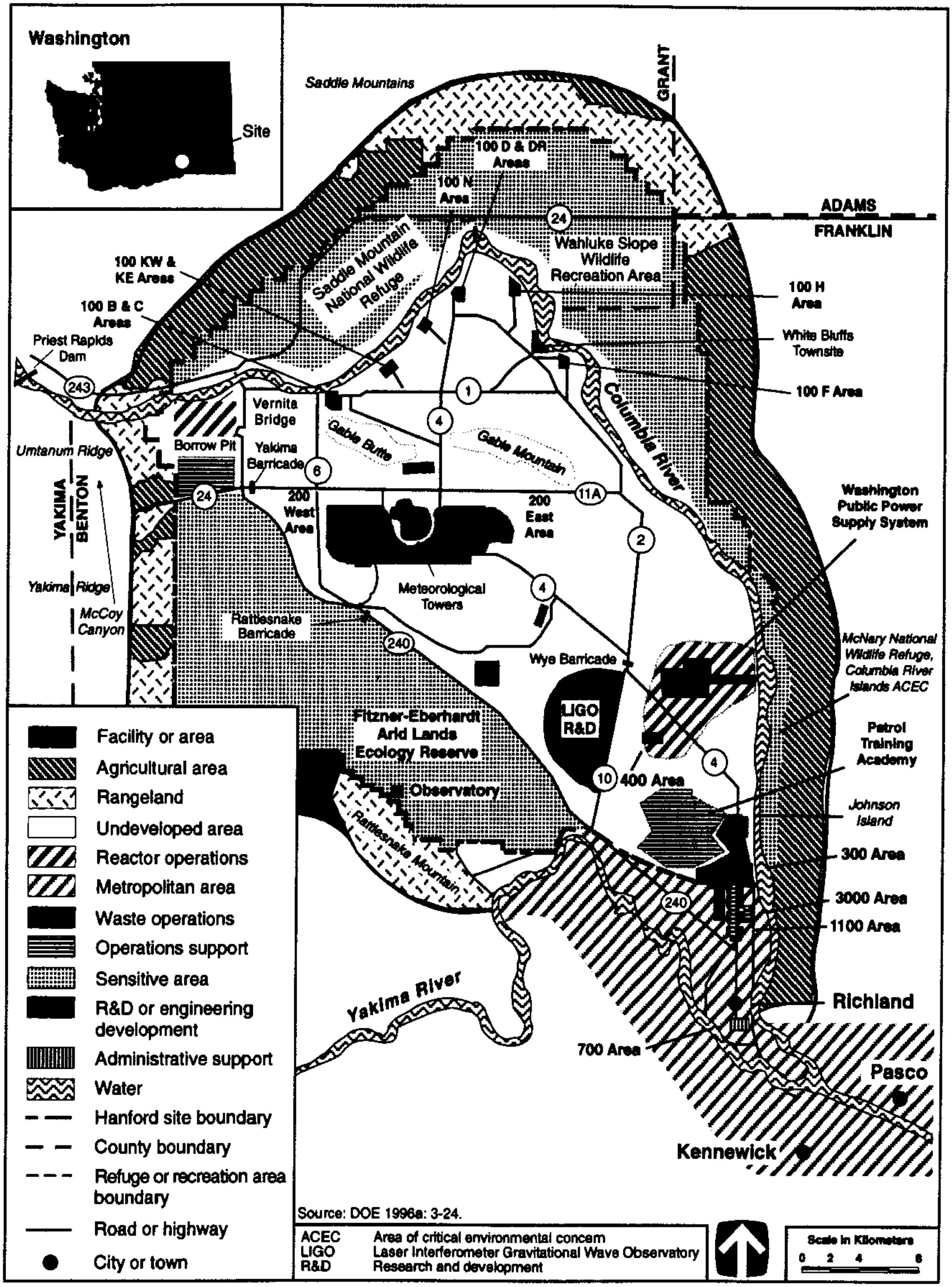


Figure 3–9. Generalized Land Use at Hanford and Vicinity

are the primary land uses. The Environmental Restoration Disposal Facility provides disposal capacity for environmental remediation waste generated during remediation of the Hanford Site (DOE 1996b:4-110).

The 400 Area occupies 0.6 km^2 (0.2 mi^2) and is about 8 km (5 mi) northwest of the 300 Area (DOE 1995b:4-2). It is the site of FFTF used in the testing of breeder reactor systems. Also in this area is FMEF, an unused building designed to fabricate fast breeder reactor fuel.

The *Hanford Site Development Plan* provides an overview of land use, infrastructure, and facility requirements to support the DOE missions at Hanford (DOE 1996b:4-109). Included in the plan is a Master Plan section that outlines the relationship of the land and the infrastructure required to support Hanford Site missions (DOE 1996b:4-109). The DOE Richland Operations Office has undertaken new comprehensive land-use planning to define how to best use the land at Hanford for the next 30 to 40 years (DOE 1996a:3-23). Its *Comprehensive Land-Use Plan* identifies existing and planned land uses, with accompanying restrictions; covers a specific timeframe; and will be updated as necessary.

Private lands bordering Hanford are subject to the planning regulations of Benton, Franklin, and Grant Counties and the city of Richland. Most of the land at Hanford is situated in Benton County. Benton County and the city of Richland have a comprehensive land-use planning process under way, with deadlines mandated under the State of Washington Growth Management Act of 1990 (DOE 1996a:3-23).

Under separate treaties signed in 1855, lands occupied by the present Hanford Site were ceded to the United States by the Confederated Tribes and Bands of the Yakima Indian Nation and by the Confederated Tribes of the Umatilla Indian Reservation (DOE 1996b:4-115). Under these treaties, the tribes retained the right to fish in their usual and accustomed places, and to hunt, gather roots and berries, and pasture horses and cattle on open, unclaimed lands. Tribal fishing rights have been recognized as effective within the Hanford Reach. DOE considers Hanford's past nuclear materials production mission and its current mission of waste management inconsistent with the continued exercise of these treaty-reserved privileges (DOE 1996b:4-115, 4-116).

3.2.10.1.2 Proposed Facility Locations

The 200 East Area is on a plateau about 11 km (6.8 mi) from the Columbia River. The 200 East and West Areas cover about 16 km^2 (6.2 mi^2) and have been dedicated for some time to fuel-reprocessing and waste management and disposal activities (DOE 1995b:4-2). Waste operations are confined primarily to the 200 Areas. The 200 East Area had previously been used to reprocess irradiated nuclear fuel and to store the resulting waste (DOE 1996c:4-50). The land is currently disturbed and is designated for waste operations. The distance from the 200 East Area to the nearest site boundary is approximately 10 km (6.2 mi).

The land in the 400 Area is currently disturbed and is designated for reactor operations. The distance from the 400 Area to the nearest site boundary is 7 km (4.3 mi).

3.2.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.2.10.2.1 General Site Description

Hanford is in the Pasco Basin of the Columbia Plateau north of the city of Richland, which is at the confluence of the Yakima and Columbia Rivers. The topography of land in the vicinity of Hanford ranges from generally flat to gently rolling. Rattlesnake Mountain, rising to 1,060 m (3,480 ft) above mean sea level, forms the southwestern boundary of the site (DOE 1995a:4-33). Gable Mountain and Gable Butte are the highest land forms within the site, rising approximately 60 m (200 ft) and 180 m (590 ft), respectively. The Columbia River flows through the northern part of the site and, turning south, forms part of the eastern site boundary. White Bluffs, steep whitish-brown bluffs adjacent to the Columbia River and above the northern boundary of the river in this region, are a striking feature of the landscape (Neitzel 1996:4.125).

Typical of the regional shrub-steppe desert, the site is dominated by widely spaced, low-brush grasslands. A large area of unvegetated, mobile sand dunes extends along the east boundary, and unvegetated blowouts are scattered throughout the site. Hanford is characterized by mostly undeveloped land, with widely spaced clusters of industrial buildings along the southern and western banks of the Columbia River and at several interior locations.

The adjacent visual landscape consists primarily of rural rangeland and farms; the city of Richland, part of the Tri-Cities area, is the only adjoining urban area. Viewpoints affected by DOE facilities are primarily associated with the public access roadways (including State Routes 24 and 240, Hanford Road, Horn Rapids Road, Route 4 South, and Steven Drive), the bluffs, and the northern edge of the city of Richland. The WPPSS nuclear reactors and DOE facilities are brightly lit at night and are highly visible from many areas. Developed areas are consistent with a Visual Resource Management (VRM) Class 5 designation, while the remainder of the Hanford Site ranges in VRM designation from Class 3 to Class 4.

Site facilities across Hanford can be seen from elevated locations (e.g., Gable Mountain), a few public roadways (State Routes 24 and 240), and the Columbia River. State Route 24 provides public access to the northern portion of the site. The height of structures ranges from about 3 to 30 m (10 to 100 ft), with a few stacks and towers that reach 60 m (200 ft). Viewsheds along this highway include limited views of the Columbia River where the road drops down into the river valley. A turnout on State Route 24 along the north side of the river offers views of the river and B- and C-Reactors. A rest stop along the road to the south of the river provides views of the Umtanum Ridge to the west, the Saddle Mountains to the north, and the Columbia River valley to the east and west (DOE 1996b:4-96). State Route 240 provides public access to the southwestern portion of the Hanford Site. Viewsheds along this highway include the flat, open lands of the Arid Lands Ecology Reserve in the foreground to the west, with the prominent peaks of Rattlesnake Mountain and the extended ridgelines of the Rattlesnake Hills in the background. From the highway, views are expansive due to the flat terrain, with Saddle Mountain in the distance to the north and steam plumes from the WPPSS reactor cooling towers often visible in the distance to the east. Views of DOE facilities from the surface of the Columbia River are generally blocked by high riverbanks; however, steam plumes from the WPPSS facility are visible.

3.2.10.2.2 Proposed Facility Locations

Facilities in the 200 East Area are in the interior of the Hanford Site and cannot be seen from the Columbia River or State Route 24. Views to the east from State Route 240 include fairly flat terrain, with the structures of the 200 East and 200 West Areas in the middle ground with Gable Butte and Gable Mountain visible in the background. Developed areas within the 200 East Area are consistent with a VRM Class 5 designation. Natural features of visual interest within a 40-km (25-mi) radius include the Columbia River at 10 km (6.2 mi), Gable Butte at 10 km (6.2 mi), Rattlesnake Mountain at 14 km (8.7 mi), and Gable Mountain at 5.3 km (3.3 mi).

FMEF, the tallest building in the 400 Area, is 30 m (100 ft) tall and can be seen from State Route 240. Developed areas within the 400 Area are consistent with a VRM Class 5 designation. Natural features of visual interest within a 40-km (25-mi) radius include the Columbia River at 6.8 km (4.2 mi), Gable Butte at 27 km (17 mi), Rattlesnake Mountain at 17 km (11 mi), and Gable Mountain at 19 km (12 mi) (Mecca 1997a:18).

3.2.11 Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various proposed alternatives.

3.2.11.1 General Site Description

Hanford has numerous research, processing, and administrative facilities. An extensive infrastructure system supports these facilities, as shown in Table 3–12.

Table 3–12. Hanford Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	420	420
Railroads (km)	204[a]	204[a]
Electricity		
Energy consumption (MWh/yr)	323,128	2,484,336
Peak load (MW)	60.7	283.6
Fuel		
Natural gas (m^3/yr)	459,200	20,804,000
Oil (l/yr)	9,334,800	14,775,000[b]
Coal (t/yr)	NA[c]	NA[c]
Water (l/yr)	2,754,000,000	8,263,000,000

[a] DOE is in the process of discontinuing rail service to most of Hanford (see Section 3.2.11.1.1).
[b] As supplies get low, more can be supplied by truck or rail.
[c] See Section 3.2.1.1.1.
Key: NA, not applicable.
Source: Teal 1997:4.

3.2.11.1.1 Transportation

Hanford has a network of paved roads, with 104 km (65 mi) of the 420 km (261 mi) of these roads accessible to the public. The site is crossed by State Route 240, which is the main route traveled by the public. Most onsite employees travel Route 4, the primary highway from the Tri-Cities area to most Hanford outer work locations. A recently constructed access road between State Route 240 and the 200 West Area has alleviated peak traffic congestion on Route 4. Access to the outer areas (100 and 200 Areas) is controlled by DOE at the Yakima, Wye, and Rattlesnake barricades (DOE 1996a:3-26; Mecca 1997a:126).

Onsite rail transport to Hanford is provided by a short-line railroad. Hanford's railroad is a Class III Railroad System, as defined by the Federal Railroad Administration. Its common carrier tie is with the Union Pacific Railroad in Richland (DOE 1996a:3-26; Mecca 1997a:126). The site railroad is in transition from DOE ownership to the Port of Benton with a planned date of October 1, 1998. At that time only the southern portion of the rail line that is connected to and serviced by Union Pacific would be transferred. It is expected that the Port of Benton will also have track rights as far north as the WPPSS reactors. By September 30, 1998, DOE rail operations will be discontinued. There are no current plans for service north of WPPSS (Sandberg 1998a).

3.2.11.1.2 Electricity

Most site electric power is purchased from the Bonneville Power Administration and routed through substations and switching stations in a manner that provides supply redundancy on the electrical transmission and distribution systems. Bonneville Power Administration electric power is provided to three distinct systems on the Hanford Site, the 100/200 Area System, the 300 Area System, and the 400 Area System (Mecca 1997a:137). Power for the 700, 1100, and 3000 Areas is provided by the city of Richland (DOE 1996b:4-93).

3.2.11.1.3 Fuel

Natural gas, provided by the Cascade Natural Gas Corporation, is used in a few locations at Hanford. Fuel oil and propane are also used in some areas. Oil capacity is only limited by the number of deliveries by truck (DOE 1996a:3-27).

3.2.11.1.4 Water

The Columbia River is the primary source of raw water for Hanford. Average annual river flow through the site is approximately 203 million l/min (54 million gal/min) (Mecca 1997a:126). The Export Water System supplies raw river water to the 100-B, 100-D, 200 East, 200 West, and 251-W potable water filtration and treatment systems. Daily pumping averages about 72 million l/day (19 million gal/day) (Rohl 1994:2-2). Wells supply water to the 400 Area and a variety of low-use facilities at remote locations (Mecca 1997a:126).

3.2.11.1.5 Site Safety Services

The Hanford fire department operates four fire stations within the Hanford Site. The stations are strategically located to ensure minimum response time to all facilities. The fire department also provides the site with ambulance, emergency medical technicians, and advanced first aid-certified firefighters (Mecca 1997a:154).

3.2.11.2 Proposed Facility Locations

A summary of the infrastructure characteristics of the 200 East Area and the 400 Area's FMEF is shown in Table 3–13.

Table 3–13. Hanford Infrastructure Characteristics for 200 East Area and FMEF

	200 East Area		FMEF	
Resource	Current Usage	Capacity	Current Usage	Capacity
Electricity				
Energy consumption (MWh/yr)	66,671	345,000	7,300	61,000
Peak load (MW)	16.6	40.0	4.1	26.6
Fuel				
Natural gas (m^3/yr)	NA	NA	NA	NA
Oil (l/yr)	7,294,220[a]	NA[b]	760	18,900[b]
Coal (t/yr)	NA	NA	NA	NA
Water (l/yr)	688,600,000	2,596,000,000	41,690,000	397,950,000

[a] See Sandberg 1998c.
[b] As supplies get low, more can be supplied by truck or rail.
Key: FMEF, Fuels and Materials Examination Facility; NA, not applicable.
Source: DOE 1996a; Teal 1997:4.

3.2.11.2.1 Electricity

Power to the 100/200 Area electrical system is provided from two sources, the Bonneville Power Administration Midway substation at the northwestern site boundary, and a transmission line from the Bonneville Power Administration Ashe substation. The 100/200 Area electrical system consists of about 80 km (50 mi) of 230-kV transmission lines, six primary substations, about 217 km (135 mi) of 13.8-kV distribution lines, and 124 secondary substations. The 100/200 Area transmission and distribution systems, as with the Bonneville Power Administration source lines, have redundant routings to ensure electrical service to individual areas and designated facilities within those areas (Mecca 1997a:137). The substation providing power to the 200 Area has a peak load capacity of 40 MW (Teal 1997:4).

Primary electric power to the 400 Area is provided by two 115-kV Bonneville Power Administration transmission lines, one from the Bonneville Power Administration Benton substation and the second from the Bonneville Power Administration White Bluffs substation. There is one 13.8-kV tie line from the 300 Area to the 400 Area emergency power system that also provides alternate power for maintenance outages. Redundancy in the distribution lines to designated facilities ensures continuity of service and rerouting of power for maintenance of system components. The approximate lengths of distribution lines in the 400 Area are as follows: 13.8-kV lines, 7.3 km (4.5 mi); 2.4-kV lines, 518 m (1,700 ft); and 480-V lines, 14.6 km (9.1 mi). There are two substations in the 400 Area: 451A, which serves FFTF reactor and associated buildings, and 451B, which serves FMEF and associated buildings (Mecca 1997a:168, 169). The peak load capacity for FMEF is 26.6 MW and the current usage is 4.1 MW (Teal 1997:4).

3.2.11.2.2 Fuel

Coal-fire steam generation facilities have been shut down at Hanford. The conversion to oil-fired sources was completed in 1998 (see Section 3.2.1.1.1). Fuel usage at 200 Area would be about 7,294,220 l/yr (1,926,935 gal/yr) (Sandberg 1998c). Fuel usage and capacity at FMEF are 760 l/yr (201 gal/yr) and 18,900 l/yr (4,993 gal/yr), respectively (Teal 1997:4).

3.2.11.2.3 Water

The 200 East Area is the major consumer of raw water delivered via the Export Water System. That water is received at the 11.4-million-l (3-million-gal) 282-E Reservoir at a capacity of 9,842 l/min (2,600 gal/min). Monthly average potable water flow in the 200 East Area ranges between 3,028 and 3,312 l/min (800 and 875 gal/min). Daily average flow can vary widely, depending primarily on area activity (Rohl 1994:2-5, 2-6).

The 400 Area receives water from three underground deep-water wells. Each of these wells has a pumping capacity of 833 l/min (220 gal/min). Water is pumped to three aboveground storage tanks that have a combined capacity of 3,028,320 l (800,000 gal). The observed flow ranges from 681 l/min (180 gal/min) during the summer months to 284 l/min (75 gal/min) during the winter months (Rohl 1994:2-7).

3.3 INEEL

INEEL is in southeastern Idaho and is 55 km (34 mi) west of Idaho Falls, 61 km (38 mi) northwest of Blackfoot, and 35 km (22 mi) east of Arco (see Figure 2–3). The site has about 445 km (277 mi) of roads, both paved and unpaved, and 48 km (30 mi) of railroad track (DOE 1996a:3-104).

There are 450 buildings and 2,000 support structures at INEEL with more than 279,000 m^2 (3 million ft^2) of floor space in varying conditions of utility. INEEL has approximately 25,100 m^2 (270,000 ft^2) of covered warehouse space and an additional 18,600 m^2 (200,000 ft^2) of fenced yard space. The total area of the various machine shops is 3,035 m^2 (32,665 ft^2) (DOE 1996a:3-104).

There have been 52 research and test reactors at INEEL used over the years to test reactor systems, fuel and target design, and overall safety. In addition to its nuclear reactor research, other INEEL facilities are operated to support reactor operations. These facilities include HLW and LLW processing and storage sites, hot cells, analytical laboratories, machine shops, laundry, railroad, and administrative facilities. Other activities include management of one of DOE's largest storage sites for LLW and TRU waste. Until 1992, spent reactor fuels were reprocessed at INTEC to recover enriched uranium and other isotopes. Due to a DOE decision to terminate spent fuel reprocessing, INTEC was transferred to the DOE Office of Environmental Management program for disposition. INTEC contains the new Waste Calcining Facility, which processes liquid HLW streams to a calcined solid (granular form). Beginning in the early part of the next century, a waste immobilization facility will convert the calcined solids into a glass or ceramic for disposal in a Federal repository. Additionally, miscellaneous spent fuel from both DOE and commercial sources is scheduled for interim storage at INTEC. Within the existing security perimeter, the Fuel Processing Facility (FPF) is a special nuclear material storage and processing facility that is 95 percent complete and has never been operated (DOE 1996a:3-104).

DOE activities at INEEL have been divided among eight distinct and geographically separate function areas as listed in Table 3–14.

DOE Activities. Environmental management activities include R&D for waste processing at the Power Burst Facility and providing waste management expertise to the Radioactive Waste Management Complex. The Power Burst Facility performs R&D for waste reduction programs and the Boron Neutron Capture Therapy Program. Waste management efforts at INEEL are directed toward safe and environmentally sound treatment, storage, and disposal of radioactive, hazardous, and sanitary waste. Major waste reduction facilities include the Waste Engineering Development Facility, the Waste Experimental Reduction Facility, and the Mixed Waste Storage Facility (DOE 1996a:3-104).

The following additional DOE activities are at INEEL:

- The Test Area North complex consists of several experimental reactors and support facilities conducting R&D activities on reactor performance. These facilities include the technical support facility, the containment test facility, the water reactor research test facility, and the inertial engine test facility. The inertial engine test facility has been abandoned, and no future activities are planned. The remaining facilities support ongoing programs.

- Materials testing and environmental monitoring activities were conducted in the Auxiliary Reactor Area. The facilities in this area are scheduled for decontamination and decommissioning (D&D).

Table 3–14. Current Missions at INEEL

Mission	Description	Sponsor
Argonne National Laboratory–West	Conduct research and develop technology to deal with nuclear issues such as stabilization of spent nuclear fuel; development and qualification of high-level nuclear waste forms; characterization, treating and stabilization of mixed waste to allow disposal; nuclear facility decommissioning; and similar activities.	Office of Nuclear Energy; Assistant Secretary for Environmental Management
Radioactive Waste Management Complex	Provide waste management functions for present and future site and DOE needs.	Assistant Secretary for Environmental Management
Power Burst Area	Perform waste processing, technology research, and development; provide interim storage for hazardous wastes.	Assistant Secretary for Environmental Management
Test Area North	Perform research on spent nuclear fuel casks, and spent nuclear fuel handling systems. Perform disassembly and decommissioning of large radioactive equipment. House a project to manufacture armor packages for Army tanks.	Office of Nuclear Energy
Test Reactor Area	Perform irradiation service, develop nuclear instruments, and conduct safety programs; develop methods to meet radioactive release limits.	Office of Nuclear Energy; Office of Naval Reactors
Idaho Nuclear Technology and Engineering Center	Provide spent fuel storage and high-level waste processing.	Assistant Secretary for Environmental Management
Naval Reactors Facility	Standby facility for conducting ship propulsion reactor research and training.	Office of Naval Reactors
Central Facilities Area	Provide centralized support services for the site.	Idaho Operations Office

Source: DOE 1996a:3-105.

- The ANL–W facility area consists of several major complexes, including the Experimental Breeder Reactor II, Transient Reactor Test Facility, Zero Power Physics Reactor, Hot Fuel Examination Facility, Fuel Cycle Facility, and Fuel Manufacturing Facility. The Experimental Breeder Reactor II was used to demonstrate the integral fast reactor concept. The Transient Reactor Test Facility and the Zero Power Physics Reactor are used to conduct reactor analysis and safety experiments. The Hot Fuel Examination Facility provides inert-atmosphere containment for handling and examining irradiated reactor fuel. The Fuel Cycle Facility has been modified for the integral fast reactor program to demonstrate remote reprocessing and refabrication. The Fuel Manufacturing Facility is used to manufacture metallic fuel elements and store plutonium material.

- The Test Reactor Area contains the Advanced Test Reactor. This reactor is used for irradiation testing of reactor fuels and material properties; instrumentation for naval reactors; and production of radioisotopes in support of nuclear medicine, industrial applications, research, and product sterilization.

- The Naval Reactors Facility is operated under jurisdiction of DOE's Pittsburgh Naval Reactors Office. Included at this facility are the submarine prototypes and the expended core facility. Activities include testing of advanced design equipment and new systems for current naval nuclear propulsion plants and obtaining data for future designs.

- The Central Facilities Area provides sitewide support services, including transportation, shop services, health services, radiation monitoring, and administrative offices.

Non-DOE Activities. Non-DOE activities at INEEL include research being conducted by the National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey, and various institutions of higher learning. These activities support the designation of INEEL as a National Environmental Research Park (DOE 1996a:3-106).

3.3.1 Air Quality and Noise

3.3.1.1 Air Quality

Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

3.3.1.1.1 General Site Description

The climate at INEEL and the surrounding region is characterized as that of a semiarid steppe. The average annual temperature at INEEL is 5.6 °C (42 °F); average monthly temperatures range from a minimum of -8.8 °C (16.1 °F) in January to a maximum of 20 °C (68 °F) in July. The average annual precipitation at INEEL is 22 cm (8.7 in) (Clawson, Start, and Ricks 1989:55, 77). Prevailing winds at INEEL are southwest to west-northwest with a secondary maximum frequency from the north-northeast to northeast. The average annual windspeed is 3.4 m/s (7.5 mph) (DOE 1996a:3-112). Additional information related to meteorology and climatology at INEEL is presented in Appendix F of the *Storage and Disposition Final PEIS* (DOE 1996a:F-8–F-11).

INEEL is within the Eastern Idaho Intrastate AQCR #61. None of the areas within INEEL and its surrounding counties are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1997e). The nearest nonattainment area for particulate matter is in Pocatello, about 80 km (50 mi) to the south. Applicable NAAQS and Idaho State ambient air quality standards are presented in Table 3–15.

The nearest PSD Class I area to INEEL is Craters of the Moon National Monument, Idaho, about 53 km (33 mi) west-southwest from the center of the site. There are no other Class I areas within 100 km (62 mi) of INEEL. PSD permits have been obtained for the coal-fired steam-generating facility next to INTEC and FPF, which is not expected to be operated (DOE 1996a:3-112).

The primary sources of air pollutants at INEEL include calcination of high-level radioactive liquid waste, combustion of coal for steam, and combustion of fuel oil for heating. Other emission sources include waste burning, coal piles, industrial processes, vehicles, and fugitive dust from burial and construction activities. Table 3–15 presents the existing ambient air concentrations attributable to sources at INEEL, which are based on maximum emissions for the year 1990. These emissions were modeled using meteorological data from 1992 (DOE 1996a:3-112–3-114). Actual annual emissions from sources at INEEL are less than these levels, and the estimated concentrations bound the actual INEEL contribution to ambient levels. Only those pollutants that would be emitted for any of the surplus plutonium disposition alternatives are presented. Concentrations shown in Table 3–15 attributable to INEEL are in compliance with applicable guidelines and regulations.

Measured air pollutant concentrations at INEEL air-monitoring locations during 1995 indicates an annual average nitrogen dioxide concentration of 3.8 $\mu g/m^3$; sulfur dioxide concentrations of 15 $\mu g/m^3$ for

Table 3–15. Comparison of Ambient Air Concentrations From INEEL Sources With Most Stringent Applicable Standards or Guidelines, 1990

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	Concentration ($\mu g/m^3$)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	284
	1 hour	40,000[b]	614
Nitrogen dioxide	Annual	100[b]	4
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50[b]	3
	24 hours	150[b]	33
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	80[b]	6
	24 hours	365[b]	135
	3 hours	1,300[b]	579
Hazardous and other toxic compounds			
Benzene	Annual	0.12[f]	0.029
Ethylene glycol	24 hours	6,350[f]	(g)

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period. The NAAQS (EPA 1997b), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is ≤ 1. The 1-hr ozone standard applies only to nonattainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 $\mu g/m^3$. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standard is ≤ 1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] Federal and State standard.
[c] Federal standard.
[d] Not directly emitted or monitored by the site.
[e] No data is available with which to assess $PM_{2.5}$ concentrations.
[f] Acceptable ambient concentration listed in *Rules for the Control of Air Pollution in Idaho.* The concentration applies only to new (not existing) sources and is used here as a reference level.
[g] No concentration reported.

Key: NAAQS, National Ambient Air Quality Standards.

Note: The NAAQS also include standards for lead. No sources of lead emissions have been identified for any of the alternatives presented in Chapter 4. Emissions of other air pollutants not listed here have been identified at INEEL, but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the *Storage and Disposition Final PEIS* (DOE 1996a). EPA recently revised the ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 $\mu g/m^3$ (0.12 ppm) to an 8-hr concentration of 157 $\mu g/m^3$ (0.08 ppm). During a transition period while States are developing State implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in nonattainment areas (EPA 1997c:38855). For particulate matter, the current PM_{10} annual standard is retained, and two $PM_{2.5}$ standards are added. These standards are set at a 15-$\mu g/m^3$ 3-year annual arithmetic mean based on community-oriented monitors and a 65-$\mu g/m^3$ 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr PM_{10} standard is based on the 99th percentile of 24-hr concentrations. The existing PM_{10} standards will continue to apply in the interim period (EPA 1997d:38652).

Source: Abbott, Crockett, and Moor 1997:7; EPA 1997b; ID DHW 1995.

3-hr averaging, 10 $\mu g/m^3$ for 24-hr averaging, and 2.1 $\mu g/m^3$ for the annual average; and an annual average total suspended particulate concentration of 15 $\mu g/m^3$ (Abbott, Crockett, and Moor 1997:7). Measured concentrations attributable to INEEL are in compliance with applicable guidelines and regulations. Additional information on ambient air quality at INEEL and detailed information on emissions of other pollutants at INEEL are provided in the *INEEL Site Environmental Report for 1995* (Mitchell, Peterson, and Hoff 1996:6-4–6-6).

3.3.1.1.2 Proposed Facility Location

The meteorological conditions for INEEL are considered to be representative of the INTEC area. Primary sources of pollutants at INTEC include the New Waste Calcining Facility and coal-fired steam-generating facilities (Mitchell, Peterson, and Hoff 1996:6-4, 6-5). These facilities are sources of carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM_{10}. The Waste Calcining Facility is a large source of nitrogen dioxide at INEEL.

3.3.1.2 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.3.1.2.1 General Site Description

Major noise emission sources within INEEL include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most INEEL industrial facilities are far enough from the site boundary that noise levels at the boundary would not be measurable or would be barely distinguishable from background levels (DOE 1996a:3-112).

Existing INEEL-related noises of public significance are from the transportation of people and materials to and from the site and in-town facilities via buses, trucks, private vehicles, helicopters, and freight trains. Noise measurements along U.S. Route 20 about 15 m (50 ft) from the roadway indicate that the sound levels from traffic range from 64 to 86 dBA and that the primary source is buses (71 to 80 dBA) (Abbott, Brooks, and Martin 1991:64). While few people reside within 15 m (50 ft) of the roadway, the results indicate that INEEL traffic noise might be objectionable to members of the public residing near principal highways or busy bus routes. Noise levels along these routes may have decreased somewhat due to reductions in employment and bus service at INEEL in the last few years. The acoustic environment along the INEEL site boundary in rural areas and at nearby areas away from traffic noise is typical of a rural location: the average day-night average sound level is in the range of 35 to 50 dBA (EPA 1974:B-4). Except for the prohibition of nuisance noise, neither the State of Idaho nor local governments have established any regulations that specify acceptable community noise levels applicable to INEEL (DOE 1996a:F-32).

The EPA guidelines for environmental noise protection recommend an average day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (DOT 1995). It is expected that for most residences near INEEL, the day-night average sound levels are compatible with the residential land use, although for some residences along major roadways noise levels may be higher than 65 dBA.

Next Section

Citation Previous Section

3.3.1.2.2 Proposed Facility Location

No distinguishing noise characteristics have been identified at the INTEC area. INTEC is far enough—about 12 km (7.5 mi)—from the site boundary that noise levels from the facilities are not measurable or are barely distinguishable from background levels.

3.3.2 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders.

3.3.2.1 Waste Inventories and Activities

INEEL manages the following types of waste: HLW, TRU, mixed TRU, LLW, mixed LLW, hazardous, and nonhazardous. HLW would not be generated by surplus plutonium disposition activities at INEEL, and therefore, will not be discussed further. Waste generation rates and the inventory of stored waste from activities at INEEL are provided in Table 3–16. Table 3–17 summarizes the INEEL waste management capabilities. More detailed descriptions of the waste management system capabilities at INEEL are included in the *Storage and Disposition Final PEIS* (DOE 1996a:3-141–145, E-33–E-48) and the *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995b:2.2-30).

Table 3–16. Waste Generation Rates and Inventories at INEEL

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact handled	0	39,300
Remotely handled	0	200
LLW	2,624	18,634
Mixed LLW		
RCRA	180	25,734
TSCA	<1	2
Hazardous	835[b]	NA[c]
Nonhazardous		
Liquid	2,000,000[d]	NA[c]
Solid	62,000	NA[c]

[a] Includes mixed TRU waste.
[b] Includes 760 m^3 that is recyclable.
[c] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
[d] Projected annual average generation for 1997–2006.
Key: LLW, low-level waste; NA, not applicable; RCRA, Resource Conservation and Recovery Act; TRU, transuranic; TSCA, Toxic Substances Control Act.
Source: DOE 1996d:15, 16, except hazardous and nonhazardous solid waste (DOE 1996a:3-142, 3-143) and nonhazardous liquid waste (Werner 1997).

EPA placed INEEL on the National Priorities List on December 21, 1989. In accordance with CERCLA, DOE entered into a consent order with EPA and the State of Idaho to coordinate cleanup activities at INEEL under one comprehensive strategy. This agreement integrates DOE's CERCLA response obligations with RCRA corrective action obligations. Aggressive plans are in place to achieve early remediation of sites that

Table 3–17. Waste Management Capabilities at INEEL

Facility Name/Description	Capacity	Status	TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment Facility (m^3/yr except as otherwise specified)								
INTEC HEPA Filter Leach, m^3/day	0.21	Online	X	X	X	X		
INTEC Debris Treatment and Containment, m^3/day	88	Online	X	X	X	X		
Advanced Mixed Waste Treatment Project	6,500	Planned for 2003		X		X		
INTEC NWCF	1,500	Online	X	X	X	X		
ANL–W Remote Treatment Facility	42	Planned for 2000	X	X	X	X		
ANL–W HFEF Waste Characterization Area	37	Online	X	X				
INTEC Waste Immobilization Facility	400	Planned for 2008	X	X	X	X		
INTEC Liquid Effluent Treatment and Disposal Facility	16,600	Online				X		
INTEC HLW Evaporator	1,050	Online	X	X	X	X		
INTEC Process Equipment Waste Evaporator	16,600	Online	X	X	X	X		
ANL–W Sodium Processing Facility	698	Online				X		
Test Area North Cask Dismantlement	11	Online				X		
WROC - Debris Sizing, kg/hr	1,149	Planned for 2000			X	X		
WROC - Macroencapsulation, kg/hr	2,257	Planned for 1999				X		
WROC - Stabilization, m^3/day	7.6	Online				X		
WERF	49,610	Online			X	X	X	
INTEC Cold Waste Handling Facility	3,700	Online						X
INTEC Sewage Treatment Plant	3,200,000	Online						X
Storage Facility (m^3)								
ANL–W Radioactive Sodium Storage	75	Online		X		X		
ANL–W Sodium Components Maintenance Shop	200	Online				X		
ANL–W Radioactive Scrap and Waste Storage	193	Online	X	X	X	X		
ANL–W EBR II Sodium Boiler Drain Tank	64	Online				X		
ANL–W HFEF Waste Characterization Area	37	Online	X	X				
INTEC FDP HEPA Storage	25	Online		X		X		
INTEC NWCF HEPA Storage	1	Online		X		X		

Table 3–17. Waste Management Capabilities at INEEL (Continued)

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
INTEC CPP-1619 Storage	45	Online				X	X	
INTEC CPP-1617 Staging	510	Online				X	X	
INTEC NWCF HEPA Filter Storage	141	Online		X		X		
RWMC TRU Storage Area-1, 2, and R	64,900	Online		X				
RWMC Waste Storage	112,400	Online		X	X	X		
RWMC Intermediate-Level Storage	100	Online		X	X	X		
RE Retrieval Modification Facility	93,400	Online		X				
WROC PBF Mixed LLW Storage	129	Online				X	X	
Portable Storage at SPERT IV	237	Online				X	X	
PBF WERF Waste Storage Building	685	Online				X	X	
Test Area North 647 Waste Storage	104	Online				X		
Test Area North 628 SMC Container Storage	125	Online				X		
Disposal Facility(m^3/yr)								
RWMC Disposal Facility	37,700	Online			X			
CFA Landfill Complex	48,000	Online						X
Percolation Ponds	2,000,000	Online						X

Key: ANL–W, Argonne National Laboratory–West; CFA, Central Facilities Area; CPP, Chemical Processing Plant; EBR, Experimental Breeder Reactor; FDP, Fluorinel Dissolution Process; Haz, hazardous; HEPA, high-efficiency particulate air; HFEF, Hot Fuel Examination Facility; HLW, high-level waste; INTEC, Idaho Nuclear Technology and Engineering Center; LLW, low-level waste; NWCF, New Waste Calcining Facility; PBF, Power Burst Facility; RWMC, Radioactive Waste Management Complex; SMC, Specific Manufacturing Complex; SPERT, Special Power Excursion Reactor Test; TRU, transuranic; WERF, Waste Experimental Reduction Facility; WROC, Waste Reduction Operations Complex.
Source: Abbott 1998; Abbott, Crockett, and Moor 1997:20; Moor 1998; Werner 1997.

represent the greatest risk to workers and the public. The goal is to complete remediation of contaminated sites at INEEL to support delisting from the National Priorities List by 2019 (DOE 1996a:3-141). More information on regulatory requirements for waste disposal is provided in Chapter 5.

3.3.2.2 Transuranic and Mixed Transuranic Waste

TRU waste generated since 1972 is segregated into contact-handled and remotely handled categories and stored at the Radioactive Waste Management Complex in a form designed for eventual retrieval (DOE 1996a:3-144). Some TRU waste is also stored at the Radioactive Scrap and Waste Facility at ANL–W (DOE 1995b:2.2-36). There is very little TRU waste generated at INEEL. Most of the TRU waste in storage was received from the Rocky Flats Environmental Technology Site (DOE 1996a:3-144). TRU waste is currently being stored pending shipment to WIPP beginning in 1998 (DOE, 1997b:17). TRU waste will be treated to meet WIPP waste acceptance criteria, packaged in accordance with DOE and DOT requirements, and transported to WIPP for disposal (DOE 1996a:3-144).

The existing treatment facilities for TRU waste at INEEL are limited to testing, characterization, and repackaging. The planned Waste Characterization Facility will characterize TRU waste and either reclassify it (if it is found to be LLW) for disposal on the site, or prepare it so that it meets WIPP waste acceptance criteria (DOE 1996a:E-35).

The Advanced Mixed Waste Treatment Project will be a private sector treatment facility. This facility shall (1) treat waste to meet WIPP waste acceptance criteria, RCRA Land Disposal Restrictions (LDR), and required Toxic Substances Control Act standards; (2) reduce waste volume and life-cycle cost to DOE; and (3) perform tasks in a safe and environmentally compliant manner (Mitchell, Peterson, and Hoff 1996:3-16). Construction of a mixed LLW Disposal Facility and Plasma Hearth Treatment Facility are being considered to support commercial treatment of mixed TRU waste and alpha-contaminated mixed LLW subject to funding restraints and additional NEPA review (DOE 1996a:E-35).

Waste containing between 10 and 100 nCi/g of transuranic radionuclides is called alpha LLW. Although this waste is technically considered LLW rather than TRU waste, it cannot be disposed of at INEEL because it does not meet all INEEL LLW disposal facility acceptance criteria. Alpha LLW and alpha mixed LLW are managed together as part of the TRU waste program. It is expected that these wastes will be treated by the Advanced Mixed Waste Treatment Project and then disposed of at WIPP (DOE 1995b:2.2-34, 2.2-35).

3.3.2.3 Low-Level Waste

Liquid LLW is either evaporated and processed to calcine or solidified before disposal (DOE 1996a:E-35). INTEC has the capability to treat aqueous LLW. Liquid LLW is concentrated at the INTEC process equipment waste evaporator, with the condensed vapor processed by the Liquid Effluent Treatment and Disposal Facility. The concentrated materials remaining after evaporation are pumped to the INTEC tank farm (DOE 1995b:2.2-39). Some small volumes of liquid LLW are solidified at the Waste Experimental Reduction Facility for disposal at the Radioactive Waste Management Complex. In addition, small volumes of aqueous LLW are discharged to the double-lined pond at the Test Reactor Area for evaporation (DOE 1995b:2.2-39).

Most solid LLW at INEEL is sent to the Waste Experimental Reduction Facility for treatment by incineration, compaction, size reduction, or stabilization before shipment for disposal at the Radioactive Waste Management Complex or offsite disposal facilities (Werner 1997). Disposal occurs in pits and concrete-lined soil vaults in the subsurface disposal area of the Radioactive Waste Management Complex (DOE 1995b:2.2-39). About 40 percent of the LLW generated at INEEL (that contain less than 10 nCi/g of radioactivity) is buried in shallow trenches; the remaining 60 percent at the Radioactive Waste Management Complex following treatment for volume reduction. Additionally, some LLW is shipped off the site to be incinerated, and the residual ash is returned to INEEL for disposal. The Radioactive Waste Management Complex is expected to be filled to capacity by the year 2030 (Mitchell, Peterson, and Hoff 1996:3-26), although some proposals would close the LLW Disposal Facility by 2006 (DOE 1998b:B-4).

3.3.2.4 Mixed Low-Level Waste

Mixed LLW is divided into two categories for management purposes: alpha mixed LLW and beta-gamma mixed LLW. Most of the alpha mixed LLW stored at INEEL is waste that has been reclassified from mixed TRU waste and is managed as part of the TRU waste program. Therefore, this section deals only with beta-gamma mixed LLW (DOE 1995b:2.2-39, 2.2-40).

Mixed LLW, including polychlorinated biphenyls–contaminated LLW, is stored in several onsite areas awaiting the development of treatment methods (DOE 1996a:3-144). Mixed LLW is stored at the Mixed Waste Storage Facility (or Waste Experimental Reduction Facility Waste Storage Building) and portable storage units at the Power Burst Facility area. In addition, smaller quantities of mixed LLW are stored in various facilities at INEEL including the Hazardous Chemical/Radioactive Waste Facility at INTEC, and the Radioactive Sodium Storage Facility and Radioactive Scrap and Waste Storage Facility at ANL–W (DOE 1995b:2.2-41). Although mixed wastes are stored in many locations at INEEL, the bulk of that volume is solid waste stored at the Radioactive Waste Management Complex (DOE 1996a:E-39).

Aqueous mixed LLW is concentrated at INTEC. The condensate from the waste evaporator is then processed by the Liquid Effluent Treatment and Disposal Facility. The concentrated material remaining after evaporation (mixed LLW) is pumped to the INTEC tank farm for storage (DOE 1995a:2.2-42, 2.2-43).

As part of the site treatment plans required by the FFCA, preferred treatment options have been identified to eliminate the hazardous waste component for many types of mixed LLW (DOE 1995b:2.2-42). Mixed LLW is or will be processed to RCRA LDR treatment standards through several treatment facilities. Those treatment facilities and operational status are: (1) Waste Experimental Reduction Facility Incinerator (operational), (2) Waste Experimental Reduction Facility Stabilization (operational), (3) Test Area North cask dismantlement (operational), (4) Sodium Process Facility (operational), (5) High-Efficiency Particulate Air (HEPA) Filter Leach (operational), (6) Waste Reductions Operations Complex Macroencapsulation (March 1999), (7) Waste Reduction Operations Complex Mercury Retort (March 2000), (8) Debris Treatment (September 2000), and (9) Advanced Mixed Waste Treatment Project (March 2003). Commercial treatment facilities are also being considered, as appropriate (Werner 1997). Currently, limited amounts of mixed LLW are disposed of at Envirocare of Utah (Werner 1997).

3.3.2.5 Hazardous Waste

About 1 percent of the total waste generated at INEEL is hazardous waste. Most of the hazardous waste generated annually at INEEL is transported off the site for treatment and disposal (DOE 1995b:2.2-45). Offsite shipments are surveyed to determine that the wastes have no radioactive content (are not mixed waste) (DOE 1996a:3-145).

Highly reactive or unstable materials, such as waste explosives, are addressed on a case-by-case basis and are either stored, burned, or detonated at the Reactive Storage and Treatment Area near the Auxiliary Reactor Area (DOE 1995b:2.2-46). The Waste Handling Facility Project at ANL–W will be implemented to handle ANL–W hazardous waste (DOE 1996a:3-145).

3.3.2.6 Nonhazardous Waste

More than 94 percent of the waste generated at INEEL is classified as industrial waste and is disposed of on the site in a landfill complex in the Central Facilities Area and at the Bonneville County landfill (DOE 1995b:2.2-47). The onsite landfill complex contains separate areas for petroleum-contaminated media, industrial waste, and asbestos waste (Werner 1997). The onsite landfill is 4.8 ha (12 acres) and is being expanded by 91 ha (225 acres) to provide capacity for at least 30 years (DOE 1996a:3-145).

The Cold Waste Handling Facility was recently put into operation at INTEC. This system allows increased volumes of nonhazardous waste to be inspected, recycled, shredded, compacted, and segregated, thereby reducing the amount of material sent to disposal (Mitchell, Peterson, and Hoff 1996:3-24). Combustible waste is taken to the solid waste handling facility for sorting and cubing. The cubed material is taken to a steam-generating facility and converted from waste to energy (Werner 1997).

Sewage is disposed of in surface impoundments in accordance with terms of the October 7, 1992, consent order. Waste in the impoundments is allowed to evaporate; the resulting sludge is placed in the landfill. Solids are separated and reclaimed where possible (DOE 1996a:3-145). Nonhazardous service wastewater generated at INTEC is disposed to percolation ponds at a flow rate of 3.8 million to 7.6 million l/day (1 million to 2 million gal/day) (Werner 1997). The INTEC sanitary sewer system collects and transfers sanitary waste to the sewage treatment lagoons east of INTEC for treatment and disposal. This system has a capacity of 3,200,000 m^3/yr (4,190,000 yd^3/yr) (Abbott, Crockett, and Moor 1997:20).

3.3.2.7 Waste Minimization

The DOE Idaho Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at INEEL. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The DOE Idaho Operations Office published its first waste minimization plan in 1990, which defined specific goals, methodology, responsibility, and achievements of programs and organizations. The achievements and progress have been updated at least annually (DOE 1996a:E-33).

The INEEL waste minimization program has significantly reduced the quantities of hazardous waste generated at INEEL. For example, in 1992, 760 m^3 (994 yd^3) of hazardous waste was recycled. Recyclable hazardous materials include metals (such as bulk lead, mercury, chromium), solvents, fuel, and other waste materials (DOE 1995b:2.2-45). Soon the use of nonhazardous chemicals and the recycling of those for which there is no substitute should nearly eliminate the generation of hazardous waste (DOE 1996a:E-39).

Another goal of the INEEL waste minimization program is to reduce nonhazardous waste generation by 50 percent over the next 5 years (DOE 1996a:3-145). During 1993–1995, INEEL recycled more than 680,400 kg (1.5 million lb) of paper and cardboard (Mitchell, Peterson, and Hoff 1996:3-26). Efforts are also under way to expand the recycling program to include asphalt and metals and to convert scrap wood into mulch (DOE 1995b:2.2-48).

3.3.2.8 Preferred Alternatives From the WM PEIS

Preferred alternatives from the WM PEIS (DOE 1997a:summary, 97) are shown in Table 3–18 for the four waste types analyzed in this SPD EIS. A decision on the future management of these wastes could result in the construction of new waste management facilities at INEEL and the closure of other facilities. Decisions on the various waste types are expected to be announced in a series of RODs to be issued on this WM PEIS. In fact, the TRU waste ROD was issued on January 20, 1998 (DOE 1998a). The ROD states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ." More detailed information and DOE's alternatives for the future configuration of waste management facilities at INEEL is presented in the WM PEIS and the TRU waste ROD.

3.3.3 Socioeconomics

Statistics for employment and regional economy are presented for the REA as defined in Appendix F.9 which encompasses 13 counties around INEEL located in Idaho and Wyoming. Statistics for population, housing, community services, and local transportation are presented for the ROI, a four-county area (in Idaho) in which 94.4 percent of all INEEL employees reside as shown in Table 3–19. In 1997, INEEL employed 8,291 persons (about 5.5 percent of the REA civilian labor force) (Werner 1997).

Table 3–18. Preferred Alternatives From the WM PEIS

Waste Type	Preferred Action
TRU and mixed TRU	DOE prefers the regionalized alternative for treatment and storage of INEEL's TRU waste. Under this alternative, some TRU waste could be received from RFETS for treatment.[a]
LLW	DOE prefers to treat INEEL's LLW on the site. INEEL could be selected as one of the regional disposal sites for LLW.
Mixed LLW	DOE prefers regionalized treatment at INEEL. This includes the onsite treatment of INEEL's wastes and could include treatment of some mixed LLW generated at other sites. INEEL could be selected as one of the regional disposal sites for mixed LLW.
Hazardous	DOE prefers to continue to use commercial facilities for hazardous waste treatment.

[a] ROD for TRU waste (DOE 1998a) states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ."
Key: LLW, low-level waste; RFETS, Rocky Flats Environmental Technology Site; TRU, transuranic.
Source: DOE 1997a:summary, 97.

Table 3–19. Distribution of Employees by Place of Residence in the INEEL Region of Influence, 1997

County	Number of Employees	Total Site Employment (Percent)
Bonneville	5,553	67
Bingham	1,077	13
Bannock	615	7.4
Jefferson	583	7
ROI total	7,828	94.4

Source: Werner 1997.

3.3.3.1 Regional Economic Characteristics

Selected employment and regional economy statistics for the INEEL REA, Idaho, and Wyoming are summarized in Figure 3–10. Between 1990 and 1996, the civilian labor force in the REA increased 26 percent to the 1996 level of 150,835. In 1996, the annual unemployment average in the REA was 4.8 percent, which was slightly less than the annual unemployment average for Idaho (5.2 percent) and Wyoming (5 percent) (DOL 1997a).

In 1995, service activities represented the largest sector of employment in the REA (27.1 percent). This was followed by retail trade (20.4 percent), and government (19.5 percent). The totals for these employment sectors in Idaho were 21.5 percent, 19.6 percent, and 18.7 percent, respectively. The totals for these employment sectors in Wyoming were 21.1 percent, 20.8 percent, and 25 percent, respectively (DOL 1997b).

3.3.3.2 Population and Housing

In 1996, the ROI population totaled 213,547. Between 1990 and 1996, the ROI population increased by 10.6 percent, compared with an 17.5 percent increase in Idaho's population (DOC 1997). Between 1980 and 1990, the number of housing units in the ROI increased by 6.7 percent, compared with the 10.2 percent increase in Idaho. The total number of housing units in the ROI for 1990 was 69,760 (DOC 1994). The 1990 ROI homeowner vacancy rate was 2.1 percent compared with the Idaho's rate of 2.0 percent. The ROI renter vacancy rate was 8.3 percent compared with the Idaho's rate of 7.3 percent (DOC 1990a). Population and housing trends are displayed in Figure 3–11.

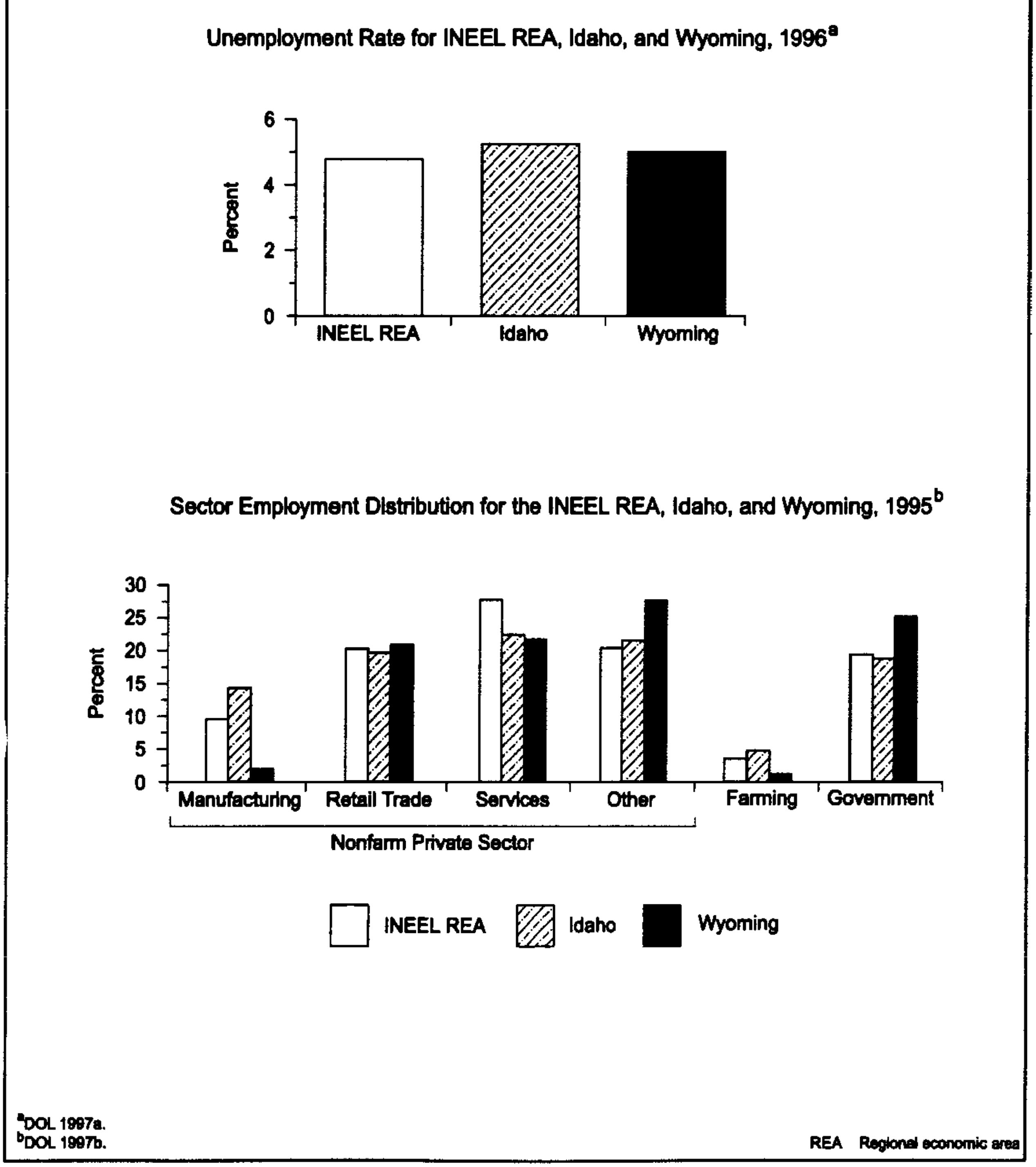
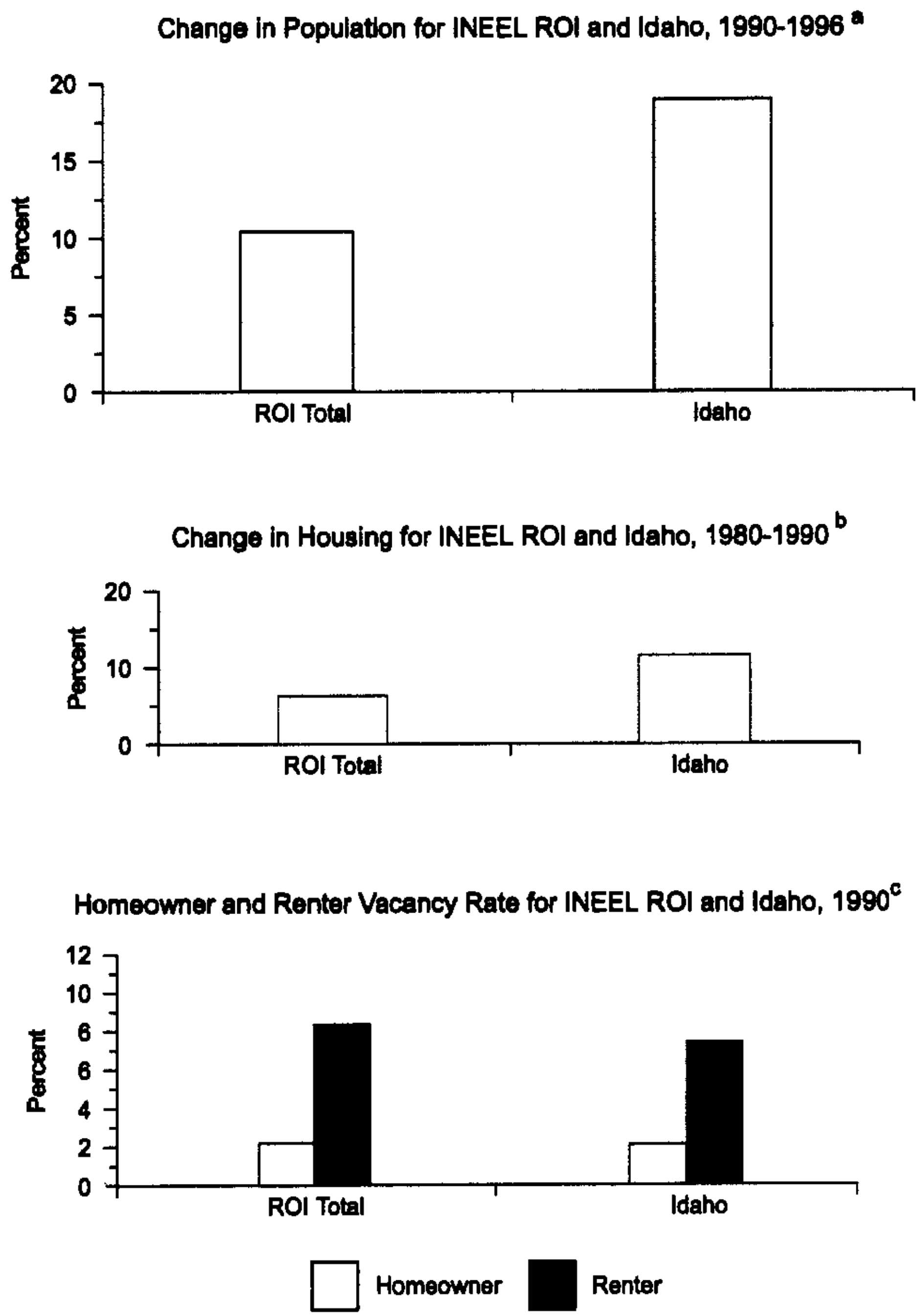


Figure 3–10. Employment and Local Economy for the INEEL Regional Economic Area and the States of Idaho and Wyoming



[a] DOC 1997.
[b] DOC 1994.
[c] DOC 1990a.

ROI Region of Influence

Figure 3–11. Population and Housing for the INEEL Region of Influence and the State of Idaho

3.3.3.3 Community Services

3.3.3.3.1 Education

Thirteen school districts provide public education services and facilities in the INEEL ROI. As shown in Figure 3–12, they operated at between 50 percent (Swan Valley District) and 100 percent (Shelley District) capacity in 1997. In 1997, the average student-to-teacher ratio for the INEEL ROI was 18.8:1 (Nemeth 1997a). In 1990, the average student-to-teacher ratio for Idaho was 12.8:1 (DOC 1990b, 1994).

3.3.3.3.2 Public Safety

In 1997, a total of 475 sworn police officers were serving the four-county ROI. In 1997, the average ROI officer-to-population ratio was 2.2 officers per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 1.5 officers per 1,000 persons (DOC 1990b). In 1997, 560 paid and volunteer firefighters provided fire protection services in the INEEL ROI. The average firefighter-to-population ratio in the ROI in 1997 was 2.6 firefighters per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 1.2 firefighters per 1,000 persons (DOC 1990b). Figure 3–13 displays the ratio of sworn police officers and firefighters to the population for the INEEL ROI.

3.3.3.3.3 Health Care

In 1996, a total of 329 physicians served the ROI. The average ROI physician-to-population ratio was 1.5 physicians per 1,000 persons as compared with a 1996 State average of 1.7 physicians per 1,000 persons (Randolph 1997). In 1997, there were five hospitals serving the four-county ROI. The hospital bed-to-population ratio averaged 4.6 hospital beds per 1,000 persons (Nemeth 1997c). This compares with the 1990 State average of 3.3 beds per 1,000 persons (DOC 1996:128). Figure 3–13 displays the ratio of hospital beds and physicians to the population for all the counties in the INEEL ROI.

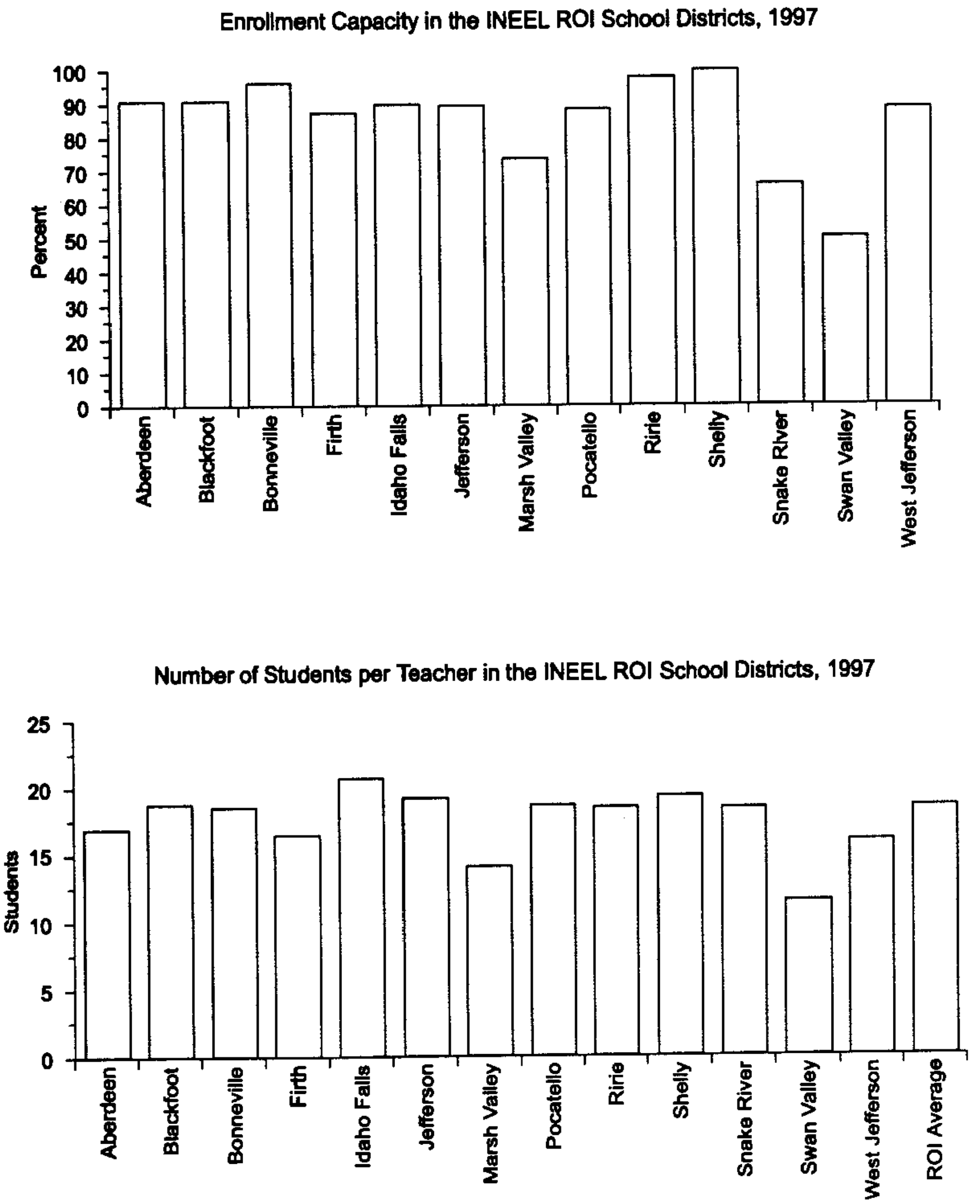
3.3.3.4 Local Transportation

Vehicular access to INEEL is provided by U.S. Routes 20 and 26 to the south and State Routes 22 and 33 to the north. U.S. Routes 20 and 26 and State Routes 22 and 33 all share rights-of-way west of INEEL (see Figure 2–3).

There are two road segments that could be affected by the disposition alternatives: U.S. Route 20 from U.S. Routes 26 and 91 at Idaho Falls to U.S. Route 26 East and U.S. Routes 20 and 26 from U.S. Route 26 East to State Routes 22 and 33.

There are no current road improvement projects affecting access to INEEL; however, there are two planned road improvement projects that could affect future access to INEEL. There are plans to resurface State Route 33 from the intersection of State Routes 28 and 33 to 13 km (8.1 mi) east of this intersection. There are also plans for routine paving of segments along State Route 28 from now until the year 2000 (Bala 1997).

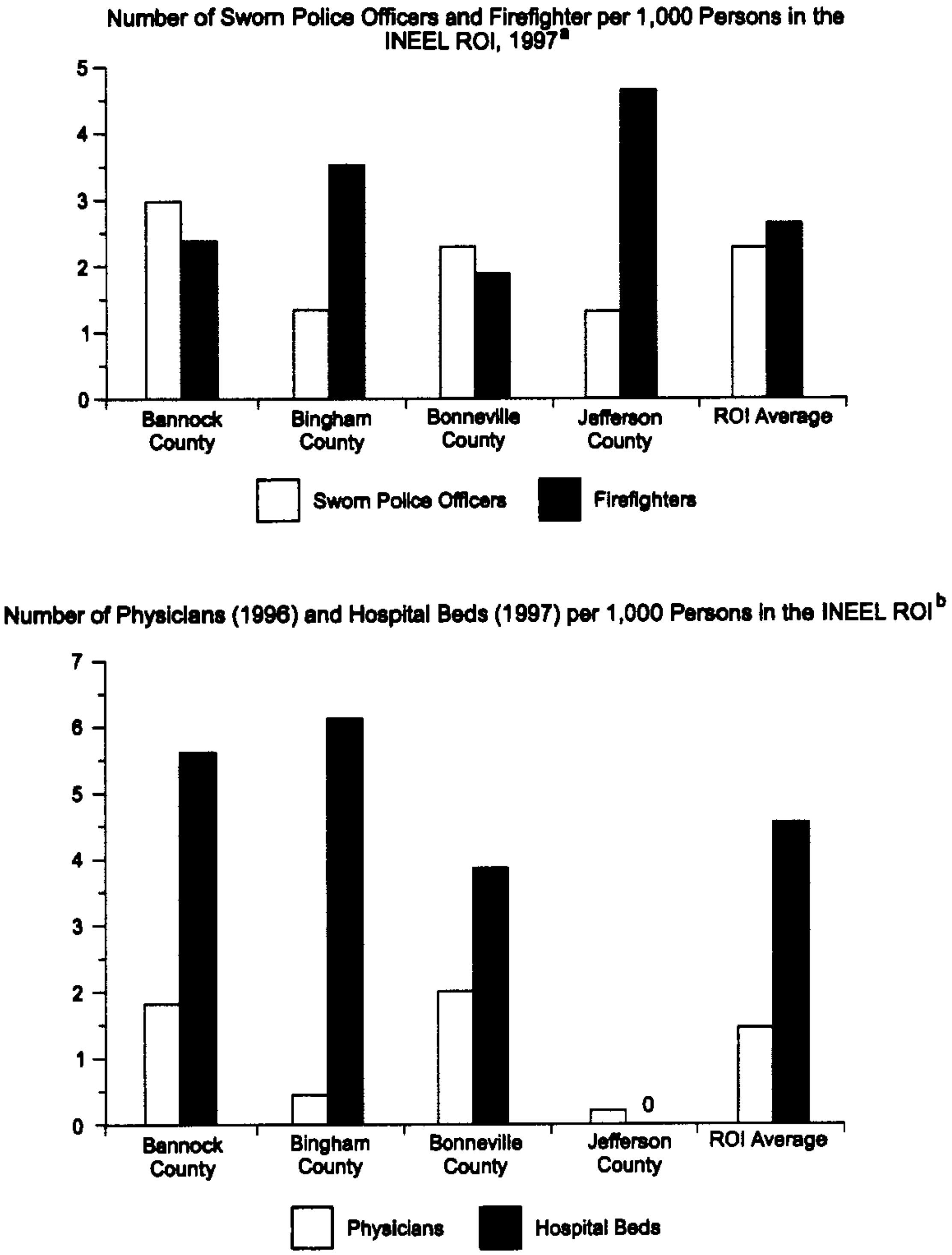
DOE shuttle vans provide transportation between INEEL facilities and Idaho Falls for DOE and contractor personnel. The major railroad in the ROI is the Union Pacific Railroad. The railroad's Blackfoot-to-Arco Branch provides rail service to the southern portion of INEEL. A DOE-owned spur connects the Union Pacific Railroad to INEEL by a junction at Scovill Siding. There are no navigable waterways within the ROI capable of accommodating waterborne transportation of material shipments to INEEL. Fanning Field in Idaho Falls



Source: Nemeth 1997a.

ROI Region of influence

Figure 3–12. School District Characteristics for the INEEL Region of Influence



[a]Nemeth 1997b.
[b]Nemeth 1997c; Randolph 1997.

ROI Region of Influence

Figure 3–13. Public Safety and Health Care Characteristics for the INEEL Region of Influence

and Pocatello Municipal Airport in Pocatello provide jet air passenger and cargo service for both national and local carriers. Numerous smaller private airports are located throughout the ROI (DOE 1996a).

3.3.4 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.3.4.1 Radiation Exposure and Risk

3.3.4.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of INEEL are shown in Table 3–20. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to INEEL operations.

Table 3–20. Sources of Radiation Exposure to Individuals in the INEEL Vicinity Unrelated to INEEL Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation[a]	
Cosmic radiation	48
External terrestrial radiation	73
Internal terrestrial/cosmogenic radiation	40
Radon in homes (inhaled)	200[b]
Other background radiation[c]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	426

[a] Mitchell et al. 1997:4-21.
[b] An average for the United States.
[c] NCRP 1987:11, 40, 53.

Releases of radionuclides to the environment from INEEL operations provide another source of radiation exposure to individuals in the vicinity of INEEL. Types and quantities of radionuclides released from INEEL operations in 1996 are listed in *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1996* (Mitchell et al. 1997:7-4, 7-5). The doses to the public resulting from these releases are presented in Table 3–21. These doses fall within radiological limits per DOE Order 5400.5 (DOE 1993a:II-1–II-5) and are much lower than those of background radiation.

Using a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from INEEL operations in 1996 is estimated to be 1.6×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of INEEL operations is less than 2 in 100 million. (It takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Table 3–21. Radiation Doses to the Public From Normal INEEL Operations in 1996 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**
Maximally exposed individual (mrem)	10	0.031	4	0	100	0.031
Population within 80 km (person-rem)[b]	None	0.24	None	0	100	0.24
Average individual within 80 km (mrem)[c]	None	0.0020	None	0	None	0.0020

[a] The standards for individuals are given in DOE Order 5400.5 (DOE 1993a:II-1–II-5). As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, as published in 58 FR 16268 (DOE 1993b:para. 834.7). If the potential total dose exceeds the 100 person-rem value, it is required that the contractor operating the facility notify DOE.

[b] About 121,500 in 1996.

[c] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

Source: Mitchell, Peterson, and Hoff 1996:4-48.

According to the same risk estimator, 1.2×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of INEEL from normal operations in 1996. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The 1995 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Famighetti 1998:964). Based on this mortality rate, the number of fatal cancers expected during 1995 from all causes in the population living within 80 km (50 mi) of INEEL was 243. This expected number of fatal cancers is much higher than the 1.2×10^{-4} fatal cancers estimated from INEEL operations in 1996.

INEEL workers receive the same doses as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. Table 3–22 presents the average dose to the individual worker and the cumulative dose to all workers at INEEL from operations in 1996. These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995a:para. 835.202). According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers[4] (Appendix F.10), the number of projected fatal cancers among INEEL workers from normal operations in 1996 is 0.082.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1996* (Mitchell et al. 1997). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) are also presented in that report.

3.3.4.1.2 Proposed Facility Location

External radiation doses and concentrations of gross alpha, plutonium, and americium in air have been measured in the INTEC area. In 1996, the annual average dose along the boundary of INTEC was about 180 mrem. If radiation from the "hot spots" along this boundary (e.g., the tree farm) is not included, the dose is reduced to about 150 mrem. This is about 20 mrem higher than the average dose measured at the offsite control locations. Concentrations in air of gross alpha, plutonium 239/240 and americium 241 in 1995 were 5×10^{-4} pCi/m^3, 2.1×10^{-5} pCi/m^3, and 6×10^{-6} pCi/m^3, respectively. The gross alpha value was about three times lower than that measured at the offsite control locations, and the plutonium 239/240, and americium 241

[4] The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 3–22. Radiation Doses to Workers From Normal INEEL Operations in 1996 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual**
Average radiation worker (mrem)	None[b]	125[c]
Total workers (person-rem)[d]	None	205[c]

[a] The radiological limit for an individual worker is 5,000 mrem/yr. However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

[c] Does not include doses received at the Naval Reactors Facility. The impacts associated with this facility fall under the jurisdiction of the Navy as part of the Nuclear Propulsion Program.

[d] About 1,650 (badged) in 1995.

Source: Abbott, Crockett, and Moor 1997;DOE 1995a:para. 835.202.

values were each about 50 percent higher. In 1996, the concentration of gross alpha was about 1×10^{-3} pCi/m^3 in the INTEC area. No measurements of plutonium or americium in air were reported in this area in 1996 (Mitchell, Peterson, and Hoff 1996:4-10, 4-17, 4-18, 4-28, 4-31; Mitchell et al.1997:4-4, 4-19, 4-21, 4-23).

3.3.4.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Section 3.3.1.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emissions and NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur via inhalation of air containing hazardous chemicals released to the atmosphere during normal INEEL operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those via the inhalation pathway. At INEEL, the risk to public health from water ingestion and direct exposure pathways is low because surface water is not used for drinking or as a receptor for wastewater discharges.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.3.1. These baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information on estimating the health impacts of hazardous chemicals is presented in Appendix F.10.

Exposure pathways to INEEL workers during normal operation may include the inhalation of contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. INEEL workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals used in the operational processes ensures that these standards are not exceeded. Additionally, DOE requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, workplace conditions at INEEL are substantially better than required by standards.

3.3.4.3 Health Effects Studies

Epidemiological studies were conducted on communities surrounding INEEL to determine whether there are excess cancers in the general population. Two of these are described in more detail in Appendix M.4.4 of the *Storage and Disposition Final PEIS* (DOE 1996a:M-233, M-234). No excess cancer mortality was reported, and although excess cancer incidence was observed, no association thereof with INEEL was established. A study by the State of Idaho completed in June 1996 found excess brain cancer incidence in the six counties surrounding INEEL, but a follow-up survey concluded that "there was nothing that clearly linked all these cases to one another or any one thing."

No occupational epidemiological studies have been completed at INEEL to date, but several worker health studies were initiated recently at INEEL and another is almost complete. Researchers from the Boston University School of Public Health in cooperation with the National Institute of Occupational Safety and Health (NIOSH), are investigating the effects of workforce restructuring (downsizing) in the nuclear weapons industry. The health of displaced workers will be studied. Under a NIOSH cooperative agreement, the epidemiologic evaluation of childhood leukemia and paternal exposure to ionizing radiation now includes INEEL as well as other DOE sites. Another study began in October 1997, *Medical Surveillance for Former Workers at INEEL*, is being carried out by a group of investigators consisting of the Oil, Chemical, and Atomic Workers International Union, Mt. Sinai School of Medicine, the University of Massachusetts at Lowell, and the Alice Hamilton College. A cohort mortality study of the workforce at INEEL being conducted by NIOSH is not expected to be released until December 1998. DOE has implemented an epidemiologic surveillance program to monitor the health of current INEEL workers. A discussion of this program is given in Appendix M.4.4 of the *Storage and Disposition Final PEIS* (DOE 1996a:M-233, M-234).

3.3.4.4 Accident History

DOE conducted a study, the *Idaho National Engineering Laboratory Historical Dose Evaluation* (DOE/ID-12119), to estimate the potential offsite radiation doses for the entire operating history of INEEL (DOE 1996a:3-139). Releases resulted from a variety of tests and experiments as well as a few accidents at INEEL. The study concluded that these releases contributed to the total radiation dose during test programs of the 1950s and early 1960s. The frequency and size of releases has declined since that time. There have been no serious unplanned or accidental releases of radioactivity or other hazardous substance at INEEL facilities in the last 10 years of operation.

3.3.4.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, preparedness, and response.

Government agencies whose plans are interrelated with the INEEL emergency plan for action include the State of Idaho, Bingham County, Bonneville County, Butte County, Clark County, Jefferson County, the Bureau of Indian Affairs, and the Fort Hall Indian Reservation. INEEL contractors are responsible for responding to emergencies at their facilities. Specifically, the emergency action director is responsible for recognition, classification, notifications, and protective action recommendations. At INEEL, emergency preparedness resources include fire protection from onsite and offsite locations and radiological and hazardous chemical material response. Emergency response facilities include an emergency control center at each facility, at the INEEL warning communication center, and at the INEEL site emergency operations center. Seven INEEL medical facilities are also available to provide routine and emergency service.

DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997. These actions and the timeframe in which they must be implemented are presented in Section 3.2.4.5.

3.3.5 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. In the case of INEEL, the potentially affected area includes only parts of central Idaho.

The potentially affected area surrounding INTEC is defined by a circle with an 80-km (50-mi) radius centered at FPF (lat. 43°34'12.5" N, long. 112°55' 55.4" W). The total population residing within that area in 1990 was 117,712. The proportion of the population there that was considered minority was 9.9 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and for the State of Idaho, 7.7 (DOC 1992).

Figure 3–14 illustrates the racial and ethnic composition of the minority population in the potentially affected area centered at FPF. At the time of the 1990 census, Hispanics and Native Americans were the largest minority groups within that area, constituting 6 percent and 2.6 percent of the total population, respectively, during the 1990 census. Asians constituted about 1 percent, and blacks, about 0.3 percent (DOC 1992).

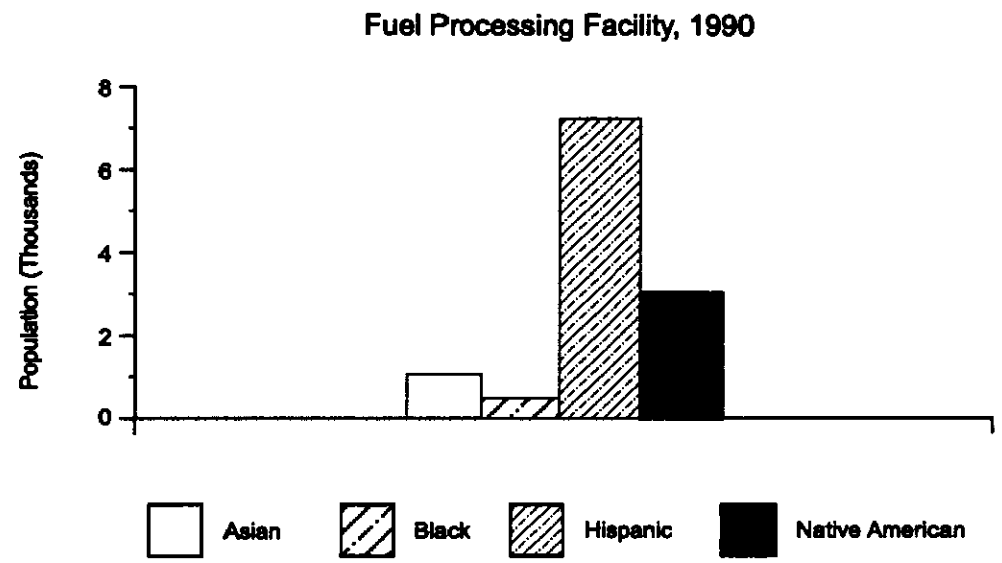
A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 14,255 persons (12.1 percent of the total population) residing within the potentially affected area around INTEC reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that Idaho reported 13.3 percent.

3.3.6 Geology and Soils

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

3.3.6.1 General Site Description

The upper 1 to 2 km (0.6 to 1.2 mi) of the crust beneath INEEL is composed of interlayered basalt and sediment. The sediments are composed of fine-grained silts that were deposited by wind; silts, sands, and



Source: DOC 1992.

Figure 3–14. Racial and Ethnic Composition of Minorities Around the Fuel Processing Facility at INEEL

gravels deposited by streams; and clays, silts, and sands deposited in lakes. Rhyolitic (granite-like) volcanic rocks of unknown thickness lie beneath the basalt sediment sequence. The rhyolitic volcanic rocks were erupted between 6.5 and 4.3 million years ago (Barghusen and Feit 1995:2.3-17).

Within INEEL, economically viable sand, gravel, and pumice resources have been identified. Several quarries have supplied these materials to various onsite construction projects (DOE 1996a:3-121). Geothermal resources are potentially available in parts of the Eastern Snake River Plain, but neither of two boreholes—INEEL-1 (drilled to a depth of 3,048 m [10,000 ft] to explore for geothermal resources 8 km [5 mi] north of INTEC) and WO-2 (drilled to a depth of 1,524 km [5,000 ft] 4.8 km [3 mi] east of INTEC)—encountered rocks with significant geothermal potential (Abbott, Crockett, and Moor 1997:11).

There is no potential for sinkholes or unstable conditions at INTEC. Lava tubes, which could have adverse effects similar to those of sinkholes, do occur in the INEEL area, but extensive drilling and foundation excavation in the INTEC area over the past few decades has revealed no lava tubes beneath the site. Drilling for foundation engineering investigations at FPF has also revealed no lava tubes (Abbott, Crockett, and Moor 1997:10).

The Arco Segment of the Lost River Fault and the Howe Segment of the Lemhi Fault terminate about 30 km (19 mi) from the INEEL boundary and are considered capable. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years (DOE 1996a:3-121).

According to the Uniform Building Code, INEEL, located on the Eastern Snake River Plain, is in Seismic Zone 2B, meaning that moderate damage could occur as a result of an earthquake. Historic and recent seismic data cataloged by NOAA, the National Earthquake Information Center, the University of Utah, and the INEEL Seismic Network indicate that earthquakes in the region occur primarily in the Intermountain Seismic Belt and the Centennial Tectonic Belt. The seismic characteristics of the Eastern Snake River Plain and the adjacent Basin and Range Province are different; the plain has historically experienced few and small earthquakes. No earthquakes have been recorded within about 48 km (30 mi) of the site (DOE 1996a:3-121). An earthquake with a maximum horizontal acceleration of 0.15g is calculated to have an annual probability of occurrence of 1 in 5,000 at a central INEEL location (Barghusen and Feit 1995:2.3-17).

The largest historic earthquake near INEEL took place in 1983 about 107 km (66 mi) to the northwest, near Borah Peak in the Lost River Range. The earthquake measured 7.3 on the Richter scale with a resulting peak ground acceleration of 0.022g to 0.078g at INEEL. An earthquake of greater than 5.5 magnitude can be expected about every 10 years within a 322-km (200-mi) radius of INEEL (DOE 1996a:3-121).

Volcanic hazards at INEEL can come from sources inside or outside the Snake River Plain. Most of the basaltic volcanic activity occurred at the Craters of the Moon National Monument 20 km (12 mi) southwest of INEEL between 4 million and 2,100 years ago. The probability of volcanic activity affecting facilities at INEEL is very low. In fact, the Volcanism Working Group for the *Storage and Disposition Final PEIS* (DOE 1996a) estimated that the conditional probability of basaltic volcanism affecting a south-central INEEL location is at most once per 40,000 years. The rhyolite domes along the Axial Volcanic Zone formed between 1.2 million and 300,000 years ago and have a recurrence interval of about 200,000 years. Therefore, the probability of future dome formation affecting INEEL facilities is also very low (DOE 1996a:3-121–3-123).

INEEL soils are derived from volcanic and clastic rocks from nearby highlands. In the southern part of the site, the soils are gravelly to rocky and generally shallow. The northern portion is composed mostly of unconsolidated clay, silt, and sand. No prime farmland lies within the INEEL boundaries. Generally, the soils are acceptable for standard construction techniques (DOE 1996a:3-107, 3-123). More detailed descriptions of the geology and the soil conditions at INEEL are included in the *Storage and Disposition Final PEIS* (DOE 1996a:3-121–3-123).

3.3.6.2 Proposed Facility Location

The nearest capable fault is in the South Creek Segment of the Lemhi Fault, about 26 km (16 mi) north of INTEC. All soil near INTEC was originally fine loam over a sand or sand-cobble mix deposited in the floodplain of the Big Lost River. However, all soils within the INTEC fences have been disturbed. The soils beneath the INTEC area are not subject to liquefaction because of the high content of gravel mixed with the alluvial sands and silts. In addition, the sediments are not saturated (Abbott, Crockett, and Moor 1997:10).

3.3.7 Water Resources

3.3.7.1 Surface Water

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

3.3.7.1.1 General Site Description

Three intermittent streams drain the mountains near INEEL: Big Lost River, Little Lost River, and Birch Creek. These intermittent streams carry snowmelt in the spring and are usually dry by midsummer. Several years can pass before any offsite waters enter DOE property. Big Lost River and Birch Creek are the only streams that regularly flow onto INEEL. Little Lost River is usually dry by the time it reaches the site because of upstream use of the flow for irrigation. None of the rivers flow from the site to offsite areas. Big Lost River discharges into the Big Lost River sinks, and there is no surface discharge from these sinks (Barghusen and Feit 1995:2.3-2, 2.3-21; DOE 1996a:3-115).

Big Lost River has been classified by the State of Idaho for domestic and agricultural use, cold water biota development, salmon spawning, primary and secondary recreation, and other special resource uses. Surface waters, however, are not used for drinking water on the site, nor is any wastewater discharged directly to them. Moreover, there are no surface water rights issues at INEEL, because INEEL facilities currently neither discharge directly to, nor make withdrawals from, these water bodies. None of the rivers have been classified as a Wild and Scenic River. Flood diversion facilities constructed in 1958 secured INEEL from the 300-year flood (DOE 1995b:4.8-1–4.8-5; 1996a:3-115).

3.3.7.1.2 Proposed Facility Location

There are no named streams within INTEC—only unnamed drainage ditches to carry storm flows away from buildings and facilities at the site. Outside INTEC, the only surface water is a stretch of Big Lost River. This is an intermittent stream that flows only after rainfall events or in the spring, when it carries snowmelt from the nearby mountains (Abbott, Crockett, and Moor 1997:5). A summary of water quality data for Big Lost River in the vicinity of INEEL is provided in the *Storage and Disposition Final PEIS* and shows no unusual concentrations of the parameters analyzed (DOE 1996a:3-115–3-117).

Flooding scenarios that involve the failure of McKay Dam and high flows in the Big Lost River have been evaluated. The results indicate that in the event of a failure of this dam, flooding would occur at INTEC and other facilities at INEEL. The low velocity and shallow depth of the water, however, would not pose a threat of structural damage to the facilities (DOE 1995b:4.8-3, 4.8-4). Localized flooding can occur due to rapid snowmelt and frozen ground conditions, but none has been reported at INTEC. A study of the 100-year flood has been completed by the U.S. Geological Survey, but the report containing the 100-year flood map is still in review. The 500-year flood has not been studied, and no flood maps are available from FEMA or other agencies (Abbott, Crockett, and Moor 1997:7). However, the probable maximum flood has been calculated, as shown on Figure 3–15 (DOE 1997c).

Purgeable organics such as 1,1-dichloroethylene, toluene, and 1,1,1-trichloroethane have been detected in wells near INTEC. Metals, including arsenic, barium, lead, mercury, selenium, and silver, were also found in samples from wells. Inorganic chemicals such as sodium and chloride have been found in these samples. Maximum values for tritium in samples from three wells averaged 23,700 pCi/l; and maximum strontium 90 values averaged 53 pCi/l (Abbott, Crockett, and Moor 1997:11, 12). These values exceed the drinking water standards for tritium and strontium 90 of 20,000 pCi/l and 8 pCi/l, respectively. The results of groundwater modeling and baseline risk assessment will be used to identify the release sites requiring further evaluation. If necessary, removal actions may be taken to prevent further migration of contaminants to the Snake River Plain Aquifer (Mitchell et al. 1997:3-5). Sanitary waste with no potential for radioactive contamination is treated in the INTEC Sewage Treatment Facility (CPP-615). This facility has a Wastewater Land Application Permit from the State of Idaho and does not discharge to surface waters, but allows land application of treated sanitary sewage. The only effluent criteria associated with flows to the sewage ponds are the amounts of total suspended solids and nitrogen released to the ponds. All compliance points for the ponds are in wells downgradient from the ponds, and the maximum allowable concentrations are similar to those in the National Primary and Secondary Drinking Water Standards (Abbott, Crockett, and Moor 1997:9, 10).

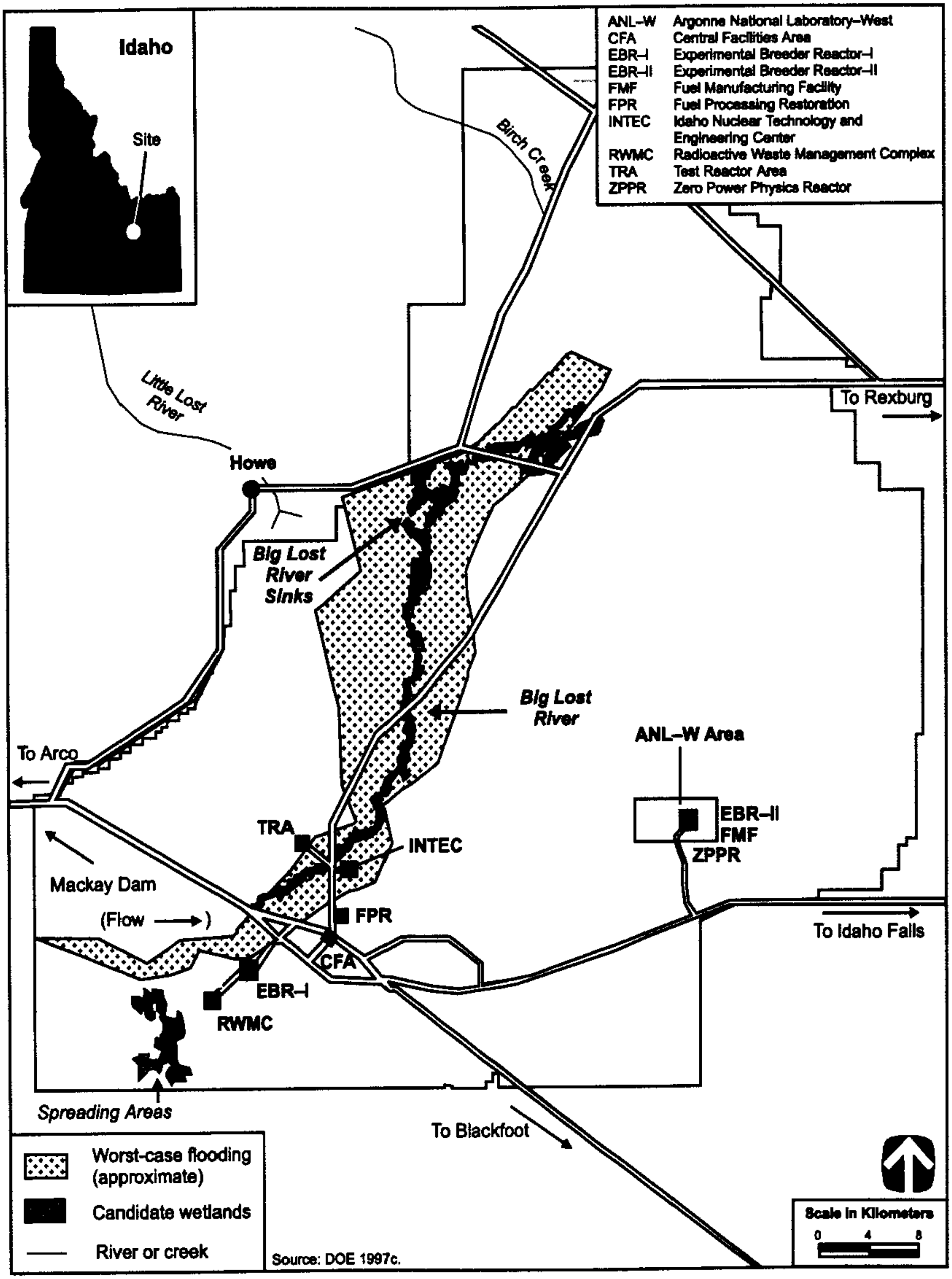


Figure 3–15. Flood Area for the Probable Maximum Flood Induced Overtopping Failure of the Mackay Dam

Drainage from corridors, roof and floor drains, and condensate from process heating, and heating, ventilation, and air conditioning systems with very low potential for radiological contamination are routed to the INTEC service waste system. Service Waste Percolation Pond 1 (SWP–1), southeast of Building CPP-603, has a surface area about of 18,400 m^2 (198,000 ft^2) and is 4.9 m (16 ft) deep. Service Waste Pond 2, immediately west of SWP–1, has a surface area of 46 m^2 (495 ft^2). Both ponds are fenced to keep out wildlife (Abbott, Crockett, and Moor 1997:9).

Consideration is being given to relocating the percolation pond to reduce the potential impacts on a contaminated perched water zone. Consideration is also being given to obtaining an NPDES permit to allow direct discharge into Big Lost River. These actions are independent of the proposed action analyzed in this SPD EIS and would be preceded by appropriate NEPA documentation (Abbott, Crockett, and Moor 1997:10).

3.3.7.2 Groundwater

Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

3.3.7.2.1 General Site Description

The Snake River Plain aquifer is classified by EPA as a Class I sole source aquifer. It lies below the INEEL site and covers about 24,860 km^2 (9,600 mi^2) in southeastern Idaho. This aquifer serves as the primary drinking water source in the Snake River Basin and is believed to contain 1.2 quadrillion to 2.5 quadrillion l (317 trillion to 660 trillion gal) of water. Recharge of the groundwater comes from Henry's Fork of the Snake River, Big Lost River, Little Lost River, and Birch Creek. Rainfall and snowmelt also contribute to the aquifer's recharge (DOE 1996a:3-115–3-117).

Groundwater generally flows laterally at a rate of 1.5 to 6.1 m/day (5 to 20 ft/day). It emerges in springs along the Snake River from Milner to Bliss, Idaho. Depth to the groundwater table ranges from about 60 m (200 ft) below ground in the northeast corner of the site to about 300 m (1,000 ft) in the southeast corner (DOE 1995b;4.8-5, 1996:3-117).

Perched water tables occur below the site. These perched water tables tend to slow the migration of pollutants that might otherwise reach the Snake River Plain aquifer (DOE 1996a:3-117).

INEEL has a large network of monitoring wells—about 120 in the Snake River Plain aquifer and another 100 drilled in the perched zone. The wells are used for monitoring to determine the compliance of specific actions with requirements of RCRA and CERCLA, as well as routine monitoring to evaluate the quality of the water in the aquifer. The aquifer is known to have been contaminated with tritium; however, the concentration dropped 93 percent between 1961 and 1994, possibly due to the elimination of tritium disposal, radioactive decay, and dispersion throughout the aquifer. Other known contaminants include cesium 137, iodine 129, strontium 90, and nonradioactive compounds such as TCE. Components of nonradioactive waste entered the aquifer as a result of past waste disposal practices. Elimination of groundwater injection exemplifies a change in disposal practices that has reduced the amount of these constituents in the groundwater (DOE 1996a:3-117, 3-119).

From 1982 to 1985, INEEL used about 7.9 billion l/yr (2.1 billion gal/yr) from the Snake River Plain aquifer, the only source of water at INEEL. This represents less than 0.3 percent of the groundwater withdrawn from that aquifer. DOE holds a Federal Reserved Water Right for the INEEL site that permits a pumping capacity of approximately 2.3 m^3/s (80 ft^3/s) with a maximum water consumption of 43 billion l/yr (11 billion gal/yr). INEEL's priority on water rights dates back to its establishment in 1950 (DOE 1996a:3-119).

3.3.7.2.2 Proposed Facility Location

Generally, the groundwater near INEEL, including INTEC, flows from the north and northeast to the south and southwest (Barghusen and Feit 1995:2.3-23).

Water for the INTEC is supplied by two deep wells located in the northwest corner of the INTEC. The wells are about 180 m (590 ft) deep and about 36 cm (14 in) in diameter (Abbott, Crockett, and Moor 1997:9). These wells can each supply up to approximately 11,000 l/min (3,000 gal/min) of water for use in the INTEC fire water, potable water, treated water, and demineralized water systems (Werner 1997). Pumping has little effect on the level of the groundwater, because the withdrawals are so small relative to the volume of water in the aquifer and the amount of recharge available. The production wells at INTEC have historically contained measurable quantities of strontium 90. In 1992, the highest concentration was 1 pCi/l, compared with the EPA maximum Primary Drinking Water Standard of 8 pCi/l. Sampling has yielded similar results over time (Barghusen and Feit 1995:2.3-23–2.3-29).

3.3.8 Ecological Resources

Ecological resources are defined as terrestrial (predominantly land) and aquatic (predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this SPD EIS, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special status species—that is, "nonsensitive" versus "sensitive" habitat.

3.3.8.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

3.3.8.1.1 General Site Description

INEEL is dominated by fairly undisturbed shrub-steppe vegetation that provides important habitat for nearly 400 plant species and numerous animal species native to the region's cool desert environment. Facilities and operating areas occupy 2 percent of INEEL, and approximately 60 percent of the surrounding area is used by sheep and cattle for grazing (DOE 1996a:3-125). Six broad vegetative categories representing nearly 20 distinct habitats have been identified on the INEEL site. Approximately 90 percent of INEEL is covered by shrub-steppe vegetation, which is dominated by big sagebrush, saltbrush, rabbitbrush, and native grasses, and contains a diversity of forbs (Figure 3–16) (DOE 1997c:44).

The large, undeveloped tracts of land used by INEEL for safety and security buffers also provide important habitat for plants and animals. Because INEEL is at the mouth of several mountain valleys, large numbers of mammals and migratory birds of prey are funneled onto the site. During some winters, thousands of pronghorn antelope and sage grouse can be found in the low and big sagebrush communities in the northern region. The juniper communities in the northwestern and southwestern regions provide important nesting areas for raptors and songbirds (DOE 1996a:3-125; 1997c:42).

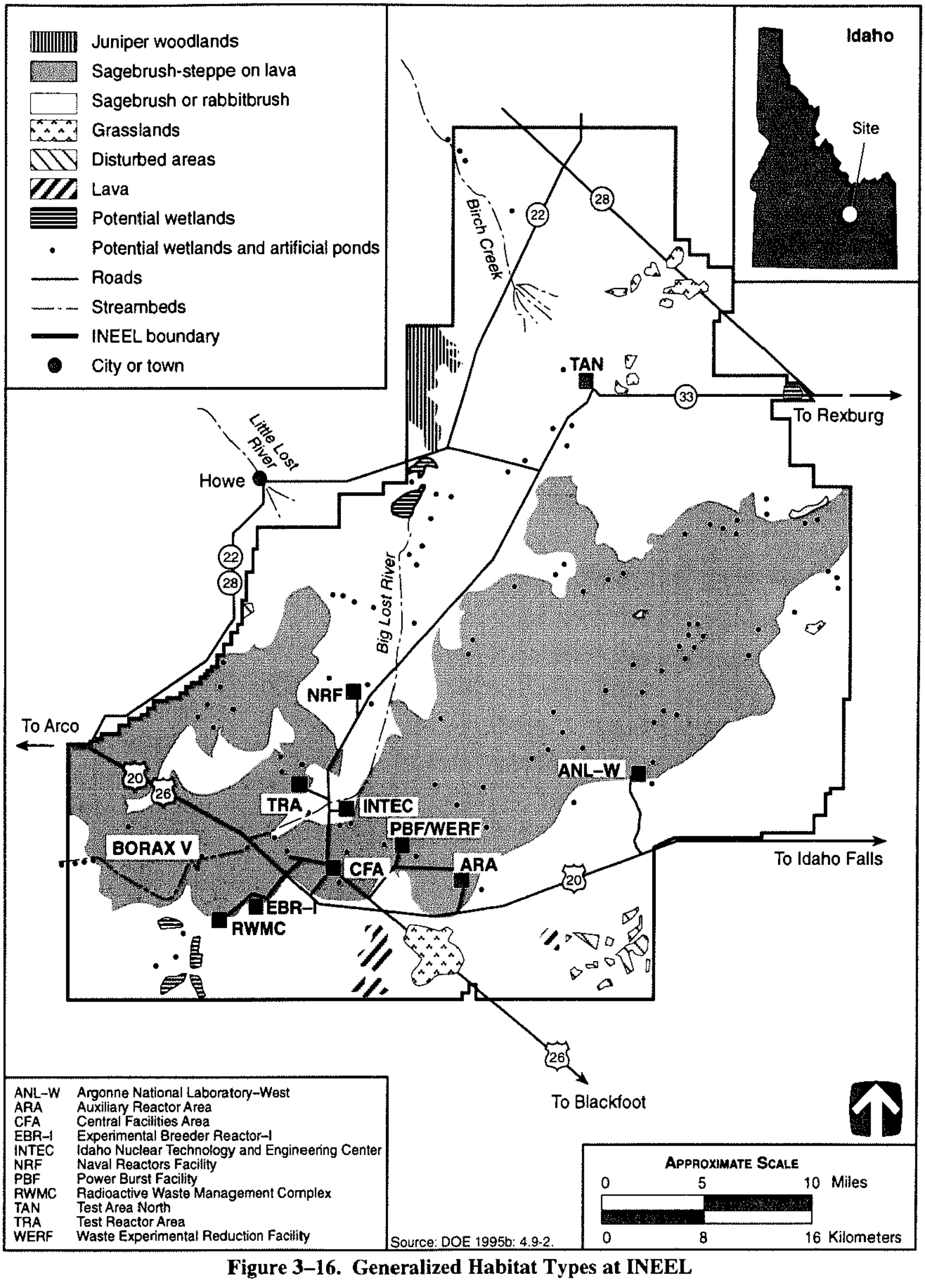


Figure 3–16. Generalized Habitat Types at INEEL

Animal species found at INEEL include 2 species of amphibians, 210 species of birds, 9 species of fish, 43 species of mammals, and 11 species of reptiles (DOE 1997c:42). Commonly observed animals include the short-horned lizard, gopher snake, sage sparrow, Townsend's ground squirrel, and black-tailed jackrabbit (DOE 1996a:3-125). Important game animals that reside at INEEL include roughly 30 percent of Idaho's pronghorn antelope population, sage grouse, mule deer, and elk. Hunting of pronghorn antelope and elk is permitted under controlled conditions to reduce damage to crops on private lands and is restricted to within about 0.8 km (0.5 mi) inside the property boundary of INEEL (DOE 1995b:4.2-1; 1996a:3-125). Predators observed on the INEEL site include bobcats, mountain lions, badgers, and coyotes (DOE 1997c:42).

Aquatic habitat is limited to three intermittent streams (Big Lost River, Little Lost River, and Birch Creek) that drain into four sinks in the north-central portion of INEEL and to a number of liquid-waste disposal ponds. When water from the Big Lost River does flow on the site, several species of fish are observed: brook trout, rainbow trout, mountain whitefish, speckled dace, shorthead sculpin, and kokanee salmon (DOE 1996a:3-125).

3.3.8.1.2 Proposed Facility Location

INTEC is an industrial facility with most land surfaces being disturbed, bare ground (85 percent) or facilities and pavement (13 percent). Natural areas are limited to those areas outside the fenced boundary, mainly sagebrush-steppe on lava, sagebrush, rabbitbrush, and grasslands. The onsite areas are not vegetated except for grasses, shrubs, and trees associated with lawns and landscaping, and weedy annuals and grasses commonly found in disturbed areas. These areas, as well as buildings and wastewater treatment ponds, are used by a number of species. Accordingly, animal species potentially present in the immediate area surrounding FPF are primarily limited to those species adapted to disturbed industrial areas, such as small mammals (e.g., mice, rabbits, and ground squirrels), birds (e.g., sparrows and finches), and reptiles (e.g., lizards). A comprehensive list of species potentially present within INTEC and the surrounding area is presented in the Waste Area 3 (WAG3) risk assessment work plan developed by Rodriguez et al. (1997) (Werner 1997:WAG3 Report Summary). There are no known aquatic species or habitat within the immediate environs of FPF (Abbott, Crockett, and Moor 1997:15).

3.3.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including designated wetlands) areas of the site that support threatened and endangered, State-protected, and other special status plant and animal species.[5]

3.3.8.2.1 General Site Description

Nearly all INEEL wetland habitats, with the exception of playa wetlands, are impacted by water management and diversion activities on and off the site. Agricultural demands and flood control diversions, combined with low regional precipitation, prevent permanent water in the Big Lost River and Birch Creek drainages, thus limiting the "classic" wetlands to inordinately wet periods. The Big Lost River and Birch Creek drainages support unique riparian habitats that are important to a diversity of desert animals and breeding birds (DOE 1997c:43, 44). Riparian vegetation, primarily willow and cottonwood, provides nesting habitat for hawks, owls, and songbirds (DOE 1996a:3-125). The only permanent source of surface water on INEEL is manmade ponds where flows are sustained through facility operations. These ponds represent important habitat on INEEL that would not exist otherwise (DOE 1997c:43, 44).

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[5] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

Nineteen threatened, endangered, and other special status species listed by the Federal Government or the State of Idaho may be found in the vicinity of INEEL, as shown in Table 3.4.6–1 in the *Storage and Disposition Final PEIS* (DOE 1996a:3-128).

3.3.8.2.2 Proposed Facility Location

There are no known wetlands within the immediate environs of INTEC (Abbott, Crockett, and Moor 1997:15). Manmade percolation ponds that receive permitted facility effluent and hold water intermittently are known to support the boreal chorus frog and aquatic invertebrates when water is present. Several wetland plant species have been identified in percolation ponds south of INTEC (Werner 1997:WAG3 Report Summary). INTEC does not provide critical habitat for any of the 14 threatened, endangered, or other special status species listed in Table 3–23 that may occur in the area (Werner 1997:WAG3 Report Summary).

Table 3–23. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in Areas Surrounding INTEC

Common Name	Scientific Name	Federal Status	State Status
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Black tern	*Chlidonias niger*	Species of Concern	Not listed
Burrowing owl	*Athene cunicularia*	Species of Concern	Not listed
Ferruginous hawk	*Buteo regalis*	Species of Concern	Species of Special Concern
Loggerhead shrike	*Lanius ludovicianus*	Species of Concern	Not listed
Northern goshawk	*Accipiter gentilis*	Species of Concern	Sensitive
Peregrine falcon	*Falco peregrinus*	Endangered	Endangered
Trumpeter swan	*Cygnus buccinator*	Species of Concern	Species of Special Concern
White-faced ibis	*Plegadis chihi*	Species of Concern	Not listed
Mammals			
Long-eared myotis	*Myotis evotis*	Species of Concern	Not listed
Pygmy rabbit	*Brachylagus (Sylvilagus) idahoensis*	Species of Concern	Species of Special Concern
Small-footed myotis	*Myotis subulatus*	Species of Concern	Not listed
Townsend's western big-eared bat	*Plecotus townsendii*	Species of Concern	Species of Special Concern
Reptiles			
Northern sagebrush lizard	*Sceloporus graciosus*	Species of Concern	Not listed

Key: INTEC, Idaho Nuclear Technology and Engineering Center.
Source: Werner 1997:WAG3 Report Summary.

The northern sagebrush lizard and three bat species of special concern are believed to have the greatest potential for occurrence within the environs of INTEC. This is based on a survey conducted in 1996 to evaluate the presence of suitable habitat for threatened and endangered species and species of concern. Bat usage of the area is likely to be limited to aerial hunting activities around the INTEC sewage disposal and percolation ponds. The sewage disposal and percolation ponds are routinely used by wildlife, and these facilities and a portion of the Big Lost River are within 1 km (0.6 mi) of FPF. The extent of potential usage of facility habitats by the northern sagebrush lizard is unknown (Werner 1997:WAG3 Report Summary).

Next Section

Citation Previous Section

3.3.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. INEEL has a well-documented record of cultural and paleontological resources. Guidance for the identification, evaluation, recordation, curation, and management of these resources is included in the *Final Draft Idaho National Engineering Laboratory Management Plan for Cultural Resources* (Miller 1995). There have been 1,506 cultural resource sites and isolated finds identified, including 688 prehistoric sites, 38 historic sites, 753 prehistoric isolates, and 27 historic isolates (DOE 1996a:3-129). While many significant cultural resources have been identified, only about 4 percent of the area within the INEEL site has been surveyed (DOE 1996a:3-129). Most surveys have been conducted near major facility areas in conjunction with major modification, demolition, or abandonment of site facilities.

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

3.3.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.3.9.1.1 General Site Description

Prehistoric resources identified at INEEL are generally reflective of Native American hunting and gathering activities. Resources appear to be concentrated along the Big Lost River and Birch Creek, atop buttes, and within craters or caves. They include residential bases, campsites, caves, hunting blinds, rock alignments, and limited-activity locations such as lithic and ceramic scatters, hearths, and concentrations of fire-affected rock. Most sites have not been formally evaluated for nomination to the National Register, but are considered to be potentially eligible. Given the rather high density of prehistoric sites at INEEL, additional sites are likely to be identified as surveys continue (DOE 1996a:3-129).

3.3.9.1.2 Proposed Facility Location

The INTEC area has been subject to a number of archaeological survey projects over the past two decades. Most of these investigations have been concentrated around the perimeter of the site and along existing roadways or power line corridors. Survey coverage in the area around Building 691 is complete. The inventory of identified resources includes campsites and isolated artifacts reflecting Native American hunting and gathering activities, as well as resources reflective of more recent attempts at homesteading and agriculture (Abbott, Crockett, and Moor 1997:16).

Most of the area near FPF has been surveyed, except for a small area east of the railroad tracks. Six archaeological resources have been identified within the surveyed area. Most of the sites are prehistoric and historic isolates that are not likely to yield additional information and are therefore not likely to be potentially eligible for National Register nomination (Abbott, Crockett, and Moor 1997:16).

3.3.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.3.9.2.1 General Site Description

Thirty-eight historic sites and 27 historic isolates have been identified at INEEL. These resources are representative of European-American activities, including fur trapping and trading, immigration, transportation, mining, agriculture, and homesteading, as well as more recent military and scientific/engineering R&D activities. Examples of historic resources include Goodale's Cutoff (a spur of the Oregon Trail), remnants of homesteads and ranches, irrigation canals, and a variety of structures from the World War II era. Experimental Breeder Reactor I, the first reactor to achieve a self-sustaining chain reaction using plutonium instead of uranium as the principal fuel component, is listed on the National Register and is designated a National Historic Landmark. Many other INEEL structures built between 1949 and 1974 are considered eligible for the National Register because of their exceptional scientific and engineering significance and their major role in the development of nuclear science and engineering since World War II. According to current studies, additional historic sites are likely to exist in unsurveyed portions of INEEL (DOE 1996a:3-129).

3.3.9.2.2 Proposed Facility Location

In the study area near INTEC are two historic sites, a homestead and nearby trash dump, that may be eligible for nomination to the National Register. These sites are potential sources of information on Carey Land Act–sponsored agricultural activities in the region (Abbott, Crockett, and Moor 1997:16).

A historic resource inventory of all buildings within INTEC is being conducted and will likely identify additional historic structures built between 1949 and 1974. Because it was constructed after 1974, FPF is not considered to be historic (Abbott, Crockett, and Moor 1997:16).

3.3.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts.

3.3.9.3.1 General Site Description

Native American resources at INEEL are associated with the two groups of nomadic hunters and gatherers that used the region at the time of European-American contact: the Shoshone and Bannock. Both of these groups used the area that now encompasses INEEL as they harvested floral and faunal resources and obsidian from Big Southern Butte or Howe Point. Because INEEL is considered part of the Shoshone-Bannock Tribes' ancestral homeland, it contains many localities that are important for traditional, cultural, educational, and religious reasons. This includes not only prehistoric archaeological sites, which are important in a religious or cultural heritage context, but also features of the natural landscape and air, plant, water, or animal resources that have special significance (DOE 1996a:3-129).

3.3.9.3.2 Proposed Facility Location

INTEC and the surrounding area may contain Native American resources. The existence and significance of any resources near INTEC would be established in direct consultation with the Shoshone and Bannock Tribes. INEEL recently initiated general consultation with the Shoshone and Bannock Tribes, and a working agreement was established (Abbott, Crockett, and Moor 1997:16, B-1, B-2). Consultations (see Chapter 5 for discussion) would be initiated with appropriate American Indian Tribal Governments upon publication of this SPD EIS to determine any concerns associated with the actions evaluated in this EIS.

3.3.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.3.9.4.1 General Site Description

Paleontological remains consist of fossils and their associated geologic information. The region encompassing INEEL has abundant and varied paleontological resources, including plant, vertebrate, and invertebrate remains from soils and lake and river sediments, and organic materials found in caves and archaeological sites (DOE 1995b:4.4-5).

3.3.9.4.2 Proposed Facility Location

Vertebrate fossils recovered from the Big Lost River floodplain consist of isolated bones or teeth from large mammals of the Pleistocene or Ice Age. These fossils were discovered during excavations and well-drilling operations. A single mammoth tooth was salvaged during the excavation of a percolation pond immediately south of INTEC. Other fossils have been recorded in the vicinities of the Test Reactor Area and Naval Reactors Facility. Occasional skeletal elements of fossil mammoth, horse, and camel have been retrieved from the Big Lost River diversion dam and Radioactive Waste Management Complex on the southwestern side of INEEL, and from river and alluvial fan gravels and Lake Terreton sediments near Test Area North (Abbott, Crockett, and Moor 1997:16).

3.3.10 Land Use and Visual Resources

3.3.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

INEEL is situated on approximately 2,307 km^2 (890 mi^2) of land in southeastern Idaho (DOE 1996a:3-107). INEEL is owned by the Federal Government and administered, managed, and controlled by DOE (DOE 1996a:3-107). It is primarily within Butte County, but portions of the site are also in Bingham, Jefferson, Bonneville, and Clark Counties. The site is roughly equidistant from Salt Lake City, Utah, and Boise, Idaho.

3.3.10.1.1 General Site Description

Lands surrounding INEEL are owned by the Federal Government, the State of Idaho, and private parties. Regional land uses include grazing, wildlife management, rangeland, mineral and energy production, recreation, and crop production. Approximately 60 percent of the surrounding area is used by sheep and cattle for grazing. Small communities and towns near the INEEL boundaries include Mud Lake to the east; Arco, Butte City, and Howe to the west; and Atomic City to the south (DOE 1995b:4.2-5). Two National Natural Landmarks border INEEL: Big Southern Butte (2.4 km [1.5 mi] south) and Hell's Half Acre (2.6 km [1.6 mi] southeast) (DOE 1996a:3-107). A portion of Hell's Half Acre National Natural Landmark is designated as a Wilderness Study Area. The Black Canyon Wilderness Study Area is also adjacent to INEEL (DOE 1996a:3-107).

Land-use categories at INEEL include facility operations, grazing, general open space, and infrastructure such as roads. Generalized land uses at INEEL and vicinity are shown in Figure 3–17. Facility operations include industrial and support operations associated with energy research and waste management activities. Land is also used for recreation and environmental research associated with the designation of INEEL as a National Environmental Research Park. Much of INEEL is open space that has not been designated for specific use. Some of this space serves as a buffer zone between INEEL facilities and other land uses. About 2 percent of the total INEEL site area (46 km^2 [18 mi^2]) is used for facilities and operation (DOE 1995b:4.2-1). Approximately 9,000 ha (22,240 acres) or 4 percent of the total acreage at INEEL is available for radioactive waste management facilities (DOE 1997a:vol. I, 4-20). Public access to most facilities is restricted. Approximately 6 percent of the INEEL site, or 140 km^2 (54 mi^2), is public roads and utilities that cross the site. Recreational uses include public tours of general facility areas and Experimental Breeder Reactor I (a National Historic Landmark), and controlled hunting, which is generally restricted to 0.8 km (0.5 mi) within the INEEL boundary. Between 1,210 km^2 (467 mi^2) and 1,420 km^2 (548 mi^2) are used for cattle and sheep grazing. A 3.6-km^2 (1.4-mi^2) portion of this land, at the junction of Idaho State Highways 28 and 33, is used by the U.S. Sheep Experiment Station as a winter feedlot for about 6,500 sheep (DOE 1995b:4.2-1).

INTEC is about 4.8 km (3 mi) north of the Central Facilities Area. The plant is situated on approximately 85 ha (210 acres) within the perimeter fence. An additional 22 ha (54 acres) of the plant area lie outside the fence (DOE 1997b). The INTEC complex houses reprocessing facilities for Government-owned defense and research spent fuels. Facilities at INTEC include spent fuel storage and reprocessing areas, a waste solidification facility and related waste storage bins, remote analytical laboratories, and a coal-fired steam-generating plant.

DOE land-use plans and policies applicable to INEEL include the *INEL Institutional Plan for FY 1994–1999* (DOE 1994b) and the *INEL Technical Site Information Report* (DOE 1995b:vol. 2, part A, 4.2-1). The *Institutional Plan* provides a general overview of INEEL facilities, strategic program descriptions, and major construction projects, and identifies specific technical programs and capital equipment needs. The *Information Report* (DOE 1995b:vol. 2, part A) presents a 20-year master plan for development activities at the site. Land-use planning for INEEL administrative and laboratory facilities located in the city of Idaho Falls is subject to Idaho Falls planning and zoning restrictions (DOE 1996a:3-107).

All county plans and policies encourage development adjacent to previously developed areas to minimize the need for infrastructure improvements and to avoid urban sprawl. Because INEEL is remote from most developed areas, INEEL lands and adjacent areas are not likely to experience residential and commercial development, and no new development is planned near the site. Recreational and agricultural uses, however, are expected to increase in the surrounding area in response to greater demand for recreational areas and the conversion of rangeland to cropland (DOE 1995b:4.2-5).

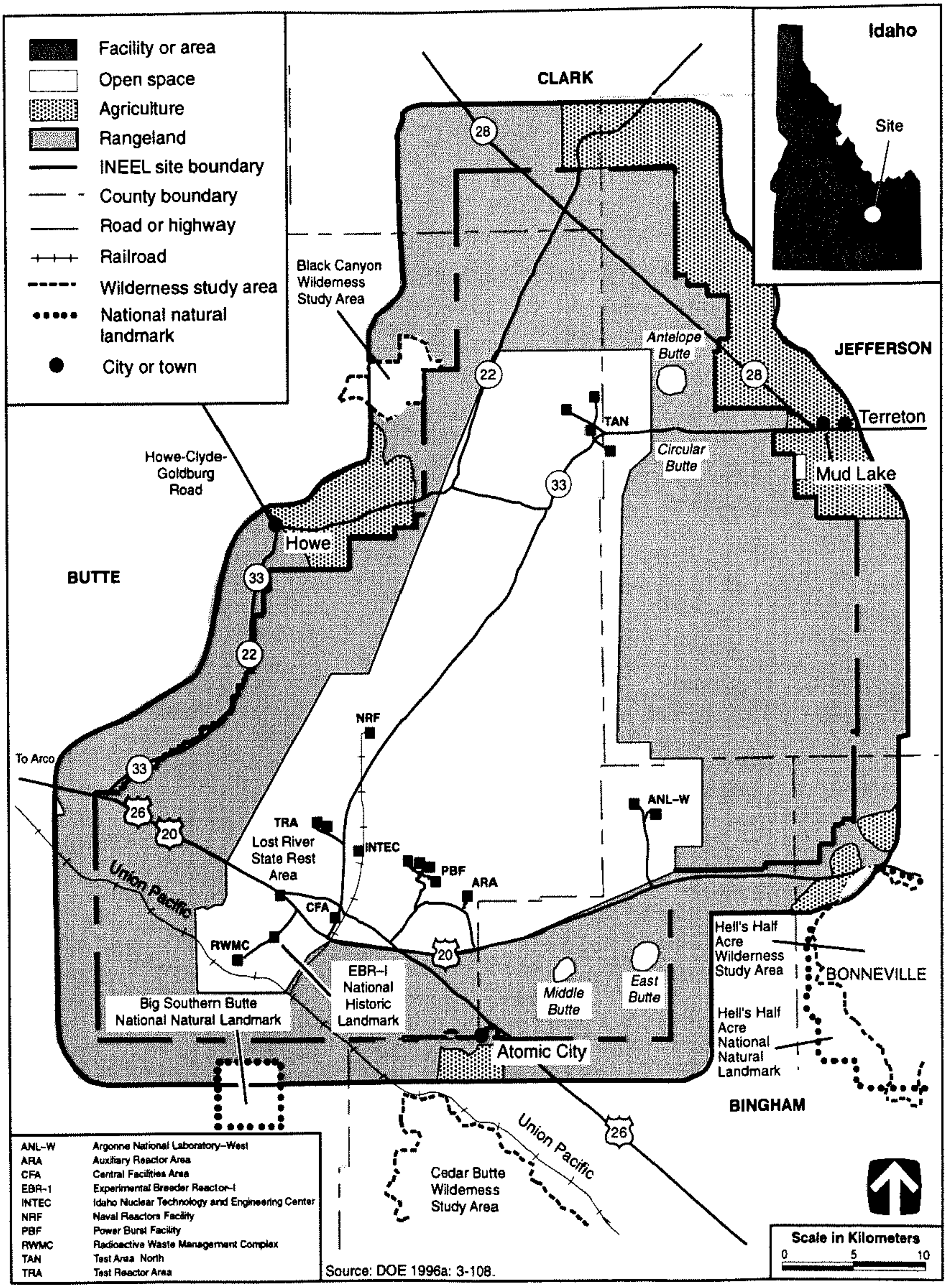


Figure 3–17. Generalized Land Use at INEEL and Vicinity

The Fort Bridger Treaty of July 3, 1868, secured the Fort Hall Reservation as the permanent homeland of the Shoshone-Bannock Peoples. According to the treaty, tribal members reserved rights to hunting, fishing, and gathering on surrounding unoccupied lands of the United States. While INEEL is considered occupied land, it was recognized that certain areas on the INEEL site have significant cultural and religious significance to the tribes. A *1994 Memorandum of Agreement with the Shoshone-Bannock Tribes* (DOE 1994c:1) provides tribal members access to the Middle Butte to perform sacred or religious ceremonies or other educational or cultural activities.

3.3.10.1.2 Proposed Facility Location

FPF is not currently being used and is being maintained on standby. This building, the largest at INTEC, is in the middle of an area of several warehouse and administrative facilities. The land, currently disturbed, is designated for waste-processing operations. FPF is 12 km (7.5 mi) from the nearest site boundary.

3.3.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.3.10.2.1 General Site Description

The INEEL site is bordered on the north and west by the Bitterroot, Lemhi, and Lost River mountain ranges. Volcanic buttes near the southern boundary of INEEL can be seen from most locations on the site. INEEL generally consists of open desert land predominantly covered by large sagebrush and grasslands. Pasture and farmland border much of the site.

Ten facility areas are on the INEEL site. Although INEEL has a master plan, no specific visual resource standards have been established. INEEL facilities have the appearance of low-density commercial/industrial complexes widely dispersed throughout the site. Structure heights range from about 3 to 30 m (10 to 100 ft); a few stacks and towers reach 76 m (250 ft). Although many INEEL facilities are visible from highways, most facilities are more than 0.8 km (0.5 mi) from public roads (DOE 1995b:4.5-1). The operational areas are well defined at night by the security lights.

The Craters of the Moon National Monument is about 20 km (12 mi) southwest of INEEL's western boundary. It includes a designated Wilderness Area, which must maintain Class I air quality standards. Lands adjacent to the site, under BLM jurisdiction, are designated as VRM Class 2 areas (DOE 1995b:4.5-2). This designation obliges preservation and retention of the existing character of the landscape. Lands within the INEEL site are designated as VRM Class 3 and 4, the most lenient classes in terms of modification (DOE 1995b:4.5-2). The Black Canyon Wilderness Study Area, adjacent to INEEL, is under consideration by BLM for Wilderness Area designation, approval of which would result in an upgrade of its VRM class from Class 2 to Class 1 (DOE 1995b:4.5-2). The Hell's Half Acre Wilderness Study Area is about 2.6 km (1.6 mi) southeast of INEEL's eastern boundary. This area, famous for its lava flow and hiking trails, is managed by BLM.

3.3.10.2.2 Proposed Facility Location

While FPF is the largest building on the site, the tallest structure is the stack connected to INTEC; it is 76 m (250 ft) tall. INTEC is visible in the middle ground from State Highways 20 and 26, with Saddle Mountain in the background. Natural features of visual interest within a 40-km (25-mi) radius include Big Lost River at 0.8 km (0.5 mi), Big Southern Butte National Natural Landmark at 20 km (12 mi), Saddle Mountain at 40 km (25 mi), Middle Butte at 18 km (11 mi), Hell's Half Acre Wilderness Study area at 35 km (22 mi) and East Butte at 23 km (14 mi) (Abbott, Crockett, and Moor 1997:4).

3.3.11 Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various proposed alternatives.

3.3.11.1 General Site Description

INEEL has extensive production, service, and research facilities. An extensive infrastructure supports these facilities, as shown in Table 3–24.

Table 3–24. INEEL Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	445[a]	445[a]
Railroads (km)	48	48
Electricity		
Energy consumption (MWh/yr)	232,500	394,200
Peak load (MW)	42	124
Fuel		
Natural gas (m^3/yr)	NA	NA
Oil (l/yr)[b]	5,820,000	16,000,000[c]
Coal (t/yr)	11,340	11,340[c]
Water (l/yr)	6,000,000,000[d]	43,000,000,000[e]

[a] Includes paved and unpaved roads.
[b] Includes fuel oil and propane.
[c] As supplies get low, more can be supplied by truck or rail.
[d] See Werner 1997:2.
[e] See DOE 1995b:vol. II, part A, 4.13-1.
Key: NA, not applicable.
Source: DOE 1996a:3-110.

3.3.11.1.1 Transportation

The road network at INEEL provides for onsite transportation; the railroads for deliveries of large volumes of coal and oversized structural components. Commercial shipments are by truck and plane, but some bulk materials are transported by train, and waste by truck and train (DOE 1995b:vol. I, 4.11-1).

About 140 km (87 mi) of paved surface has been developed out of the 445 km (277 mi) of roads on the site, including about 29 km (18 mi) of service roads that are closed to the public. Most of the roads are adequate for the current level of normal transportation activity and could handle increased traffic volume (DOE 1995b:vol. I, 4.11-1).

Idaho Falls receives railroad freight service from Butte, Montana, to the north, and from Pocatello, Idaho, and Salt Lake City, Utah, to the south. The Union Pacific Railroad's Blackfoot-to-Arco Branch crosses the southern portion of INEEL and provides rail service to the site. This branch connects with a DOE spur line at the Scoville Siding, then links with developed areas within INEEL. Rail shipments to and from INEEL usually are limited to bulk commodities, spent nuclear fuel, and radioactive waste (DOE 1995b:vol. I, 4.11-3).

3.3.11.1.2 Electricity

Commercial electric power is supplied to INEEL from the Antelope substation through two feeders to the federally owned Scoville substation, which supplies electric power directly to the site electric power distribution system. Electric power supplied by Idaho Power Company is generated by hydroelectric generators along the Snake River in southern Idaho and by the Bridger and Valmy coal-fired thermal electric generation plants in southwestern Wyoming and northern Nevada (DOE 1995b:vol. II, part A, 4.13-2). Characteristics of this power pool are summarized in Table 3.4.2–2 of the *Storage and Disposition Final PEIS* (DOE 1996a:3-111).

The average electrical availability at INEEL is about 394,200 MWh/yr; the average usage, about 232,500 MWh/yr. The peak load capacity for INEEL is 124 MW; the current peak load usage, about 42 MW (DOE 1996a:3-110).

3.3.11.1.3 Fuel

Fuels consumed at INEEL include several liquid petroleum fuels, coal, and propane gas. All fuels are transported to the site for storage and use. Fuel storage is provided for each facility, and the inventories are restocked as necessary (DOE 1995b:vol. II, part A, 4.13-2). The current site usage is about 5.8 million l/yr (1.5 million gal/yr). The current site usage of coal is about 11,340 t/yr (12,500 tons/yr) (DOE 1996a:3-110). If additional coal or fuel oil were needed during the year, it could be shipped onto the site.

3.3.11.1.4 Water

The Snake River Plain Aquifer is the source of all water at INEEL (DOE 1996a:3-119).The water is provided by a system of about 30 wells, together with pumps and storage tanks. That system is administered by DOE, which holds the Federal Reserved Water Right for the site of 43 billion l/yr (11 billion gal/yr) (DOE 1995b:vol. II, part A, 4.13-1). The current site usage is 6 billion l/yr (1.6 billion gal/yr) (Werner 1997:2).

3.3.11.1.5 Site Safety Services

DOE operates three fire stations at INEEL. These stations are at the north end of Test Area North, at ANL–W, and in the Central Facilities Area. Each station has a minimum of one engine company capable of supporting any fire emergency in its assigned area. The fire department also provides the site with ambulance, emergency medical technician, and hazardous material response services (DOE 1995b:vol. II, part A, 4.13-3).

3.3.11.2 Proposed Facility Location

A separate utility tunnel running off the main INTEC utility tunnel was completed and water, steam condensate, air, and other lines have been completed up to, and in some cases into, FPF when this facility was built. A summary of the infrastructure characteristics of INTEC is presented as Table 3–25.

Table 3–25. INEEL Infrastructure Characteristics for INTEC

Resource	Current Usage	Capacity
Electricity		
Energy consumption (MWh/yr)	60,000	262,800
Peak load (MW)	9.2[a]	31.4[b,c]
Fuel		
Natural gas (m^3/yr)	NA	NA
Oil (l/yr)	757,000	1,112,720[d,e]
Coal (t/yr)	13,000	NA[e]
Water (l/yr)	45,420,000	227,100,000

[a] Demand.
[b] Equivalent to 30 MW continuous use per year.
[c] Based on a 95 percent power factor.
[d] Available capacity is INTEC tank storage capacity in liters.
[e] As supplies get low, more can be supplied by truck or rail.
Key: INTEC, Idaho Nuclear Technology and Engineering Center; NA, not applicable.
Source: Abbott, Crockett, and Moor 1997:20; Werner 1997:1.

3.3.11.2.1 Electricity

Electric power for INTEC is routed into the main electrical room from a 14-kV feeder in Unit Substation 2, north of the building. The current capacity available for INTEC is 262,800 MWh/yr (Abbott, Crockett, and Moor 1997:20).

3.3.11.2.2 Fuel

Fuel oil and propane are supplied from INTEC. The current capacity of fuel oil and propane is approximately 1.1 million l/yr (291,000 gal/yr); the usage, approximately 757,000 l/yr (200,000 gal/yr) (Abbott, Crockett, and Moor 1997:20).

3.3.11.2.3 Water

Water service is available through connection to the INTEC water supply system, which obtains its water from two deep wells located north of the INTEC main process area. The water withdrawn from the Snake River Plain Aquifer is a small fraction of the available supply (Abbott, Crockett, and Moor 1997:9). The current annual capacity of water available for FPF is about 230 million l/yr (61 million gal/yr); and the current usage for the facility is about 45 million l/yr (12 million gal/yr) (Werner 1997:1).

3.4 PANTEX PLANT

Pantex is in Carson County along U.S. Highway 60 and lies about 27 km (17 mi) northeast of downtown Amarillo, Texas (Figure 2–4). Pantex lies in the Texas Panhandle on the Llano Estacado (staked plains) portion of the Great Plains. The topography at Pantex is relatively flat, characterized by rolling grassy plains and natural playa basins. The term "playa" is used to describe the more than 17,000 ephemeral lakes in the Texas Panhandle, usually less than 1 km (0.6 mi) in diameter, that receive water runoff from the surrounding area. The region is a semiarid farming and ranching area. Pantex is surrounded by agricultural land, but several significant industrial facilities are also nearby (DOE 1996a:3-146).

Pantex was first used by the U.S. Army for loading conventional ammunition shells and bombs from 1942 to 1945. In 1951, the Atomic Energy Commission arranged to begin rehabilitating portions of the original plant and constructing new facilities for nuclear weapons operations. The current missions are shown in Table 3–26. Weapons assembly, disassembly, and stockpile surveillance activities involve handling (but not processing) of encapsulated uranium, plutonium, and tritium, as well as a variety of nonradioactive hazardous or toxic chemicals (DOE 1996a:3-146).

Table 3–26. Current Missions at Pantex

Mission	Description	Sponsor
Plutonium storage	Provide storage of pits from dismantled nuclear weapons	Assistant Secretary for Defense Programs
High explosive(s) components	Manufacture for use in nuclear weapons	Assistant Secretary for Defense Programs
Weapons assembly	Assemble new nuclear weapons for the stockpile	Assistant Secretary for Defense Programs
Weapons maintenance	Retrofit, maintain, and repair stockpile weapons	Assistant Secretary for Defense Programs
Quality assurance	Stockpile quality assurance testing and evaluation	Assistant Secretary for Defense Programs
Weapons disassembly	Disassemble stockpile weapons as required	Assistant Secretary for Defense Programs
Test and training programs	Assemble nuclear weapon-like devices for training	Assistant Secretary for Defense Programs
Weapons dismantlement	Dismantle nuclear weapons no longer required	Assistant Secretary for Defense Programs
Development support	Provide support to design agencies as requested	Assistant Secretary for Defense Programs
Environmental management	Environmental restoration and waste management activities	Assistant Secretary for Environmental Management

Source: DOE 1996a:3-146.

DOE Activities. All DOE activities at Pantex, except for environmental restoration and some waste management programs, fall under the DOE Office of the Assistant Secretary for Defense Programs. Historically, DOE's mission for Pantex primarily included assembly and delivery to the U.S. Department of Defense (DoD) a variety of nuclear weapons. Today, the primary roles of Pantex are the disassembly of U.S. nuclear weapons being returned to DOE by DoD, maintenance and repair of nuclear weapons, and interim staging of plutonium pits. These operations are in compliance with the negotiated downsizing of the U.S. and the former Soviet nuclear forces (DOE 1996a:3-147).

Other activities that have been, and will continue to be, conducted under DOE's national security mission include certain maintenance and monitoring activities of the remaining nuclear weapons stockpile, modification and assembly of existing nuclear weapons systems, and production of high-explosive components for nuclear weapons. DOE also conducts quality evaluation of weapons, quality assurance testing of weapons components, and R&D supporting nuclear weapons activities at the plant. DOE's national security responsibilities are mandated by statutes, Presidential directives, and congressional authorization and appropriations (DOE 1996a:3-147).

The change in mission emphasis from assembly to disassembly of nuclear weapons has caused an increase in some waste streams. Waste management operations at Pantex in the near term would add facilities to enhance capabilities to adequately handle existing waste streams. Improved facilities for hazardous waste staging, treatment, and storage would be coupled with increased use of commercial offsite facilities to treat mixed waste streams. Upon completion of the current backlog of dismantlements due to stockpile reduction, waste generation is likely to decrease (DOE 1996a:3-147).

Non-DOE Activities. Texas Tech University pursues agricultural activities on both DOE-owned and DOE-leased property (DOE 1996a:3-147).

3.4.1 Air Quality and Noise

3.4.1.1 Air Quality

Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

3.4.1.1.1 General Site Description

The climate at Pantex and the surrounding region is characterized as semiarid with hot summers and rather cold winters. The average annual temperature in the Amarillo region is 13.8 °C (56.9 °F); temperatures range from an average daily minimum of -5.7 °C (21.8 °F) in January to an average daily maximum of 32.8 °C (91.1 °F) in July. The average annual precipitation is 49.8 cm (19.6 in). Prevailing winds at Pantex are from the south. The average annual windspeed is 6 m/s (13.5 mph) (NOAA 1994a). Additional information related to meteorology and climatology at Pantex is presented in Appendix F of the *Storage and Disposition Final PEIS* (DOE 1996a:F-11, F-12) and in the site environmental information document (M&H 1996a:6-1–6-19).

Pantex is within the Amarillo-Lubbock Intrastate AQCR #211. None of the areas within Pantex and this AQCR are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1997f). Applicable NAAQS and Texas State ambient air quality standards are presented in Table 3–27.

There are no PSD Class I areas within 100 km (62 mi) of Pantex. None of the facilities at Pantex have been required to obtain a PSD permit (DOE 1996f:4-118–4-120).

The primary emission sources of criteria pollutants at Pantex are the steam plant boilers, the explosives-burning operation, and emissions from onsite vehicles. Emission sources of hazardous or toxic air pollutants include the high-explosives synthesis facility, the explosives-burning operation, paint spray booths, miscellaneous laboratories, and other small operations (DOE 1996f:4-134). The boilers and high-explosives synthesis facility operate under air permits from the Texas Natural Resource Conservation Commission (TNRCC). The paint

Table 3–27. Comparison of Ambient Air Concentrations From Pantex Sources With Most Stringent Applicable Standards or Guidelines, 1993

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	Concentration ($\mu g/m^3$)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	161
	1 hour	40,000[b]	924
Nitrogen dioxide	Annual	100[b]	0.90
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50[b]	8.73
	24 hours	150[b]	88.5
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	80[b]	<0.01
	24 hours	365[b]	<0.01
	3 hours	1,300[b]	<0.01
	30 minutes	1,048[f]	<0.01
Other regulated pollutants			
Hydrogen sulfide	30 minutes	112[f]	(g)
Total suspended particulates	3 hours	200[f]	(h)
	1 hour	400[f]	(h)
Hazardous and other toxic compounds			
Benzene	1 hour	75[i]	19.4[j]
	24 hours	3[i]	(j)
Ethylene glycol	1 hour	260[i]	(h)
	24 hours	26[i]	(h)

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (EPA 1997b), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is ≤1. The 1-hr ozone standard applies only to nonattainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 $\mu g/m^3$. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standard is ≤1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and State standard.

[c] Federal standard.

[d] Not directly emitted or monitored by the site.

[e] No data is available with which to assess $PM_{2.5}$ concentrations.

[f] State standard.

[g] No sources identified at the site.

[h] No site boundary concentrations from Pantex facilities presented in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components.*

[i] TNRCC effects screening levels are "tools" used by the Toxicology and Risk Assessment Staff to evaluate impacts of air pollutant emissions. They are not ambient air standards. If ambient levels of air contaminants exceed the screening levels, it does not necessarily indicate a problem, but would trigger a more indepth review. The levels are set where no adverse effect is expected.

[j] Concentration reported as a 30-min average. No 24-hr concentration reported.

Note: The NAAQS also includes standards for lead. No sources of lead emissions have been identified for any of the alternatives presented in Chapter 4. Emissions of other air pollutants not listed here have been identified at Pantex, but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996f). EPA recently revised the ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 $\mu g/m^3$ (0.12 ppm) to an 8-hr concentration of 157 $\mu g/m^3$ (0.08 ppm). During a transition period while States are developing State implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in nonattainment areas (EPA 1997c:38855). For particulate matter, the current PM_{10} annual standard is retained, and two $PM_{2.5}$ standards are added. These standards are set at a 15-$\mu g/m^3$ 3-year annual arithmetic mean based on community-oriented monitors and a 65 $\mu g/m^3$ 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr PM_{10} standard is based on the 99th percentile of 24-hr concentrations. The existing PM_{10} standards will continue to apply in the interim period (EPA 1997d:38652).

Source: DOE 1996f:4-127–4-133; EPA 1997b; TNRCC 1997a, 1997b.

spray booths, miscellaneous laboratories, and other small operations are allowed under TNRCC standard exemptions. The explosive-burning operation is allowed under the TNRCC hazardous waste permit (DOE 1997d:21, 22).

With the exception of thermal treatment of high explosives at the burning ground, most stationary sources of nonradioactive atmospheric releases are fume hoods and building exhaust systems some of which have HEPA filters for control of particulate emissions. Table 3–27 presents the ambient air concentrations attributable to sources at Pantex, which are based on emissions for the year 1993. These emissions were modeled using meteorological data from 1988 (DOE 1996f:4-123) and represent maximum output conditions. Actual annual emissions for some pollutants are somewhat less than these levels, and the estimated concentrations bound the actual Pantex contribution to ambient levels. Only those pollutants that would be emitted for any of the surplus plutonium disposition alternatives are presented. Additional information on ambient air quality at Pantex and detailed information on emissions of other pollutants at Pantex are discussed in the *Final EIS for the Continued Operation of Pantex* (DOE 1996f:4-117–4-135, B-3–B-61) and the 1996 *Environmental Report for Pantex Plant* (DOE 1997d:21, 22, 78–84). Concentrations of nonradiological air pollutants shown in Table 3–27 are in compliance with applicable regulations or are below applicable health effects-screening levels, the concentration of hazardous air pollutants determined by TNRCC to have minimal effect on human health and the environment.

Measurements of PM_{10} and various volatile organic compounds are made at Pantex. During 1993, only one 24-hr PM_{10} measurement exceeded the NAAQS level, while in 1994 the PM_{10} NAAQS level was exceeded 1 day in January and 1 day in June. Windblown dust is indicated as a major contributor to some of these exceedances. The concentrations of carbon monoxide, sulfur dioxide, and nitrogen dioxide from Pantex combined with those from background (non-Pantex) sources—are expected to be in compliance with the ambient air quality standards. Measured concentrations of 1-2-dibromoethane exceeded the effects-screening levels once in 1995. However, monitoring in the last quarter of 1995 and 1996 showed that all organic compounds measured were below their respective effects-screening levels (DOE 1996f:4-121–4-123; M&H 1997:8, 12, 35–37). 1-2-dibromoethane is not emitted at Pantex. The air quality monitoring program is described in the annual site environmental monitoring reports (DOE 1997d).

Annual PM_{10} measured concentrations during 1995 were less than 24 $\mu g/m^3$ at all monitoring locations, and except one measurement of 170 $\mu g/m^3$ during a grass fire, 24-hr PM_{10} measured concentrations were below 129 $\mu g/m^3$ (TNRCC 1997c:13–15).

3.4.1.1.2 Proposed Facility Location

The meteorological conditions described for Pantex are considered to be representative of the Zone 4 area. Primary sources of pollutants in Zone 4 include a natural gas-fired boiler, drum sampling, and bulk handling of chemicals (DOE 1996f:B-10–B-29).

3.4.1.2 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.4.1.2.1 General Site Description

Major noise emission sources within Pantex include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, construction and materials-handling equipment, vehicles), as well as small arms firing, alarms, and explosives detonation. Most Pantex industrial facilities are far enough from the site boundary that noise levels from these sources at the boundary are barely distinguishable from background noise. However, some noise from explosives detonation can be heard at residences north of the site, and small arms weapons firing can be heard at residences to the west (DOE 1996a:3-153, 1996f:4-161–4-170).

The acoustic environment along the Pantex boundary and at nearby residences away from traffic noise is typical of a rural location. The day-night average sound levels are in the range, 35 to 50 dBA, that is typical of rural areas (EPA 1974:B-4). Noise survey results in areas adjacent to Pantex indicate that ambient sound levels are generally low, with natural sounds and distant traffic being the primary sources. Traffic, aircraft, trains, and agricultural activities result in higher short-term levels (M&H 1996a:11-1–11-19). Traffic is the primary source of noise at the site boundary and at residences near roads. Traffic noise is expected to dominate sound levels along major roads in the area, such as U.S. Route 60. The residents most likely to be affected by noise from plant traffic along Pantex access routes are those living along Farm-to-Market (FM) 2373 and FM 683 (DOE 1996a:3-153).

Measurements of equivalent sound levels for traffic noise and other sources along the roads bounding Pantex are 53 to 62 dBA for FM 2373 at about 400 m (1300 ft) from the road; 51 to 58 dBA for FM 293 at about 70 m (230 ft); 44 to 65 dBA for FM 683 at about 40 m (130 ft); and 51 dBA for U.S. Route 60 at about 225 m (740 ft). These levels are based on a limited number of 30-min samples taken during peak and offpeak traffic periods; mostly at locations within the site boundary (M&H 1996a:11-11–11-15). The levels represent the range of daytime traffic noise levels at residences near the site.

Other sources of noise include aircraft, wind, insect activity, and agricultural activity. Except for the prohibition of nuisance noise, neither the State of Texas nor local governments have established any regulations that specify acceptable community noise levels applicable to Pantex (DOE 1996a:F-32).

The EPA guidelines for environmental noise protection recommend an average day-night sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (DOT 1995). It is expected that for most residences near Pantex, the day-night average sound level is less than 65 dBA and is compatible with the residential land use.

3.4.1.2.2 Proposed Facility Location

No distinguishing noise characteristics of Zone 4 have been identified. Zone 4 is far enough—1.8 km (1.1 mi)—from the site boundary that noise levels from the facilities are barely distinguishable from background levels.

3.4.2 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders.

Next Section

3.4.2.1 Waste Inventories and Activities

Pantex manages the following types of waste: LLW, mixed LLW, hazardous, and nonhazardous. TRU waste and mixed TRU waste are not normally generated and no HLW is currently generated at Pantex. Waste generation rates and the inventory of stored waste from activities at Pantex are provided in Table 3–28. Table 3–29 summarizes Pantex waste management capabilities. More detailed descriptions of the waste management system capabilities at Pantex are included in the *Storage and Disposition Final PEIS* (DOE 1996a:3-180–3-183, E-49–E-62) and the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (DOE 1996f:4-229).

Table 3–28. Waste Generation Rates and Inventories at Pantex

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact handled	0	0[b]
Remotely handled	0	0
LLW	139	208
Mixed LLW	24[c]	135
Hazardous	486[c,d]	153[e,f]
Nonhazardous		
Liquid	473,125[g]	NA[f]
Solid	8,007[c]	311[e,f,h]

[a] Includes mixed TRU waste.
[b] DOE 1997e:1-2.
[c] DOE 1997d:19.
[d] Includes TSCA-regulated wastes.
[e] DOE 1996f:4-233.
[f] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
[g] King 1997a.
[h] Largely composed of asbestos waste.

Key: LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996e:15, 16, except as noted.

EPA placed Pantex on the National Priorities List on May 31, 1994. Currently, environmental restoration activities are conducted in compliance with CERCLA and a RCRA permit issued in April 1991, and modified in February 1996. Environmental restoration activities are expected to be completed in 2000 (DOE 1996a:3-180). More information on regulatory requirements for waste disposal is provided in Chapter 5.

3.4.2.2 Transuranic and Mixed Transuranic Waste

Pantex does not generate or manage TRU waste as a result of normal operations, although there are procedures in place to manage TRU waste if it is generated. The small quantity of TRU waste (<1 m^3) that was stored in Building 12-24 was recently moved to LANL (DOE 1997e:1-2).

3.4.2.3 Low-Level Waste

Compactible solid LLW is processed at the LLW Compactor and stored along with the noncompactible materials for shipment to the Nevada Test Site (NTS) or a commercial vendor. Liquid LLW is being stored on the site awaiting a treatment process (DOE 1996a:3-180).

Table 3–29. Waste Management Capabilities at Pantex

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment Facility (m³/yr)								
11-09 South - Scintillation Vial Crusher/Segregator	Variable[a]	Online[b]			X			
11-09 South - Sort/Segregation and Decontamination Activities	Variable[a]	Online[b]			X	X		
11-09 South - Fluorescent Bulb Crusher	Variable[a]	Online[b]					X	
12-17 - Evaporator for Tritiated Water	Campaign	Online			X			
12-19 East - Rotary Evaporator Vacuum Distillation Units (2)	Campaign	Online						X
12-19 East - Fractional Distillation Unit	Campaign	Online						X
12-19 East - HE Precipitation Process	Campaign	Online						X
12-42 - Compactor/Drum Crusher	Variable[a]	Online[b]			X			
16-18 - HWTPF	750	Planned for 1999			X	X	X	
16-18 - HWTPF Waste Compacting	90	Planned for 1999			X	X	X	X
16-18 - HWTPF Drum Crushing	208	Planned for 1999			X	X	X	X
16-18 - HWTPF Wastewater Evaporation System	45	Planned for 1999			X			
16-18 - HWTPF Misc Drum Operations (including neutralization and filtration)	Various	Planned for 1999			X	X	X	
16-18 - HWTPF Drum Rinsing System	45	Planned for 1999					X	
16-18 - HWTPF Fluorescent Bulb Crusher	12	Planned for 1999					X	
16-18A - Solvent Recovery Unit	348	Planned for 1999					X	
16-18A - Scintillation Vial Crushing	90	Planned for 1999			X			X
Burning Ground Thermal Processing Units	Variable[c]	Online				X	X	
Wastewater Treatment Facility	946,250	Online						X
Storage Facility (m³)								
11-07A & B Pads - Container Storage Areas	402	Online			X	X	X	X
11-07 North Pad - Container Storage Unit	125	Online			X	X	X	X
11-09 North Building - Container Storage Area	379	Online			X	X	X	X

Table 3–29. Waste Management Capabilities at Pantex (Continued)

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
16-16 Building - Hazardous Waste Staging Facility	1,047	Online			X	X	X	X
Disposal Facility (m^3)								
Construction Debris Landfill (Zone 10)	21,208	Online						X

[a] Capacity included in HWTPF.
[b] Unit will move to HWTPF when operational in 1999.
[c] Permit limitations are per burning event.
Key: Haz, hazardous; HE, high explosives; HWTPF, Hazardous Waste Treatment and Processing Facility; LLW, low-level waste; TRU, transuranic.
Source: King 1997b; Lemming 1998; M&H 1997:28.

Most LLW is shipped to NTS for disposal. Pantex is presently approved to ship a number of LLW streams to NTS for disposal. Other waste streams have been through the NTS review process and have approval pending or may be included at a later date. These wastes are currently stored on the site. Radioactively contaminated classified weapon components that cannot be demilitarized and sanitized are sent to the NTS classified LLW repository (DOE 1996f:4-233, 4-235).

3.4.2.4 Mixed Low-Level Waste

Pantex treats mixed LLW in three areas: the Burning Ground, Building 11-9, and Building 12-17 (King 1997b). The Burning Ground is an open-burning area where explosives, explosive-contaminated waste, and explosive-contaminated spent solvents are burned. A large-volume reduction is attained by this treatment, and some wastes are rendered nonhazardous due to elimination of the high-explosive reactivity hazard (DOE 1996a:E-50). Building 11-9 in Zone 11 is permitted for the treatment and processing of mixed LLW and hazardous waste in tanks and containers (DOE 1996f:4-236).

Pantex has developed the *Pantex Plant Federal Facility Compliance Act Compliance Plan* to provide mixed waste treatment capability for all mixed waste streams in accordance with the FFCA of 1992 (DOE 1996a:3-180). Currently, some mixed LLW is stored on the site until it can be profiled and accepted by offsite treatment and disposal facilities, in accordance with the Pantex site treatment plan (DOE 1997d:sec. 2.3.1). The Hazardous Waste Treatment and Processing Facility is being planned to treat mixed waste (DOE 1996a:E-50).

3.4.2.5 Hazardous Waste

Pantex stores some hazardous waste on the site. Most hazardous waste generated at Pantex is shipped off the site for recycle, treatment, or disposal at commercial facilities. High explosives, high-explosive contaminated materials, and high-explosive contaminated solid wastes are burned under controlled conditions at the Burning Ground. Ash, debris, and residue resulting from this burning are transported off the site for approved disposal at a commercial RCRA-permitted facility (DOE 1996a:3-183, E-51). Polychlorinated biphenyls waste is transported to offsite permitted facilities for treatment and disposal (DOE 1996f:4-238).

3.4.2.6 Nonhazardous Waste

Management of solid waste is regulated by TNRCC. Nonhazardous waste generated at Pantex falls into Texas Class 1 or Class 2 designation. Some solid waste (inert and insoluble materials like certain scrap metals, bricks, concrete, glass, dirt, and certain plastics and rubber items that are not readily degradable) is designated as Class 2 nonhazardous waste and is disposed on the site in the Construction Debris Landfill in Zone 10. The onsite landfill is approved for both Class 2 and Class 3 wastes. The remainder of the Class 2 nonhazardous waste generated at Pantex is sanitary waste such as cafeteria and lunchroom waste, paper towels, and office waste. Most of this waste is disposed off the site at permitted landfills (such as the city of Amarillo landfill), although some goes to offsite commercial incinerators (DOE 1997d:sec. 2.3.1).

Class 1 nonhazardous waste (such as asbestos), though not hazardous by EPA's definition relative to RCRA, is handled in much the same manner as hazardous waste and is sent to offsite treatment or disposal facilities (DOE 1997d:sec. 2.3.1). Medical waste is dispositioned through a commercial vendor who picks up and transports the waste (DOE 1996f:4-238).

Sanitary sewage and some pretreated industrial wastewater are treated by the Wastewater Treatment Facility and discharged to Playa 1 (DOE 1996f:4-238). The treated effluent from the system either evaporates or infiltrates into the ground. A proposed upgrade to the sanitary wastewater treatment system would ensure that effluent limitations are met. Included in this project is the upgrade of the existing sewage treatment lagoon, repair and replacement of deteriorated sewer lines, construction of a closed system to eliminate the use of open ditches for conveyance of industrial wastewater discharges, and improvements to the plant storm-water management system (DOE 1996a:3-183, E-51).

3.4.2.7 Waste Minimization

The goals of the Pantex pollution prevention and waste minimization program are to minimize the volume of waste generated to the extent that it is technologically and economically practical; reduce the hazard of waste through substitution or process modification; minimize contamination of real property and facilities; minimize exposure and associated risk to human health and the environment; and ensure safe, efficient, and compliant long-term management of all wastes (DOE 1996a:3-180).

Although an overall increase in waste generation of 49 percent occurred in 1996, this was largely a result of the removal of contaminated soil from ditches as part of the environmental restoration program. In fact, from 1987 to 1996, the generation of routine hazardous waste decreased by more than 99 percent. The generation of other waste types has also been reduced. The goal of reducing the generation of mixed LLW by 50 percent from 1992 levels has already been met. Another goal is to halve the generation of LLW and State-regulated (Class 1) wastes by 1999 (DOE 1997d:sec. 3.5). Pantex also participates in the Clean Texas 2000 pollution prevention program and has committed to a 50 percent reduction in 1987 chemical releases and hazardous waste generation by the year 2000 (DOE 1996f:4-232). Currently, telephone directories, paper, certain plastics, and some steel and aluminum cans are being recycled (DOE 1996a:E-51).

3.4.2.8 Preferred Alternatives From the WM PEIS

Preferred alternatives from the WM PEIS (DOE 1997a:summary, 109) are shown in Table 3–30 for the four waste types analyzed in this SPD EIS. A decision on the future management of these wastes could result in the construction of new waste management facilities at Pantex, and the closure of other facilities. Decisions on the various waste types are expected to be announced in a series of RODs to be issued on this WM PEIS. In fact, the TRU waste ROD was issued on January 20, 1998 (DOE 1998a). The ROD states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ." More detailed information on DOE's alternatives for the future configuration of waste management facilities at Pantex is presented in the WM PEIS and the TRU waste ROD.

Table 3–30. Preferred Alternatives From the WM PEIS

Waste Type	Preferred Action
TRU and mixed TRU	DOE prefers treatment and storage of Pantex TRU waste at LANL.[a]
LLW	DOE prefers to treat Pantex LLW on the site. DOE prefers to ship Pantex LLW to one of 2 or 3 regional disposal sites.
Mixed LLW	DOE prefers to treat mixed LLW generated at Pantex on the site consistent with Pantex's site treatment plan. DOE prefers to ship Pantex mixed LLW to one of 2 or 3 regional disposal sites.
Hazardous	DOE prefers to continue to use commercial facilities for hazardous waste treatment.

[a] ROD for TRU waste (DOE 1998a) states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ." The ROD did not specifically address TRU waste generated at Pantex, since there is currently no TRU waste in inventory at Pantex.

Key: LANL Los Alamos National Laboratory; LLW, low-level waste; TRU, transuranic.

Source: DOE 1997a:summary, 26, 109.

3.4.3 Socioeconomics

Statistics for employment and regional economy are presented for the REA as defined in Appendix F.9, which encompasses 32 counties surrounding Pantex in Texas and New Mexico. Statistics for population, housing, community services, and local transportation are presented for the ROI, a three-county area (in Texas) in which 93.7 percent of all Pantex employees reside as shown in Table 3–31. In 1997, Pantex employed 2,944 persons (about 1.2 percent of the REA civilian labor force) (King 1997a).

Table 3–31. Distribution of Employees by Place of Residence in the Pantex Region of Influence, 1997

County	Number of Employees	Total Site Employment (Percent)
Randall	1,629	55.3
Potter	965	32.7
Carson	167	5.7
ROI total	2,761	93.7

Source: King 1997a.

3.4.3.1 Regional Economic Characteristics

Selected employment and regional economy statistics for the Pantex REA are summarized in Figure 3–18. Between 1990 and 1996, the civilian labor force increased 19.6 percent to 250,847. In 1996, the unemployment rate in the REA was 4.6 percent, which was lower than the 5.6 percent unemployment rate in Texas and the 8.1 percent unemployment rate in New Mexico (DOL 1997a).

In 1995, government activities represented the largest sector of the employment in the REA (21.9 percent). This was followed by retail trade (19.6 percent) and services (18.8 percent). The totals for these employment sectors in Texas were 18.0 percent, 18.7 percent, and 24.7 percent, respectively. The totals for these employment sectors in New Mexico were 22 percent, 20.3 percent, and 26.7 percent, respectively (DOL 1997b).

3.4.3.2 Population and Housing

In 1996, the ROI population totaled 212,729. Between 1990 and 1996, the ROI population increased 9.6 percent compared with the 12.2 percent increase in Texas (DOC 1997). Between 1980 and 1990, the

[a]DOL 1997a.
[b]DOL 1997b.

REA Regional economic area

Figure 3–18. Employment and Local Economy for the Pantex Regional Economic Area and the States of Texas and New Mexico

number of housing units in the ROI increased by about 15.8 percent, compared with the 26.3 percent increase in Texas. The total number of housing units within the ROI for 1990 was 83,590 (DOC 1994). The 1990 homeowner vacancy rate for the ROI, 3.3 percent, was similar to the Texas rate of 3.2 percent. The renter vacancy rate, 14.2 percent, was also similar to Texas' 13 percent (DOC 1990a). Population and housing trends in the Pantex ROI are summarized in Figure 3–19.

3.4.3.3 Community Services

3.4.3.3.1 Education

Eight school districts provide public education in the Pantex ROI. As shown in Figure 3–20, school districts were operating between 56 and 100 percent of capacity in 1997. In 1997, the average student-to-teacher ratio for the ROI was 15:1 (Nemeth 1997a). In 1990, the average student-to-teacher ratio for Texas was 11.3:1 (DOC 1990b; 1994).

3.4.3.3.2 Public Safety

In 1997, a total of 542 sworn police officers were serving the ROI. The 1997 ROI average officer-to-population ratio was 2.5 officers per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 2.0 officers per 1,000 persons (DOC 1990b). In 1997, 487 paid and volunteer firefighters provided fire protection services to the Pantex ROI. The 1997 average ROI firefighter-to-population ratio was 2.3 firefighters per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 0.9 firefighters per 1,000 persons (DOC 1990b). Figure 3–21 displays the ratio of sworn police officers and firefighters to the population for the Pantex ROI.

3.4.3.3.3 Health Care

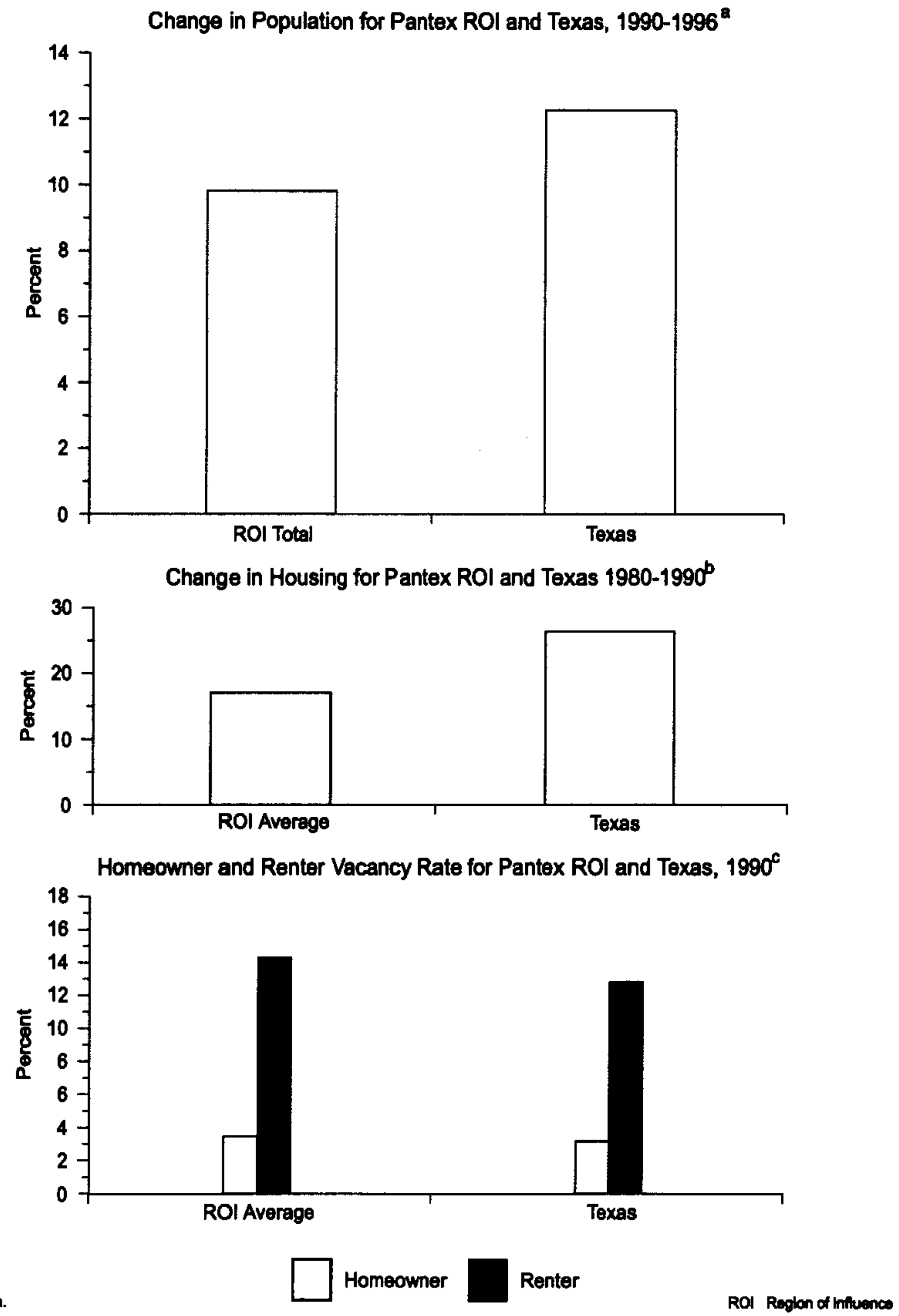
In 1996, a total of 531 physicians served the ROI. The 1996 average physician-to-population ratio in the ROI of 2.5 physicians per 1,000 persons compares with the 1996 State average of 2.2 physicians per 1,000 persons (Randolph 1997). In 1997, six hospitals serve the three-county ROI. The 1997 hospital bed-to-population ratio was 5.9 beds per 1,000 persons in the ROI (Nemeth 1997c). This compares with the 1990 State average of 3.4 beds per 1,000 persons (DOC 1996:128). Figure 3–21 displays the ratio of hospital beds and physicians to the population for the Pantex ROI.

3.4.3.4 Local Transportation

Vehicular access to Pantex is provided by FM 683 to the west and FM 2373 to the east. Both roads connect with FM 293 to the north and U.S. Route 60 to the south (see Figure 2–4). Four road segments in the ROI could be affected by route disposition alternatives: I–27 from Local Route 335 at Amarillo to I–40 at Amarillo and FM 683 from U.S. Route 60 to FM 293. The third is FM 2373 from I–40 to U.S. Route 60. The fourth is FM 2373 from U.S. Route 60 to FM U.S. Route 60 (DOE 1996a).

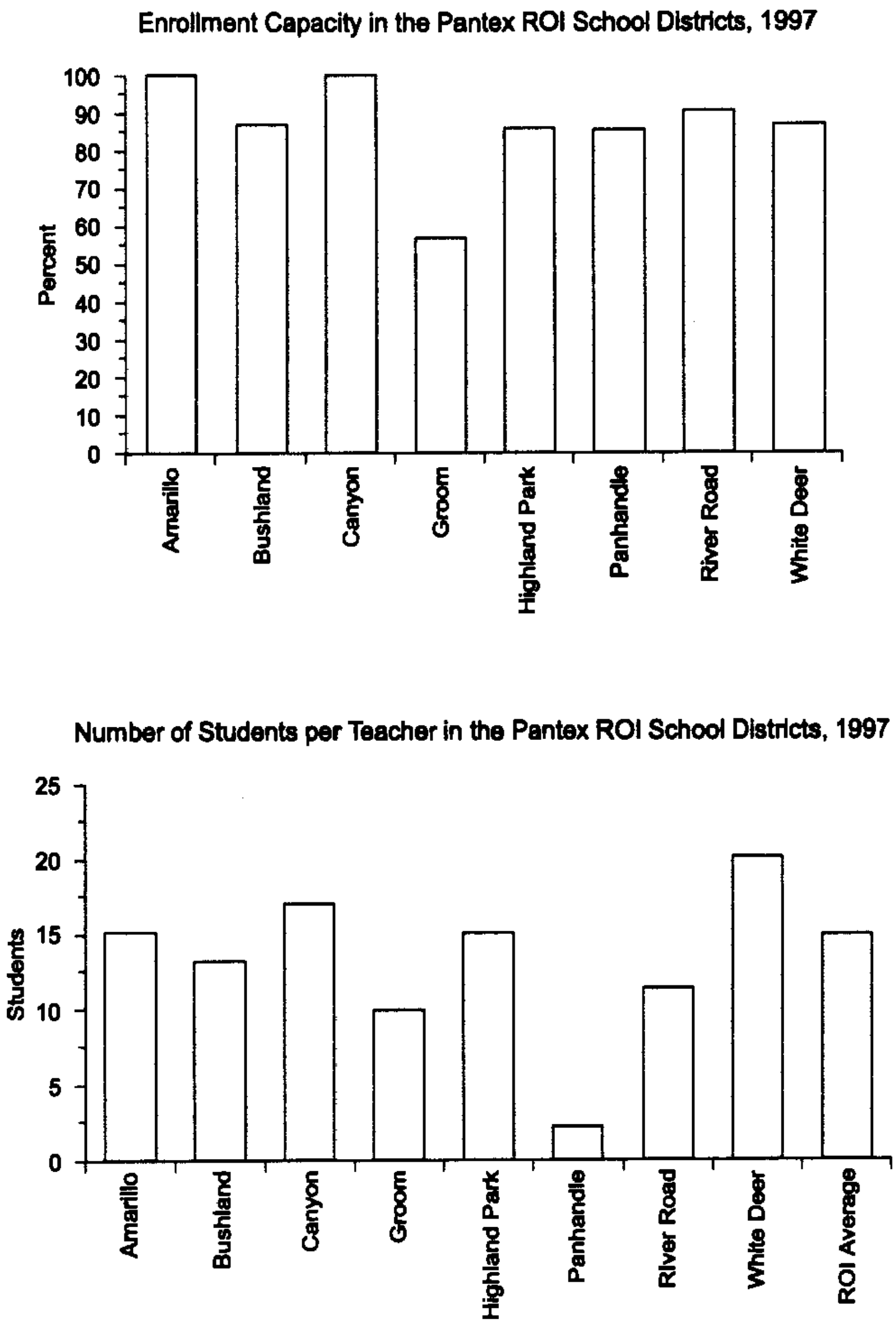
Aside from routine minor preventive maintenance paving, there is one planned road improvement project in 1998 that could affect access onto the Pantex site. This includes the construction of a bridge along FM 1912 over U.S. Route 60. There are also long-range plans to build a bridge at the intersection of FM 2373 and U.S. Route 60. Both of these projects are not expected to be initiated until the year 2000 or beyond (Nipp 1997). Even without these improvements, the road system is more than adequate for current Pantex workloads.

Amarillo City Transit provides public transport service to Amarillo, but the service does not extend to Pantex. The major railroad in the Pantex ROI is the Burlington Northern and Santa Fe Railroad, a mainline that forms



[a]DOC 1997.
[b]DOC 1994.
[c]DOC 1990a.

Figure 3–19. Population and Housing for the Pantex Region of Influence and the State of Texas

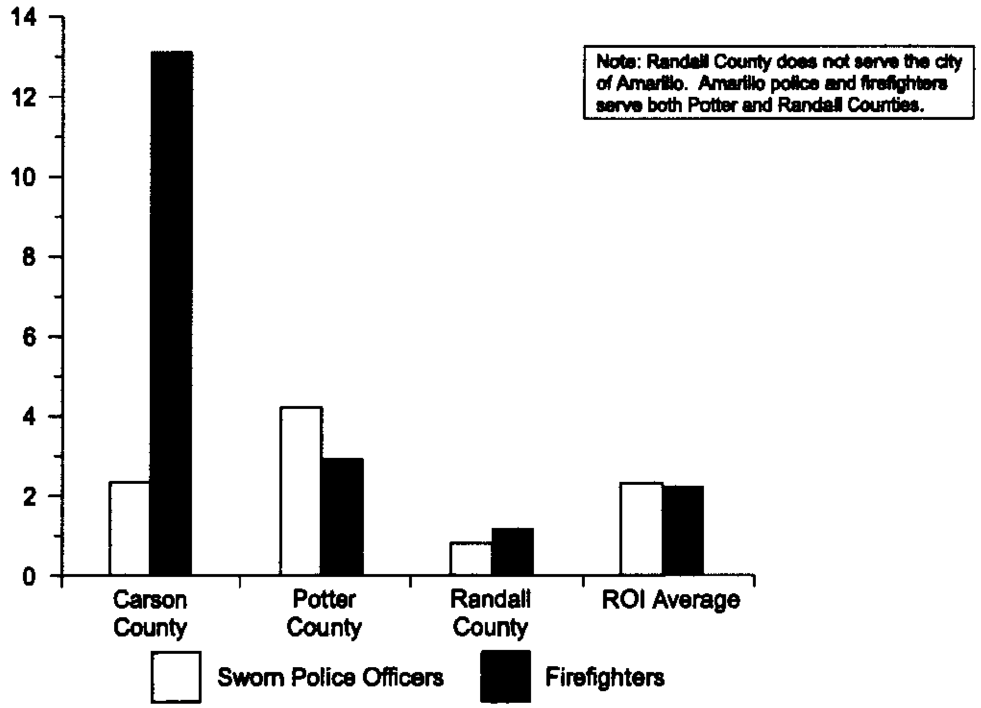


Source: Nemeth 1997a.

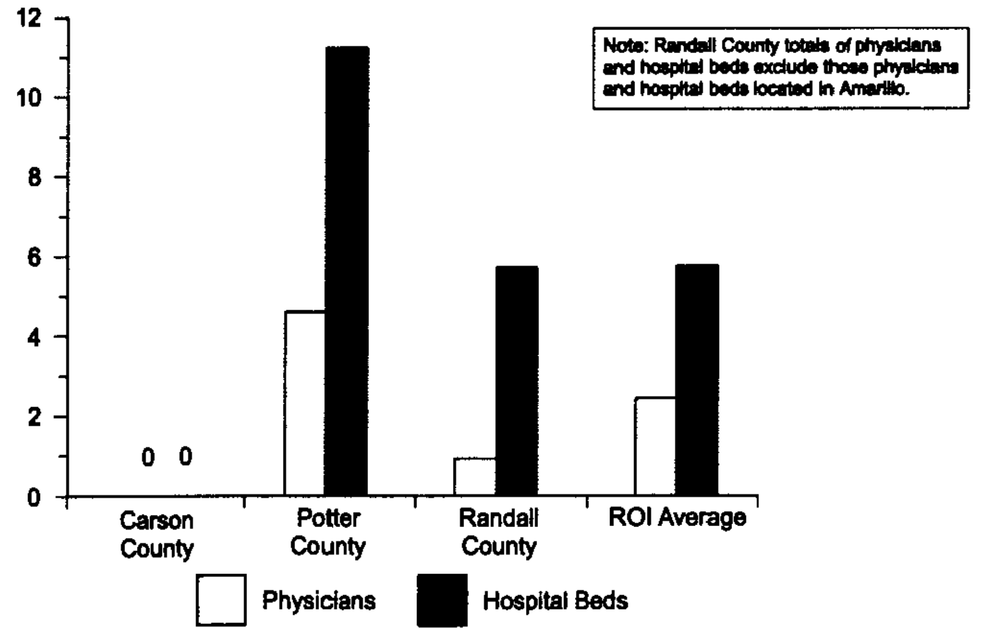
ROI Region of Influence

Figure 3–20. School District Characteristics for the Pantex Region of Influence

Number of Sworn Police Officers and Firefighters per 1,000 Persons in the Pantex ROI, 1997[a]



Number of Physicians (1996) and Hospital Beds (1997) per 1,000 Persons in the Pantex ROI[b]



[a]Nemeth 1997b.
[b]Nemeth 1997c; Randolph 1997.

ROI Region of Influence

Figure 3–21. Public Safety and Health Care Characteristics for the Pantex Region of Influence

the southern boundary of Pantex and provides direct access to the site. There are no navigable waterways within the ROI capable of accommodating material transports to the plant.

Amarillo International Airport provides jet air passenger and cargo service from national and local carriers. Several smaller private airports are located throughout the ROI (DOE 1996a).

3.4.4 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.4.4.1 Radiation Exposure and Risk

3.4.4.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of Pantex are shown in Table 3–32. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to Pantex operations.

Table 3–32. Sources of Radiation Exposure to Individuals in the Pantex Vicinity Unrelated to Pantex Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic and external terrestrial radiation[a]	93
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200[c]
Other background radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	397

[a] DOE 1997d:65.
[b] NCRP 1987:11, 40, 53.
[c] An average for the United States.

Releases of radionuclides to the environment from Pantex operations provide another source of radiation exposure to people in the vicinity of Pantex. Types and quantities of radionuclides released from Pantex operations in 1996 are listed in the *1996 Environmental Report for Pantex Plant* (DOE 1997d:64). Doses to the public resulting from these releases are given in Table 3–33. These doses fall within radiological limits per DOE Order 5400.5 (DOE 1993a:II-1–II-5) and are much lower than those of background radiation.

Using a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Pantex operations in 1996 is estimated to be 4.4×10^{-11}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Pantex operations is less than 5 in 100 billion. (It takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Table 3–33. Radiation Doses to the Public From Normal Pantex Operations in 1996 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**
Maximally exposed individual (mrem)	10	8.8×10^{-5}	4	0	100	8.8×10^{-5}
Population within 80 km (person-rem)[b]	None	2.1×10^{-3}	None	0	100	2.1×10^{-3}
Average individual within 80 km (mrem)[c]	None	7.6×10^{-6}	None	0	None	7.6×10^{-6}

[a] The standards for individuals are given in DOE Order 5400.5 (DOE 1993a:II-1–II-5). As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, as published in 58 FR 16268 (DOE 1993b:para. 834.7). If the potential total dose exceeds the 100 person-rem value, it is required that the contractor operating the facility notify DOE.

[b] About 275,000 in 1996.

[c] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

Source: DOE 1997d:65.

According to the same risk estimator, 1.1×10^{-6} excess fatal cancers are projected in the population living within 80 km (50 mi) of Pantex from normal operations in 1996. To place this number into perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The 1995 mortality rate associated with cancer for the U.S. population was 0.2 percent per year (Famighetti 1998:964). Based on this mortality rate, the number of fatal cancers expected to occur during 1996 from all causes in the population living within 80 km (50 mi) of Pantex was 550. This expected number of fatal cancers is much higher than the 1.1×10^{-6} fatal cancers estimated from Pantex operations in 1996.

Pantex workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. Table 3–34 presents the average dose to the individual worker and the cumulative dose to all workers at Pantex from operations in 1996. These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995a:para. 835.202). According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers[6] (Appendix F.10), the number of projected fatal cancers among Pantex workers from normal operations in 1996 is 0.011.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *1996 Environmental Report for Pantex Plant* (DOE 1997d). In addition, the concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) are presented in that same report.

3.4.4.1.2 Proposed Facility Location

External radiation doses and concentrations of gross alpha and plutonium in air have been measured in Zone 4. In 1996, the annual dose in Zone 4 was about 100 mrem. This is the same as measured at the offsite control location. In that same year, the Zone 4 concentration in air of plutonium 239/240 was 3.2×10^{-7} pCi/m^3. This value was about one-third less than that measured at the offsite locations (DOE 1997d:67, 77, 79).

[6] The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 3–34. Radiation Doses to Workers From Normal Pantex Operations in 1996 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual**
Average radiation worker (mrem)	None[b]	8.7
Total workers (person-rem)[c]	None	28

[a] The radiological limit for an individual worker is 5,000 mrem/yr. However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); the site must make reasonable attempts to maintain individual worker doses below this level.
[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."
[c] About 3,160 in 1996 of which approximately 2,400 were badged.
Source: DOE 1995a:para. 835.202; M&H 1997.

3.4.4.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Section 3.4.1.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emissions and NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur via inhalation of air containing hazardous chemicals released to the atmosphere during normal Pantex operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or by direct exposure, are lower than those via relative to the inhalation pathway.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.4.1. The baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. All annual concentrations are in compliance with applicable guidelines and regulations. Information on estimating the health impacts of hazardous chemicals is presented in Appendix F.10.

Exposure pathways to Pantex workers during normal operations may include the inhalation of contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. They are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals used in the operational processes ensures that these standards are not exceeded. Additionally, DOE requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, workplace conditions at Pantex are substantially better than required by standards.

3.4.4.3 Health Effects Studies

Only one cancer incidence and mortality study was conducted on the general population in communities surrounding Pantex for the period 1981 to 1992, and only one study of workers (employed between 1951 and 1978) has been done. There were no statistically significant increases in mortality among females in the general population during this period, but significant increases in prostate cancer mortality occurred among Potter County and Randall County males, and in leukemia mortality among Carson County males. No statistically significant increases in other types of cancer among males occurred during this period. Significantly fewer deaths were observed in the workforce than would be expected judging from U.S. death rates for cancer, arteriosclerotic heart disease, and digestive diseases. No specific causes of death occurred more frequently than expected. Workers were reported to show a nonstatistically significant excess of brain cancer and leukemia in the study conducted; the small number of cases could be attributed to chance alone. For a more detailed description of the studies reviewed and the findings, and for a discussion of the epidemiologic surveillance program implemented by DOE to monitor the health of current Pantex workers, refer to Appendix M.4.5 of the *Storage and Disposition Final PEIS* (DOE 1996a).

3.4.4.4 Accident History

In 1989, during a weapon disassembly and retirement operation, a release of tritium in the assembly cell occurred. Four workers received negligible doses, and a fifth, a somewhat higher, but still low dose of 1.4 mrem. No other incidents involving the accidental release of radioactivity from Pantex have taken place in more than 30 years.

3.4.4.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes planning, preparedness, and response.

Pantex has an emergency management plan to protect life and property within the facility, the health and welfare of surrounding areas, and the defense interests of the nation during any credible emergency situation. Formal mutual assistance agreements have been made with the Amarillo fire department, the National Guard, and St. Anthony's Hospital. Under accident conditions, an emergency coordinating team of DOE and Pantex contractor management personnel would initiate the Pantex emergency plan and coordinate all onsite actions.

If offsite areas could be affected, the Texas Department of Public Safety would be notified immediately and would make emergency announcements to the public and local governmental agencies in accordance with Annex R of the *State of Texas Emergency Management Plan*. Pantex has Radiological Assistance Teams equipped and trained to respond to an accident involving radioactive contamination on or off the site. In addition, the Joint Nuclear Accident Coordination Center in Albuquerque, New Mexico, can be called on if needed to mobilize radiation emergency response teams from DOE, DoD, and other participating Federal agencies.

DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997. These actions and the timeframe in which they must be implemented are presented in Section 3.2.4.5.

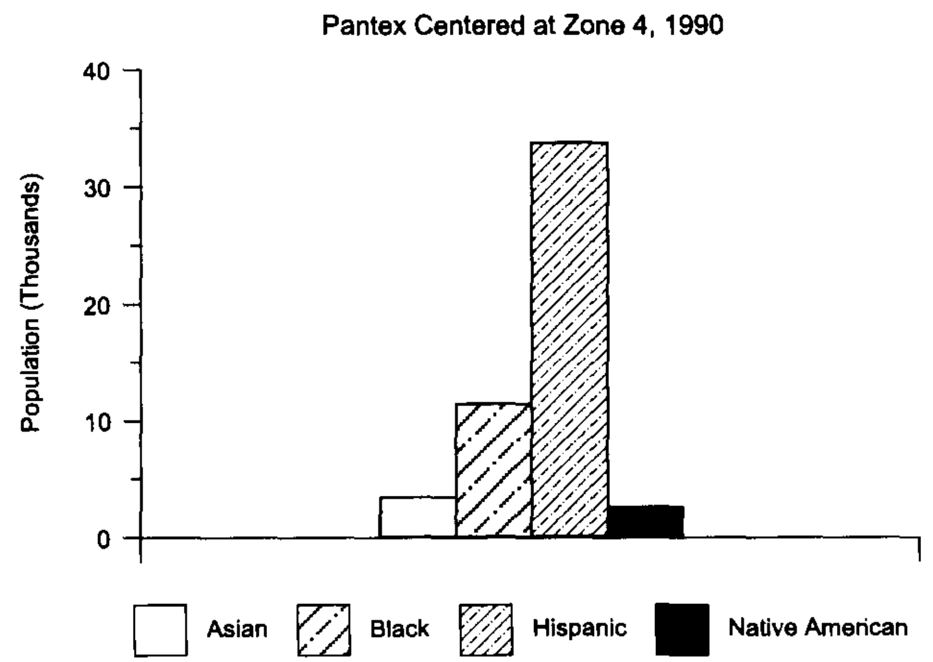
Next Section

3.4.5 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. In the case of Pantex, the potentially affected area includes only parts of northwestern Texas.

The potentially affected area around Zone 4 is defined by a circle with an 80-km (50-mi) radius centered at Pantex (lat. 35°20'0.4" N, long. 101°34'22.5" W). The total population residing within that area in 1990 was 264,651. The proportion of the population there that was considered minority was 19.1 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and for the State of Texas, 39.3 (DOC 1992).

Figure 3–22 illustrates the racial and ethnic composition of the minority population in the potentially affected area. At the time of the 1990 census, Hispanics were the largest minority group within that area, constituting 12.7 percent of the population. Blacks constituted about 4.2 percent, and Asians, about 1.3 percent. Native Americans were the smallest group, constituting about 0.8 percent (DOC 1992).



Source: DOC 1992.

Figure 3–22. Racial and Ethnic Composition of Minorities Around Pantex

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 39,420 persons (14.9 percent of the total population) residing within the potentially affected area around Zone 4 reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that Texas reported 18.1 percent.

3.4.6 Geology and Soils

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

3.4.6.1 General Site Description

Pantex is rather flat and includes four playas on DOE property and two playas on land leased from Texas Tech University (M&H 1996a:5-5). The playas are frequently dry, with clay bottoms and depths to about 9 m (30 ft) (DOE 1996a:3-165). (See Section 3.4.7.1 for additional information on these playas.) The primary surface deposits at Pantex are Pullman soils on the Southern High Plains surface and Randall soils in the playas (M&H 1996a:3-1).

The Pullman soils are the soil horizon in the uppermost section of the Quaternary-aged Blackwater Draw Formation. This formation consists of a sequence of buried soil horizons, the upper unit of mostly clay loam and caliche about 3 m (10 ft) thick and a lower unit of silty sand with caliche 10 to 24 m (30 to 80 ft) thick. The Blackwater Draw Formation overlies the Ogallala Formation (M&H 1996a:3-1).

The Ogallala Formation of Tertiary age consists of fluvial sands and gravels as well as eolian sands and silts. The top of the formation is capped by the Caprock caliche. Depths to the base of the Ogallala vary considerably, from about 90 m (300 ft) at the southwest corner of the site to about 220 m (720 ft) at the northeast corner of the site (M&H 1996a:3-I).

Underlying the Ogallala Formation are sedimentary rocks of the Triassic Dockum Group. This rock is as much as 30 m (100 ft) thick and consists of sandstone, siltstone, and mudstone. The portion of the Triassic Dockum Group near the northeastern corner of Pantex was eroded before the Ogallala was deposited directly on Permian strata (M&H 1996a:19). The Permian strata consist of deposits of salt, shale, limestone, argillaceous (clay-bearing) limestone, and dolomite. No economically viable geologic resources have been identified at Pantex (DOE 1996a:3-165).

Dissolution of salt beds within the Permian strata has resulted in sinkholes and fractures in nearby Armstrong and Hutchinson Counties in Texas. No sinkholes or fractures have been identified in Carson County, where the site is located. Recent work using shallow seismic data has determined that the structure beneath the playas at Pantex and adjacent areas shows the displacement of Ogallala strata. This displacement is attributed to the dissolution of underlying salt beds, an active geologic process in the region (DOE 1996a:3-165). In terms of the life of Pantex, the effects of that process are negligible (M&H 1997:19).

There are no capable faults in the vicinity of Pantex. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000-years (DOE 1996a:3-165). No tectonic faulting younger than late Permian is recognized at or near Pantex. An assessment of natural hazards at Pantex found three major subsurface faults and one minor surface fault. The subsurface faults range from 64 to 250 km (40 to 155 mi) in length and are 8 to 40 km (5 to 25 mi) from the plant site. The surface fault is estimated to be 6.4 km (4 mi) long and 32 km (20 mi) northwest of Pantex (M&H 1996a:3-8–3-10).

According to the Uniform Building Code, Pantex is on the boundary zone between Seismic Zones 0 and 1, meaning that little or no damage could occur as a result of an earthquake. This area is fairly free of earthquakes (DOE 1996a:3-165). Between 1906 and 1986, as few as 36 earthquakes were felt by persons in the Texas Panhandle. The strongest reported had a Modified Mercalli Intensity of VI. An earthquake of intensity VI is felt by everyone but causes little damage to competent structures. Many of the earthquake epicenters are associated with the Amarillo Uplift, about 32 km (20 mi) north of Pantex. An earthquake with a maximum horizontal acceleration of 0.17g is calculated to have an annual probability of occurrence of 1 in 5,000 at Pantex (Barghusen and Feit 1995:2.10–2.14).

There are no volcanic hazards at Pantex because there are no known areas of active volcanism in the Texas Panhandle (DOE 1996a:3-165). The nearest volcanic activity occurred 4,000 to 10,000 years ago in northeast New Mexico (M&H 1996a:3-8).

Pantex is underlain by soils of the Pullman-Randall association, which consists of nearly level to gently sloping, deep noncalcareous clays (i.e., clays containing no calcium carbonate [calcite]) and clay loams. Pullman soils underlie most of the Pantex area, but Randall soils occur in the vicinity of the playas and depressions (DOE 1996a:3-165). The Pullman soil is classified as prime farmland soil (M&H 1997:17). Soils at Pantex are acceptable for standard construction techniques (DOE 1996a:3-165). More detailed descriptions of the geology and the soil conditions at Pantex are included in the *Storage and Disposition Final PEIS* (DOE 1996a:3-165, 3-166) and the *Environmental Information Document for the Pantex Plant EIS* (M&H 1996a:3-1–3-53).

3.4.6.2 Proposed Facility Location

The soil types near Zone 4 are Pullman clay loam (0 to 1 percent and 1 to 3 percent slopes) and Osteocyte clay loam (1 to 3 percent slopes). Neither of these soils is subject to liquefaction or is unstable (M&H 1997:17).

3.4.7 Water Resources

3.4.7.1 Surface Water

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

3.4.7.1.1 General Site Description

Pantex is situated on a flat portion of the Southern High Plains of Texas. No streams or rivers flow through Pantex. Major surface water in the vicinity includes the Canadian River, 27 km (17 mi) north of the plant, Sweetwater Creek and the Salt Fork of the Red River, respectively 80 km (50 mi) and 32 km (20 mi) to the east, and the Prairie Dog Fork of the Red River, 56 km (35 mi) to the south. The Canadian River flows into Lake Meredith about 40 km (25 mi) north of the plant. Water from Lake Meredith is mixed with water pumped from the Ogallala aquifer for use as drinking water for several Southern High Plains cities. No hydrologic connections exist to transport contaminants from Pantex into either the Canadian River or Lake Meredith (M&H 1996a:5-4, 5-5).

The only naturally occurring bodies of water on the plant site are the playas and very small, unnamed, intermittent channels and ditches that may feed storm water into them. There are three playas (Playas 1, 2, and 3) on Pantex property, two (Playas 4 and 5) on the Texas Tech University property, several adjacent to Pantex, and one, called Pantex Lake, on DOE-owned property about 4 km (2.5 mi) northeast of the main portion of Pantex. Pantex Lake received discharges from the old sewage treatment facility from 1942 until the early 1970s; however, flows from the wastewater treatment facility are now discharged to Playa 1 as permitted by the State of Texas and the EPA. Currently, there are no industrial discharges diverted to Pantex Lake, Playa 3, or Playa 5, although all of the playas receive surface water runoff from precipitation events (Barghusen and Feit 1995:2.10-17–2.10-20).

Studies have suggested that most of the recharge of the underlying Ogallala aquifer within the Southern High Plains originates from water stored in the playas. However, the playas are frequently dry because of the high, naturally occurring evaporation rate. Playas in the area of the plant may be as large as 1,220 m (4,000 ft) in diameter and more than 9 m (30 ft) deep. Most of the playas are floored with a clay accumulation at the bottom that is lens shaped, being thickest in the middle and thinning out toward the edges. These clay floors may contain desiccation cracks up to 1.8 m (6 ft) deep when the floor is dry (Barghusen and Feit 1995:2.10-17).

The only surface waterway that flows throughout the year is the one that receives flow from the wastewater treatment facility and discharges into Playa 1. It flows at approximately 946,000 l/day (250,000 gal/day). The wastewater treatment facility receives and treats sanitary waste flows and some process wastewater flows. Effluent from the wastewater treatment facility is monitored pursuant to the plant's NPDES permit and TNRCC permits. The remaining channels and ditches contain flows only after storm events.

Industrial and stormwater discharges are authorized by State and Federal permits. Pantex is authorized to discharge wastewater into Playas 1, 2, and 4 under NPDES Permit TX0107107, issued June 1, 1996, and TNRCC Wastewater Discharge Permit 02296, issued June 14, 1996. These permits define the volume and quality of effluent flows that may be discharged to the playas. Storm water from industrial activities is permitted to be discharged into Playas 1, 2, 3, and 4 by general NPDES Permit TXR00G138, issued February 15, 1995. Pollution prevention plans are required by this permit, which establishes 10 outfalls throughout Pantex where effluent samples are to be taken (M&H 1997:15). Pantex is currently transitioning to the new Multi-Sector General Permit for Storm Water. This permit will require monitoring at 8 storm water outfalls (Weinreich 1997). Pantex is also authorized to discharge storm-water from construction activities that disturb more than 2 ha (5 acres) under the "Final NPDES General Permits for Storm Water Discharges from Construction Sites" (57 Federal Register 41176). A notice of intent is filed for each individual construction project and a pollution prevention plan is prepared and implemented. No sampling requirements are associated with these permitted activities (M&H 1997:15).

The playas are considered by the State of Texas to be "waters of the State." The Pantex playas have been designated as jurisdictional wetlands, and therefore are also waters of the United States (DOE 1996a:3-157). In addition to NPDES and TWRCC permits outfall monitoring, surface water is monitored for radioactive and nonradioactive parameters at several onsite locations, including the playas.

Sampling data for surface waters at the site in 1996 showed that concentrations of radionuclides were similar to historical levels and lower than the derived concentration guides for ingested water (DOE 1997d:table 10.2). Moreover, little concern emerged during the monitoring of surface waters, and discharges to them, for a variety of other parameters, including organics, metals, explosives, polychlorinated biphenyls, and pesticides. Toluene was detected twice at the wastewater treatment plant effluent outfall (Outfall 001); however, it was not detected in the plant influent 30 days prior to sampling. No noncompliances were reported at any of the other monitored outfalls or sampling points on the site. Throughout the 1996 sampling season, Pantex Lake was dry, and no samples could be collected (DOE 1997d:116).

On December 2, 1997, EPA issued Mason & Hanger Corporation at Pantex an Administrative Order regarding its NPDES Permit No. TX107107. During 1997, Pantex periodically exceeded some discharge limits set by the permit. The exceedances included ammonia, oil and grease, total suspended solids, and total metals. Although Pantex exceeded the limits set by the EPA permit, based on all available data, the levels of constituents found in the wastewater do not pose a threat to public health or the environment. The Administrative Order required correction of exceedances within 30 days, and for those exceedances that could not be corrected within 30 days, submittal of a corrective action plan. A comprehensive plan was submitted to EPA on December 22, 1997. EPA has indicated that they intend to use the plan to develop a negotiated

FFCA. In the interim, Pantex is proceeding with implementation of its corrective action plan. Corrective actions include upgrading the Waste Water Treatment Facility; soil stabilization and erosion control measures; and operational, maintenance, and monitoring program modifications. These engineered solutions are scheduled for completion in the year 2003 (Nava 1998).

Water rights in Texas fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriates water for a beneficial use has priority in the use of available water supplies over a user claiming rights at a later time. Courts also recognize riparian rights legally granted in Spanish-American Agreements. TNRCC is the administrator for water rights and the permit-issuing authority (DOE 1996a:3-160). Because Pantex does not use any surface water, it exerts no surface water rights.

Figure 3–23 shows the surface water drainage basins for each of the playas (DOE 1996f:4-76). Storm water runoff from the industrialized areas of Pantex collects within the playas and the tailwater pit and does not flow offsite. Storm water that is collected in the tailwater pit at the northeast boundary of the site is pumped to a ditch that flows to Playa One (M&H 1996a:5-7). General flooding of some low-lying portions of Pantex could occur as a result of runoff associated with precipitation and the subsequent filling of the playas. Historically, there has been no major flooding at the Pantex site (M&H 1996a:5-17–5-24; 1996b:2-11). There are no federally designated Wild and Scenic Rivers on the site (Barghusen and Feit 1995:2.10-2).

3.4.7.1.2 Proposed Facility Location

Most surface runoff near Zone 4 flows to Playa 1(M&H 1996b:2-11; 1997:24). However, a very small portion of this area flows to Playa 2. The distance between the proposed surplus plutonium disposition facilities and the drainage basin divide is sufficient to prevent storm-water flows from the proposed facilities from entering Playa 2. Playa 1 has a surface area of 32 ha (79 acres) and Playa 2, 30 ha (74 acres) (M&H 1996a:5-6). A review of flooding maps of the playas indicates that the 100-year flood elevation for Playa 1 is 1,073.4 m (3,522 ft) and for Playa 2 it is 1,074.7 m (3,526 ft). The elevation of the proposed facilities is 1,084 m (3,556 ft) (DOE 1996f:4-77).

Playa 3 is upgradient from the proposed surplus plutonium disposition facilities and the 100-year flood elevation is 1,086.5 m (3,565 ft). The maps indicate that water elevations above that of the 100-year flood would result in sheet overflow at shallow depths in the direction of the proposed facilities. Figure 3–23 shows the approximate extent of the floodplains at Pantex (DOE 1996b:4-76).

Results of surface water quality sampling from 1994 confirm that Pantex was in compliance with all water quality regulations for Playa 1 and that, with the exception of a high water level in Playa 1 in July 1994 attributable to a rainfall event, all permit requirements were met (DOE 1996a:3-157).

3.4.7.2 Groundwater

Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

3.4.7.2.1 General Site Description

The three primary hydrostratigraphic units, (i.e., separate layers of water), in the vicinity of Pantex are the Blackwater Draw Formation, the Ogallala Formation, and the Triassic Dockum Group. The units as a whole

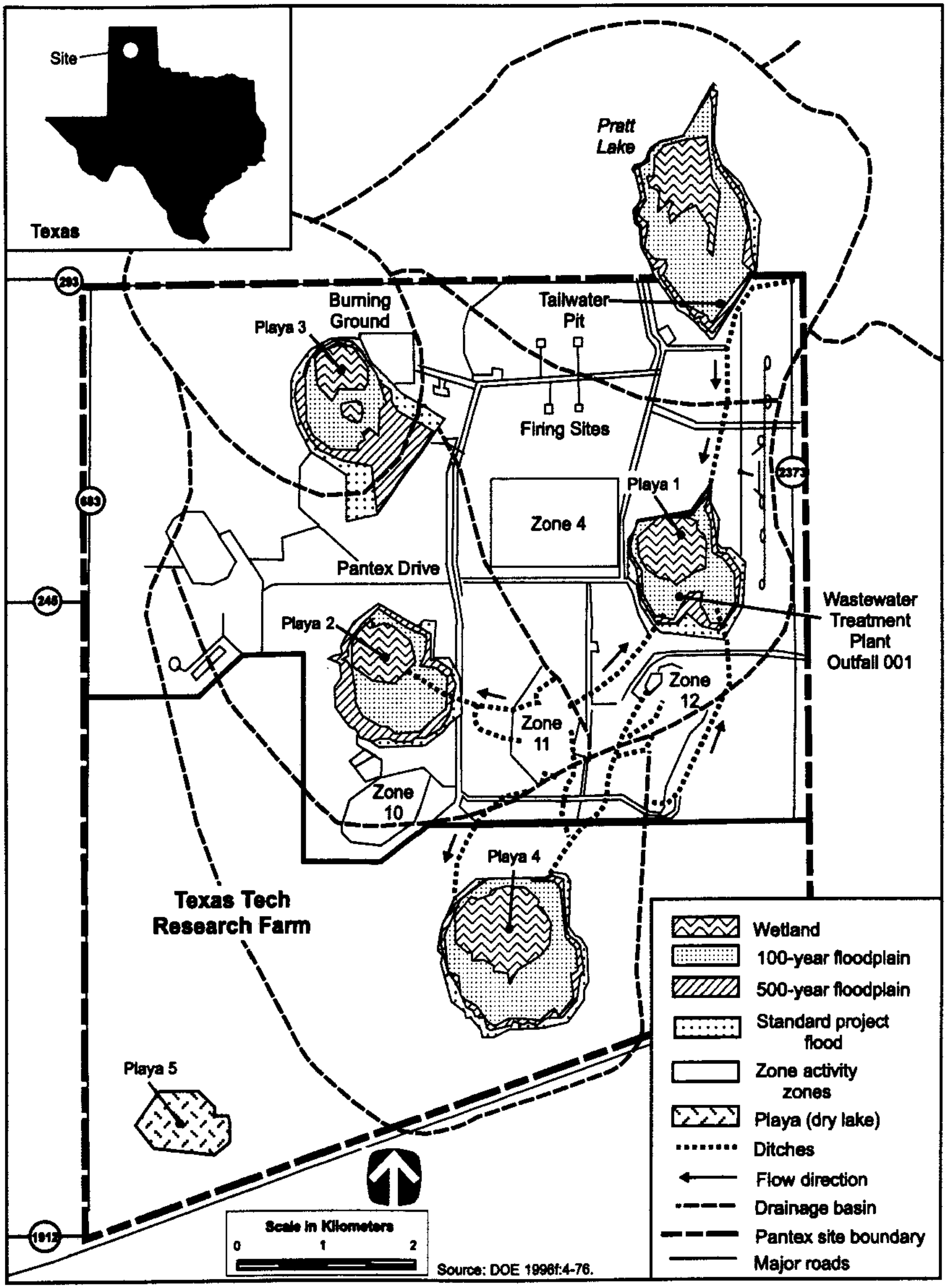


Figure 3–23. Locations of Floodplans and Playas at Pantex

constitute the vadose (unsaturated) zone, the saturated perched aquifer zone, and the lower, saturated main aquifer below the site (M&H 1996a:4-1).

The Blackwater Draw Formation has been identified as the most widespread post-Ogallala unit throughout the Southern High Plains. It consists of modified eolian sands and silts interbedded with numerous caliches composed of variably cemented carbonate layers and nodules. The thickness of the Blackwater Draw Formation at Pantex is variable, ranging from 15 to 24 m (50 to 80 ft) (M&H 1996a:4-4).

The High Plains aquifer, commonly referred to as the Ogallala aquifer, underlies the southern part of the Great Plains physiographic province. It is the primary water source for the Texas Panhandle and eastern New Mexico. The Ogallala aquifer in the vicinity of Pantex consists primarily of the saturated lower Ogallala Formation, although water is also produced from strata as old as Permian (M&H 1996a:4-4).

The Ogallala aquifer exists in unconfined conditions. Recharge occurs from precipitation and subsequent infiltration of surface water either through surface soils or through focused recharge from the numerous playas that occur across the area. Direct recharge of the aquifer can occur in those limited areas where the aquifer formation is at the surface, but no outcrops exist at Pantex. Recent evidence supports significant recharge of the aquifer below the playas in the Southern High Plains; however, evidence of such recharge has not been determined for the Ogallala aquifer at Pantex (M&H 1996a:4-1).

Water table elevations in the Ogallala aquifer near Pantex run approximately parallel to the regional land surface, which dips gently from southwest to northeast. The depth to the Ogallala groundwater aquifer varies from about 101 m (330 ft) at the southern Pantex boundary to about 140 m (460 ft) at well OW-WR-39 (M&H 1997:14). This flow direction contrasts with the regional northwest-to-southeast trend of the remaining portion of the Southern High Plains. Localized disruption of these generalized flow patterns can occur where significant withdrawals are made, such as near the city of Amarillo Carson County well field about 3.2 km (2 mi) northeast of Pantex (M&H 1996a:4-1).

The Triassic Dockum Group underlying the Ogallala Formation consists of shale, shaley siltstone, and sandstone. This unit is believed to be as thick as 30 m (100 ft) under Pantex. The lateral extent, thickness, and hydraulic characteristics of this group have not been established, and well logs usually identify these only as Triassic or red beds (M&H 1996a:4-4, 4-5).

The two main water-bearing units beneath the plant are the Tertiary Ogallala Formation and the Triassic Dockum Group. Two water-bearing zones in the Ogallala Formation are present beneath the plant. The first is a perched water zone above the main zone of saturation. One of these is present beneath Playa 1. The perched water zones consist of discontinuous perched water lenses, the lateral extent of which has not been fully determined. The second and deeper water-bearing zone is the Ogallala aquifer, which is the primary source of water for drinking, irrigation, and commercial uses (M&H 1996a:4-5). There are no designated sole source aquifers near Pantex (Barghusen and Feit 1995:2.10-2).

Five production wells in the northeast corner of Pantex provide water for the plant's needs (DOE 1996a:3-162). Pantex water use has decreased during the period from 1991 to 1995 by 231 million l (61 million gal), from a maximum of 848 million l (224 million gal) of water in 1991, to 617 million l (163 million gal) of water in 1995 (M&H 1996a:4-33, 9-8). In 1995, the city of Amarillo produced 23.6 billion l (6.2 billion gal) of water from the Ogallala aquifer via the Carson County well fields. In addition, approximately 101 billion l (27 billion gal) of water were applied for irrigation in Carson County in 1995 (DOE 1996f:4-104).

Groundwater is controlled by the individual landowner in Texas through the Doctrine of Prior Appropriations (DOE 1996a:3-160). TNRCC and the Texas Development Board are the two State agencies with major involvement in groundwater fact finding, data gathering, and analysis. Groundwater management is the responsibility of local jurisdictions through Groundwater Management Districts. Pantex is in Panhandle Groundwater District 3, which has the authority to require permits and limit the quantity of water pumped. Presently, the district does not limit the quantity of water withdrawn (DOE 1996a:3-164). Further detail on the groundwater resources at Pantex may be found in the *Storage and Disposition Final PEIS* (DOE 1996a) and the *Environmental Information Document: The Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components EIS* (M&H 1996a).

3.4.7.2.2 Proposed Facility Location

Given the nature and extent of the Ogallala aquifer, the general site description is believed to be representative of conditions beneath Zone 4. Water for the proposed facilities would be supplied from the existing site water system, which uses groundwater; no surface water would be used (M&H 1997:13).

3.4.8 Ecological Resources

Ecological resources are defined as terrestrial (predominantly land) and aquatic (predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this SPD EIS, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special status species—that is, "sensitive" versus "nonsensitive" habitat.

3.4.8.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

3.4.8.1.1 General Site Description

Pantex is on a treeless portion of the High Plains where 229 plant species and numerous animal species thrive (DOE 1996a:3-166). Short-grass prairie grasslands were the native vegetation until the prairie was converted to agricultural use for crops, grazing, or protective vegetative cover under the Conservation Reserve Program. The few remaining native grassland areas are heavily grazed by livestock. Such grazing has transformed much of the rangeland from the native blue grama-buffalo grass to brush, forbs, or cacti. Essentially all land at Pantex has been managed or disturbed to some degree. The following six basic habitat types have been identified: operational areas, grasslands, mowed areas, agricultural croplands, and playas as shown in Figure 3–24 (Battelle and M&H 1996:8, 11).

Animal species found at Pantex include 7 species of amphibians, 43 species of birds, 19 species of mammals, and 8 species of reptiles. Common bird species known to exist in the vicinity of Pantex include the western meadowlark, mourning dove, horned lark, and several species of sparrows. Raptors on the site include the Swainson's hawk, American kestrel, and burrowing owl. Frequently sighted mammals include the black-tailed jackrabbit, black-tailed prairie dog, and hispid cotton rat. Although hunting is not permitted on the site, game animals include the desert cottontail, northern bobwhite, scaled quail, and numerous waterfowl. Predators present include the badger and coyote (DOE 1996a:3-166).

Aquatic habitats are limited to Playa 1, several wastewater treatment lagoons, and ditches, and five playas that contain water after precipitation events (Playas 2, 3, 4, and 5, and Pantex Lake). Vegetation in these areas is quite variable. Playa 1 receives treated effluent from the wastewater treatment facility, and because of this year

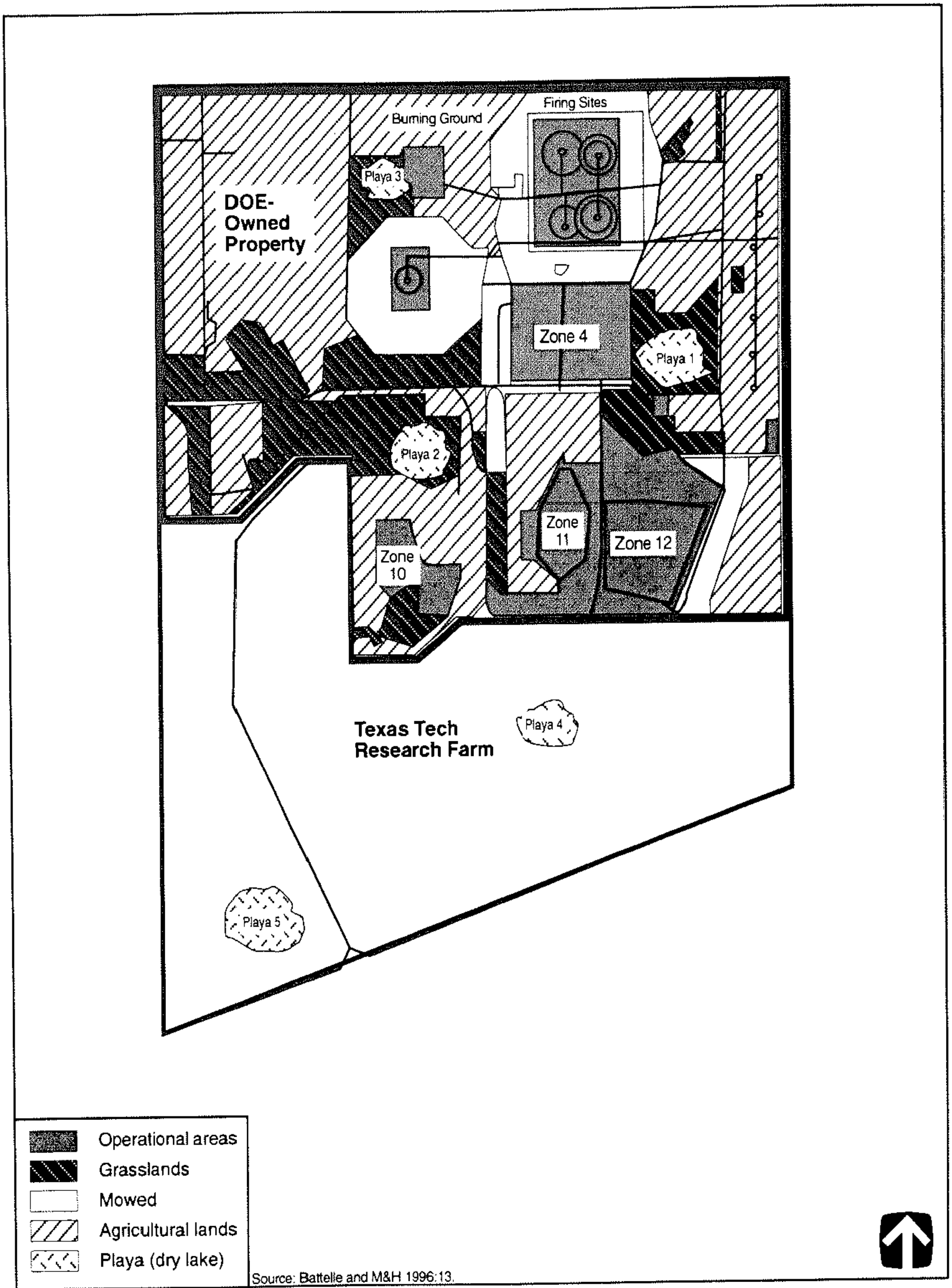


Figure 3–24. Generalized Habitat Types at Pantex (Main Plant Area)

round flow supports extensive stands of barewaist cattail, tule, or soft-stemmed bulrush. Playa 2 is nearly covered with smartweeds, while longspike spikerush is the most abundant species at Playa 3. Pantex Lake, the largest playa, supports a large number of species, longspike spikerush and wooly bursage being the most common, as is the case for Playa 4. Playa 5 is on Texas Tech University property and is not influenced by Pantex activities. The diversity of macroinvertebrates is playa-specific, and more than 80 species have been recorded (Battelle and M&H 1996:20–22).

Birds are the most conspicuous animal associated with the playas in terms of numbers, diversity, and biomass. Situated along the central flyway migratory route, the playas provide valuable habitat for migration, wintering, and nesting. The most common wintering ducks are mallards, northern pintails, green-winged teals, and American wigeons. Species known to breed in playas include the mallard, northern pintail, blue-winged teal, cinnamon teal, northern bobwhite, western meadowlark, yellow-headed blackbird, red-winged blackbird, and ring-necked pheasant (Battelle and M&H 1996:22).

3.4.8.1.2 Proposed Facility Location

The immediate environs of Zone 4 are mowed for security and fire protection purposes. The security fencing system around Zone 4 contains bare ground, whereas the interior of the zone contains areas of buffalo grass between structures (M&H 1997:20). An agricultural area northwest of Zone 4 is regularly planted with winter wheat. South of the zone is a previously cultivated area that has been revegetated with native grass species of buffalo grass, blue grama, and sideoats grama (King 1997a:8). Several animal species could be present in and around Zone 4. Mammals sighted in this area include the cottontail rabbit, black-tailed jackrabbit, striped skunk, coyote, and thirteen-lined ground squirrel. Reptiles and amphibians known to inhabit the area include the prairie rattlesnake, Texas horned lizard, Great Plains skink, bull snake, Great Plains toad, plains spadefoot toad, and tiger salamander. Birds found in the area include the western burrowing owl, western meadowlark, western kingbird, eastern kingbird, American kestrel, horned lark, mourning dove, pigeon, grasshopper sparrow, and numerous waterfowl and other species associated with wetlands (King 1997a:8; M&H 1997:20).

3.4.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including designated wetlands) areas of the site that support threatened and endangered, State-protected, and other special status plant and animal species.[7]

3.4.8.2.1 General Site Description

Playas 1, 2, 3, and 4 and Pantex Lake have been designated by USACE as jurisdictional wetlands and are therefore regulated pursuant to Section 404 of the Clean Water Act (Battelle and M&H 1996:20).

Ten threatened, endangered, or other special status species listed by the Federal Government or the State of Texas may be found in the vicinity of Pantex, as shown in Table 3.5.6–1 in the *Storage and Disposition Final PEIS* (DOE 1996a:3-166).

3.4.8.2.2 Proposed Facility Location

Portions of the drainage basins for Playas 1, 2, and 3 lie in or near Zone 4 (see Figure 3-23). Some shorebirds and waterfowl (e.g., grebes, blackbirds, teals, ducks, and heron) nest or feed within the grasslands and cultivated fields associated with these playas (King 1997a; M&H 1997:21).

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[7] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

Although there is no critical habitat for any threatened or endangered species at Pantex, three special status species may be found within the environs of Zone 4, as shown in Table 3–35. The ferruginous hawk is a common winter resident that feeds on prairie dogs and cottontail rabbits. The area west of Zone 4 is a potential feeding location because of its prairie dog towns. The prairie dogs are removed from this area at least annually. Also associated with the prairie dog towns is the western burrowing owl. Up to 10 pairs have been identified as nesting in the area just west of Zone 4. The Texas horned lizard is fairly common and is seen most frequently around the playas. Because it feeds mainly on harvester ants found throughout Pantex, there is a high probability of its occurrence in and around Zone 4 (M&H 1997:21, 22).

Table 3–35. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in Areas Surrounding Zone 4

Common Name	Scientific Name	Federal Status	State Status
Birds			
Ferruginous hawk	*Buteo regalis*	Species of Concern	Not listed
Western burrowing owl	*Athene cunicularia hypugea*	Species of Concern	Not listed
Reptiles			
Texas horned lizard	*Phrynosoma cornutum*	Species of Concern	Threatened

Source: M&H 1997:21, 22.

3.4.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. Pantex has a well-documented record of cultural resources. These resources include 69 archaeological sites indicating prehistoric Native American and historic European-American occupation and use. They also include the standing structures, foundations, and other extant features once part of the Pantex Ordnance Plant (1942-1945), the World War II predecessor of Pantex. In addition, many structures and features associated with Cold War era (1951-1991) operations at the plant are included in the cultural resource inventory. Pantex also maintains valuable historic documents, records, and artifacts pertinent to interpretation of the prehistoric and historic human activities conducted on the site (M&H 1996a).

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

Approximately 50 percent of Pantex, including DOE-leased and -owned property, has been surveyed for archaeological resources. Both the Texas State Historic Preservation Officer and the Advisory Council on Historic Preservation have agreed that additional archaeological surveys are not required. All World War II buildings, structures, and remains at Pantex have been surveyed and recorded. A building survey and an oral history program on the Cold War period are ongoing. By calendar year 1999, all the plant's cultural resources will be managed under a comprehensive Cultural Resource Management Plan required by the National Historic Preservation Act. Until that time, resources will be effectively managed through existing case-by-case procedures and interim agreements that comply with the act (M&H 1997:26, 27).

3.4.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.4.9.1.1 General Site Description

Prehistoric site types identified at Pantex include small temporary campsites and limited-activity locations characterized by surface scatters of artifacts. Archaeological surveys at Pantex have systematically covered about one-half of the facility. About 60 prehistoric sites have been recorded to date on DOE and Texas Tech University property. In consultation with the Texas State Historic Preservation Officer and the Advisory Council on Historic Preservation, DOE has determined that only two prehistoric archaeological sites are potentially eligible for inclusion on the National Register.

3.4.9.1.2 Proposed Facility Location

There are no National Register–eligible sites near Zone 4 (M&H 1997:26, 27).

3.4.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.4.9.2.1 General Site Description

Historic resources at Pantex include European-American farmstead sites represented by foundations and artifact scatters; World War II era buildings, structures, and foundations; and Cold War era buildings and structures. To date, 12 European-American farmstead sites have been surveyed and recorded. In consultation with the Texas State Historic Preservation Officer and the Advisory Council on Historic Preservation, DOE has determined that these sites are not eligible for inclusion on the National Register. All remaining World War II era buildings, structures, and foundations have been surveyed and recorded. A project is under way to survey all Cold War era buildings and structures in fiscal years 1997 and 1998. Under the terms of the programmatic agreement executed in October 1996 among DOE, the Texas State Historic Preservation Officer, and the Advisory Council on Historic Preservation (DOE 1996g), plant properties requiring modification are reviewed by plant staff, and appropriate mitigation is completed.

3.4.9.2.2 Proposed Facility Location

According to existing information, it is unlikely that unrecorded historic sites exist within Zone 4. If required, additional reviews by the State Historic Preservation Office are expected to be minimal (M&H 1997:27). Inadvertent discoveries will be addressed as discussed in Chapter 5.

3.4.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts. The identification of these resources is determined through consultations with potentially affected American Indian Tribal Governments (see Chapter 5).

3.4.9.3.1 General Site Description

A treaties search has been completed, indicating that four federally recognized Native American tribes, the Kiowa, Comanche, Apache, and Cheyenne-Arapaho Tribes of Oklahoma, are culturally affiliated with the Texas Panhandle region. Pantex staff have contacted these four and six additional tribes: the Mescalero and

Jicarilla Apache Tribes, the Caddo Tribe of Oklahoma, the Delaware Tribe of Western Oklahoma, the Wichita and affiliated tribes, and the Fort Sill Apache Tribe. As a result of these consultations no mortuary remains, associated artifacts, or traditional cultural properties have been identified at Pantex, nor are they likely to be (M&H 1997:27).

3.4.9.3.2 Proposed Facility Location

Zone 4 does not contain any recognized Native American resources. Consultations (see Chapter 5 for discussion) would be initiated with appropriate American Indian Tribal Governments upon publication of this SPD EIS to determine any concerns associated with the actions evaluated in this EIS.

3.4.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.4.9.4.1 General Site Description

The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the Southern High Plains, this formation contains Late Pleistocene vertebrate remains including bison, camel, horse, mammoth, and mastodon, with occasional evidence of their use by humans (M&H 1997:27).

3.4.9.4.2 Proposed Facility Location

No paleontological resources have been reported for Zone 4.

3.4.10 Land Use and Visual Resources

3.4.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

Pantex is in Carson County, approximately 27 km (17 mi) northeast of downtown Amarillo. The operational activities of the site are confined to 60 km^2 (23 mi^2) of land, of which approximately 37 km^2 (14 mi^2) are owned by the Federal Government. The remaining lands are leased from Texas Tech University to provide a safety and security buffer zone. In addition to the Pantex site, DOE owns a 4.4 km^2 (1.7 mi^2) portion of a large playa approximately 6.4 km (4 mi) northeast of the plant (DOE 1996a:3-148).

3.4.10.1.1 General Site Description

Regional land use within an 80-km (50-mi) radius of Pantex is predominately agricultural (DOE 1996f:4-26). Most of this expanse is devoted to rangeland along the Canadian River drainage north of Pantex and in the tributary drainage of the Red River to the south (DOE 1996f:4-26). Cropland, for both irrigated and dry-land crops, is the second largest land-use category behind rangeland. Some private property owners have enrolled their land in the Federal Conservation Reserve Program. Under terms of the program, the land cannot be cultivated or grazed for 10 years (DOE 1996f:4-22). However, most of the land is cultivated. The land surrounding Pantex is rural private property. The closest offsite residences are approximately 48 m (160 ft) from the plant boundary in the western and northeastern sectors (DOE 1996a:3-148).

Commercial, residential, industrial, institutional, and public lands constitute a small part of the total land use within an 80-km (50-mi) radius. These areas are associated mainly with the towns and cities of the region (DOE 1996f:4-26). Amarillo, which is primarily residential, is the largest urban area in the region.

Land-use categories at Pantex include industrial, agricultural, rangeland, open space, and playa areas. Generalized land uses at Pantex and the vicinity are shown in Figure 3–25. Several areas of land not actively committed to Pantex operations are used by Texas Tech University for agricultural purposes (DOE 1996a:3-148). Agricultural activities generally consist of dry farming and livestock grazing (DOE 1996a:3-148). The soil at Pantex contains several types that, according to the Natural Resources Conservation Service have been classified as prime farmland soils (DOE 1997a:4-20).

Approximately 23 percent of the Pantex site has been developed for industrial use (DOE 1996f:4-21). Pantex is divided into four major working areas: manufacturing, high-explosives development, test firing sites, and support facilities. The manufacturing area is devoted to the fabrication of high-explosives components and weapons assembly and disassembly operations. The area in which nuclear weapons operations are conducted covers approximately 80 ha (200 acres) and contains more than 100 buildings (DOE 1983:3-1). This area is surrounded by a security zone.

DOE will manage future land and facility use at Pantex through the land- and facility-use planning process. Guidance for future site development and reuse is based on long-term goals and objectives shared by DOE and stakeholders (DOE 1996f:4-24). Pantex has a *Site Development Plan* that depicts the plant upon completion of the projects outlined in the *Technical Site Information Five Year Plan.* Land resources at Pantex are expected to remain constant with continued leasing of Texas Tech University land for security and safety reasons (M&H 1996a:10-31). *The Integrated Plan for Playa Management at Pantex Plant* provides land-use guidelines for the playas and surrounding areas. This plan is being implemented as a best management plan to protect cultural and natural resources (M&H 1996c:10-41).

Within the State of Texas, land-use planning occurs only at the municipal level. The *1995 City of Amarillo Comprehensive Plan* has designated land for future growth within the city limits (DOE 1996f:4-33). Future residential development is expected to the southwest, away from the Pantex site. The East Planning Area of the city, which extends to within 3.2 km (2 mi) of Pantex, has historically been one of the slower growing residential areas. Because of the presence of the airport and industrial land use in the area, the comprehensive plan encourages compatible rather than residential use (DOE 1996a:3-148). No future land use has been projected by the city of Amarillo or county planning agencies (M&H 1996a:10-31).

No onsite areas are subject to Native American Treaty Rights.

3.4.10.1.2 Proposed Facility Location

Existing land use within Zone 4 is designated as industrial. It contains the weapons/high-explosives magazines and interim pit storage area (DOE 1996f:4-21). It also supports various DOE nuclear weapons design agencies. The land is currently disturbed and is designated for high-explosives development. Zone 4 is 1.8 km (1.1 mi) from the nearest site boundary.

Areas immediately adjacent to the zone to the north, south, and west are designated as open space. Lands to the east are primarily designated as rangeland and agricultural land. About 0.4 km (0.2 mi) to the east of Zone 4 is the Playa 1 Management Unit. Playa 1 currently receives permitted industrial and sanitary sewage

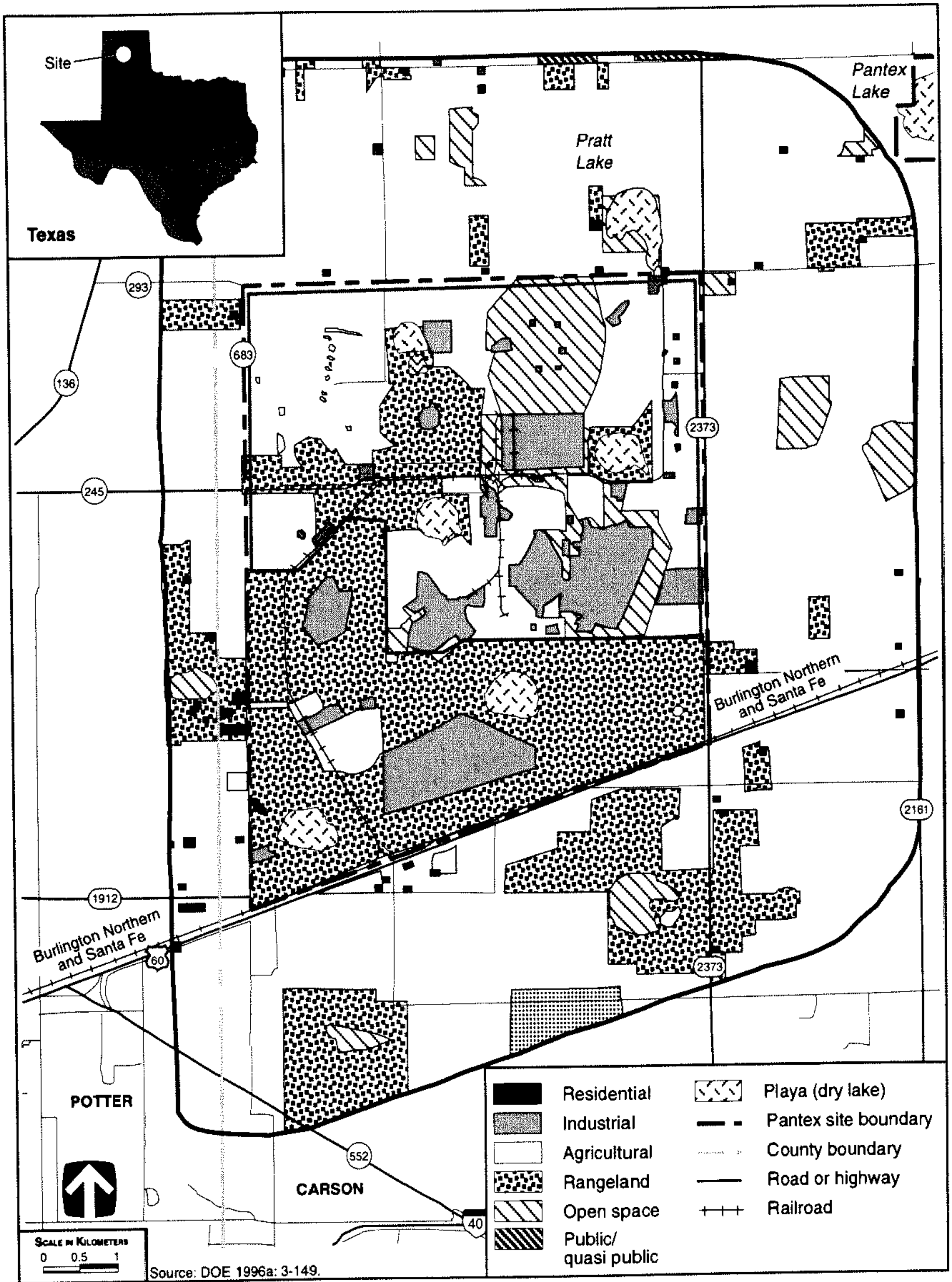


Figure 3–25. Generalized Land Use at Pantex and Vicinity

effluents from the wastewater treatment facility as well as storm-water runoff from Zones 4, 11, and 12 (M&H 1996c:4). According to the *Facility Assessment Visual Site Inspection Report* prepared under RCRA (M&H 1996c:4), previous discharges of industrial pollutants into the playa have resulted in its classification as a solid waste management unit (SWMU). Any activities disturbing the soils within an SWMU, including remedial activities, are regulated under RCRA and require additional management (M&H 1996c:4).

3.4.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.4.10.2.1 General Site Description

Pantex is in the treeless Southern High Plains of Texas. It lies in the transition zone between the North Central Plains and the Llano Estacado (staked plains) to the south. The landscape typically consists of cultivated cropland and rangeland. The plant consists of operational facilities and the inactive facilities of the former World War II ammunition plant. These industrial uses are surrounded by cropland and rangeland that blend into the offsite viewscape. The developed areas of Pantex are consistent with a VRM Class 5 designation. The remainder of Pantex ranges in VRM classification from Class 3 to Class 4 (DOE 1996a:3-148).

Public access to the plant is strictly controlled. Access to the plant perimeter is limited to three Texas FM roads and U.S. Route 60. The most visible and sensitive vantage point for Pantex facilities is located 2.4 km (1.5 mi) southeast at the intersection of U.S. Route 60 and FM 2373. U.S. Route 60 is part of the Texas Plains Trail, a scenic road on which Pantex is a designated point of interest. From this road, parts of the plant are visible as low clusters of buildings on a flat landscape. The structures range in height from about 3 to 20 m (10 to 65 ft), with cylindrical water towers that reach 50 m (165 ft). The operations areas are well defined at night by the security lights. Plant facilities are also visible from I–40, a motorist rest area approximately 10 km (6.2 mi) away being the closest vantage point. The view from this point is similar to that described for U.S. Route 60, but because of the greater distance, the plant facilities are more obscure (DOE 1996a:3-148).

3.4.10.2.2 Proposed Facility Location

Zone 4, which houses existing industrial facilities, is visible from U.S. Route 60 as a low cluster of buildings on a flat landscape. Water towers and steam stacks are the features most visible from offsite. Operations areas are well defined at night by the security lights. The closest natural feature of visual interest is Palo Duro Canyon State Park, 45 km (28 mi) to the south. Open space immediately to the west of Zone 4 is considered VRM Class 4. Zone 4 is a developed area of VRM Class 5 (DOE 1996a:3-148).

3.4.11 Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various proposed alternatives.

3.4.11.1 General Site Description

Pantex has the extensive infrastructure necessary to support operations at the plant. The key components of this infrastructure are summarized in Table 3–36.

Table 3–36. Pantex Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	76	76
Railroads (km)	27	27
Electricity		
Energy consumption (MWh/yr)	81,850	420,500
Peak load (MW)	13.6	124
Fuel		
Natural gas (m^3/yr)	12,910,000	248,000,000
Oil (l/yr)	59,960	NA[a]
Coal (t/yr)[b]	NA[b]	NA[b]
Water (l/yr)	851,600,000	3,785,000,000

[a] As supplies get low, more can be supplied by truck or rail.
[b] Coal is not used at Pantex.
Key: NA, not applicable.
Source: King 1997a:5.

3.4.11.1.1 Transportation

An onsite road system of about 76 km (47 mi) of paved surface has been developed (DOE 1996a:3-151). Roads within the plant are classified as either "primary," "secondary," or "tertiary." Primary roads are the main distribution arteries for all traffic outside and within the plant. Secondary roads supplement the primary roads and serve as collector roadways. Both the primary and secondary roads are two-lane, paved arteries. Tertiary roads are frequently single lanes, but some have two lanes when the extra width is justified by traffic volume (M&H 1996a:9-17).

Amarillo is a major rail center on the main lines of the Burlington Northern and Santa Fe, which has intermodal facilities in Amarillo. Pantex is connected to the Burlington Northern and Santa Fe system via a spur that enters the plant from the southwest. This spur provides access to the entire system as well as to other railroads (M&H 1996a:9-17, 9-19).

3.4.11.1.2 Electricity

Electrical service for the nine-county region surrounding Pantex is supplied by the Southwestern Public Service Company except for Donley County which is serviced by West Texas Utilities (M&H 1996a:9-1). Generation is mainly from coal, oil, and gas (produced by gas turbines), in order of capacity. The rest comes from nuclear, hydroelectric, and other sources. Pantex draws its power from the West Central Power Pool, characteristics of which are summarized in Table 3.5.2–2 of the *Storage and Disposition Final PEIS* (DOE 1996a:3-151).

The average electrical availability at Pantex is about 420,500 MWh/yr; the average annual usage, about 81,850 MWh/yr. The peak load capacity for the plant is 124 MW; the current peak load usage, about 13.6 MW (King 1997a:5).

3.4.11.1.3 Fuel

Fuels consumed at Pantex include liquid petroleum fuels and natural gas. Natural gas is supplied by Energas (King 1997a:3). Oil is used as a backup for the Building 16-13 steam boiler. Oil capacity is only limited by the number of deliveries of oil by truck. There is a 89,300-l (23,600-gal) fuel oil storage tank on the site. The current annual site availability of natural gas is about 248 million m^3/yr (8.8 billion ft^3/yr); and the current usage, about 12.9 million m^3/yr (456 million ft^3/yr) (King 1997a:5).

3.4.11.1.4 Water

Water for Pantex is provided by a system of five wells, together with pumps and storage tanks. The volume used by the plant between 1989 and 1995 ranged from 689 million l (182 million gal) to 946 million l (250 million gal) (M&H 1996a:9-7). The water supply system capacity is about 3.8 billion l/yr (1 billion gal/yr); the average usage of domestic water, about 850 million l/yr (225 million gal/yr) (King 1997a:5).

3.4.11.1.5 Site Safety Services

Plant fire protection is provided by the Pantex fire department, which has one onsite fire station. Personnel in the fire department maintain a high level of readiness. A minimum of eight firefighters, three of whom are certified paramedics, are on duty at all times. The fire department maintains two advanced life-support ambulances on the site (M&H 1996a:9-25).

3.4.11.2 Proposed Facility Location

Little current utility usage occurs in Zone 4 West. Given the current usage level of each utility type at Pantex, excess capacity available for Zone 4 would be as indicated in Table 3–37. There would be an electrical capacity of 338,634 MWh/yr, with a peak load of 110.4 MW; a natural gas capacity of about 235 million m^3/yr (8.3 billion ft^3/yr); and a water capacity of about 3 billion l/yr (775 million gal/yr), with a peak supply of about 8 million l/day (2 million gal/day) (King 1997a:6).

Table 3–37. Pantex Infrastructure Characteristics for Zone 4

Resource	Current Usage	Excess Site Capacity
Electrical		
Energy consumption (MWh/yr)	Negligible	338,634
Peak load (MW)	Negligible	110.4
Fuel		
Natural gas (m^3/yr)	Negligible	235,181,309
Oil (l/yr)	NA	NA[a]
Coal (t/yr)[b]	NA[b]	NA[b]
Water (l/yr)	Negligible	2,933,000,000

[a] As supplies get low, more can be supplied by truck or rail.
[b] Coal is not used at Pantex.
Key: NA, not applicable.
Source: King 1997a:6.

Next Section

3.5 SRS

SRS is about 19 km (12 mi) south of Aiken, South Carolina (Figure 2–5). First established in 1950, SRS has been involved for more than 40 years in tritium operations and nuclear material production. Today the site includes 16 major production, service, research, and development areas, not all of which are currently in operation (DOE 1996a:3-228).

There are more than 3,000 facilities at SRS, including 740 buildings with 511,000 m^2 (5.5 million ft^2) of floor area. Major nuclear facilities at SRS include fuel and plutonium storage facilities and target fabrication facilities, nuclear material production reactors, chemical separation plants, a uranium fuel processing area, liquid HLW tank farms, a waste vitrification facility, and the Savannah River Technology Center. SRS processes nuclear materials into forms suitable for continued safe storage, use, or transportation to other DOE sites. Tritium recycling facilities at SRS empty tritium from expired reservoirs, purify it to eliminate the helium decay product, and fill replacement reservoirs for nuclear weapons. Filled reservoirs are delivered to Pantex for weapons assembly and directly to DoD to replace expired reservoirs. Historically, DOE has produced tritium at SRS, but none has been produced since 1988 (DOE 1996a:3-228).

DOE Activities. The current missions at SRS are shown in Table 3–38. In the past, the SRS complex produced nuclear materials. The complex consisted of various plutonium storage facilities, five reactors (the C-, K-, L-, P-, and R-Reactors) (all inactive), a fuel and target fabrication plant, two chemical separation plants, a tritium-target processing facility, a heavy water rework facility, and waste management facilities. The K-Reactor (the last operational reactor) has been shut down with no planned provision for restart. SRS is still conducting tritium recycling operations in support of stockpile requirements using retired weapons as the tritium supply source. The separations facilities and F- and H-Canyons are planned to be used through the year 2002 to complete DOE's commitment to the Defense Nuclear Facilities Safety Board regarding stabilization of inventories of unstable nuclear materials (DOE 1996a:3-228).

Table 3–38. Current Missions at SRS

Mission	Description	Sponsor
Plutonium storage	Maintain F-Area plutonium storage facilities	Assistant Secretary for Environmental Management
Tritium recycling	Operate H-Area tritium facilities	Assistant Secretary for Defense Programs
Stabilize targets, spent nuclear fuels, and other nuclear materials	Operate F- and H-Canyons	Assistant Secretary for Environmental Management
Waste management	Operate waste management facilities	Assistant Secretary for Environmental Management
Environmental monitoring and restoration	Operate remediation facilities	Assistant Secretary for Environmental Management
Research and development	Savannah River Technology Center technical support of Defense Programs, Environmental Management, and Nuclear Energy programs	Assistant Secretary for Defense Programs; Assistant Secretary for Environmental Management; Office of Nuclear Energy

Source: DOE 1996a:3-229.

DOE Office of Environmental Management is pursuing a 10-year plan to achieve full compliance with all applicable laws, regulations, and agreements to treat, store, and dispose of existing wastes; reduce generation of new wastes; clean up inactive waste sites; remedied contaminated groundwater; and dispose of surplus facilities (DOE 1996a:3-228).

The Savannah River Technology Center provides technical support to all DOE operations at SRS. In this role, it provides process engineering development to reduce costs, waste generation, and radiation exposure. SRS has an expanding mission to transfer unique technologies developed at the site to industry. SRS is also an active participant in the Strategic Environmental R&D Program formulated to develop technologies to mitigate environmental hazards at DoD and DOE sites (DOE 1996a:3-228).

Non-DOE Activities. Non-DOE facilities and operations at SRS include the Savannah River Forest Station, the Savannah River Ecology Laboratory, and the Institute of Archaeology and Anthropology. The Savannah River Forest Station is an administrative unit of the U.S. Forest Service, which provides timber management, research support, soil and water protection, wildlife management, secondary roads management, and fire management to DOE. The Savannah River Forest Station manages 62,300 ha (154,000 acres), comprising approximately 80 percent of the site area. It has been responsible for reforestation and manages an active timber business. The Savannah River Forest Station assists with the development and updating of sitewide land use plans and provides continual support with site layout and vegetative management. It also assists in long-term wildlife management and soil rehabilitation projects (DOE 1996a:3-228).

The Savannah River Ecology Laboratory is operated for DOE by the Institute of Ecology of the University of Georgia. It has established a center of ecological field research where faculty, staff, and students perform interdisciplinary field research and gain an understanding of the impact of energy technologies on the ecosystems of the southeastern United States. This information is communicated to the scientific community, government agencies, and the general public. In addition to Savannah River Ecology Laboratory studies, the Institute of Archaeology and Anthropology is operated by the University of South Carolina to survey the archaeological resources of SRS. These surveys are used by DOE when planning new facility additions or modifications (DOE 1996a:3-229).

3.5.1 Air Quality and Noise

3.5.1.1 Air Quality

Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

3.5.1.1.1 General Site Description

The SRS region has a temperate climate with short, mild winters and long, humid summers. Throughout the year, the climate is frequently affected by warm, moist maritime air masses. The average annual temperature at SRS is 17.3 °C (63.2 °F); temperatures vary from an average daily minimum of 0 °C (32 °F) in January to an average daily maximum of 33.2 °C (91.7 °F) in July. The average annual precipitation at SRS is about 114 cm (45 in). Precipitation is distributed fairly evenly throughout the year, with the highest in summer and the lowest in autumn. There is no predominant wind direction at SRS. The average annual wind speed at Augusta National Weather Service Station is 2.9 m/s (6.5 mph) (NOAA 1994b). Additional information related to meteorology and climatology at SRS is presented in Appendix F of the *Storage and Disposition Final PEIS* (DOE 1996a:F-16, F-17) and in the *Savannah River Site Waste Management Environmental Impact Statement* (DOE 1995c:3-21–3-25).

SRS is near the center of the Augusta-Aiken Interstate AQCR #53. None of the areas within SRS and its surrounding counties are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1997g; 1997h). Applicable NAAQS and the ambient air quality standards for the States of South Carolina and Georgia are presented in Table 3–39.

Table 3–39. Comparison of Ambient Air Concentrations From SRS Sources With Most Stringent Applicable Standards or Guidelines, 1990

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	Concentration ($\mu g/m^3$)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	22
	1 hour	40,000[b]	171
Nitrogen dioxide	Annual	100[b]	5.7
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50b	3.0
	24 hours	150[b]	50.6
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	80[b]	14.5
	24 hours	365[b]	196
	3 hours	1,300[b]	823
Other regulated pollutants			
Gaseous fluoride	30 days	0.8[f]	0.09
	7 days	1.6[f]	0.39
	24 hours	2.9[f]	1.04
	12 hours	3.7[f]	1.99
Total suspended particulates	Annual	75[f]	12.6
Hazardous and other toxic compounds			
Benzene	24 hours	150[f]	31.7
Ethylene glycol	24 hours	650[f]	(g)

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (EPA 1997b), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is ≤ 1. The 1-hr ozone standard applies only to nonattainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 $\mu g/m^3$. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standards is ≤ 1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and State standard.

[c] Federal standard.

[d] Not directly emitted or monitored by the site.

[e] No data is available with which to assess $PM_{2.5}$ concentrations.

[f] State standard.

[g] No sources identified at the site.

Note: The NAAQS also includes standards for lead. No sources of lead emissions have been identified for any of the alternatives presented in Chapter 4. Emissions of other air pollutants not listed here have been identified at SRS, but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the *Storage and Disposition Final PEIS* (DOE 1996a). EPA recently revised the ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 $\mu g/m^3$ (0.12 ppm) to an 8-hr concentration of 157 $\mu g/m^3$ (0.08 ppm). During a transition period while States are developing State implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in nonattainment areas (EPA 1997c:38855). For particulate matter, the current PM_{10} annual standard is retained, and two $PM_{2.5}$ standards are added. These standards are set at a 15-$\mu g/m^3$ 3-year annual arithmetic mean based on community-oriented monitors and a 65-μ g/m^3 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr PM_{10} standard is based on the 99th percentile of 24-hr concentrations. The existing PM_{10} standards will continue to apply in the interim period (EPA 1997d:38652).

Source: DOE 1995c:4-264, 4-269; DOE 1996a:3-234; EPA 1997b; SCDHEC 1996.

There are no PSD Class I areas within 100 km (62 mi) of SRS. None of the facilities at SRS have been required to obtain a PSD permit (DOE 1996a:3-233).

The primary emission sources of criteria air pollutants at SRS are the nine coal-burning boilers and four fuel-oil-burning package boilers that produce steam and electricity, diesel engine-powered equipment, the Defense Waste Processing Facility (DWPF), the in-tank precipitation process, groundwater air strippers, the consolidated incineration facility, and various other process facilities. Other emissions and sources include fugitive particulates from coal piles and coal-processing facilities, vehicles, controlled burning of forestry areas, and temporary emissions from various construction-related activities. The emissions inventory for sources of criteria air pollutants and toxic and hazardous air pollutants at SRS for 1990 are presented in Appendix F of the *Storage and Disposition Final PEIS* (DOE 1996a:F-17, F-18).

Table 3–39 presents the ambient air concentrations attributable to sources at SRS. These concentrations are based on emissions for the year 1990 and were modeled using meteorological data from 1991 (DOE 1996a:3-233, 3-234). These concentrations are comparable to or slightly higher than concentrations for more recent years. Only those pollutants that would be emitted for any of the surplus plutonium disposition alternatives are presented. Additional information on ambient air quality at SRS is in the *SRS Environmental Report for 1995* (Arnett and Mamatey 1996:111–114). Concentrations shown in Table 3–39 attributable to SRS are in compliance with applicable guidelines and regulations. Data for 1995 from nearby South Carolina monitors at Beech Island, Jackson, and Barnwell indicate that the NAAQS for particulate matter, lead, ozone, sulfur dioxide, and nitrogen dioxide are not exceeded in the area around SRS (SCDHEC 1995:1, 25, 28, 37–39). Air pollutant measurements at these monitoring locations during 1995 showed for nitrogen dioxide an annual average concentration of 9.4 $\mu g/m^3$; for sulfur dioxide concentrations of 99 $\mu g/m^3$ for 3-hr averaging, 24 $\mu g/m^3$ for 24-hr averaging, and 5 $\mu g/m^3$ for the annual average; for total suspended particulates an annual average concentration of 37 $\mu g/m^3$; and for PM_{10} concentrations of 62 $\mu g/m^3$ for 24-hr averaging and 19 $\mu g/m^3$ for the annual average.

3.5.1.1.2 Proposed Facility Locations

The meteorological conditions described for SRS are considered representative of F-Area. Information on air pollutant emissions from F-Area is included in the overall site emissions discussed previously and presented in Appendix F of the *Storage and Disposition Final PEIS* (DOE 1996a:F-17, F-18).

The meteorological conditions described for SRS are considered representative of S-Area. Information on air pollutant emissions from S-Area is included in the previous discussion of overall site emissions and in Appendix F of the *Storage and Disposition Final PEIS* (DOE 1996a:F-17, F-18). The air pollutant sources in this area include process and diesel generator emissions.

3.5.1.2 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.5.1.2.1 General Site Description

Major noise sources at SRS are primarily in developed or active areas and include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Major noise emission sources outside of these active areas consist primarily of vehicles and rail operations. Existing SRS-related noise sources of importance to the public are those related to transportation of people and materials to and from the site, including trucks, private vehicles, helicopters, and trains (DOE 1996a:3-233–3-235).

Another important contributor to noise levels is traffic to and from SRS operations along access highways through the nearby towns of New Ellenton, Jackson, and Aiken. Noise measurements recorded during 1989 and 1990 along State Route 125 in the town of Jackson at a point about 15 m (50 ft) from the roadway indicate that the 1-hr equivalent sound level from traffic ranged from 48 to 72 dBA. The estimated day-night average sound levels along this route were 66 dBA for summer and 69 dBA for winter. Similarly, noise measurements along State Route 19 in the town of New Ellenton at a point about 15 m (50 ft) from the roadway indicate that the 1-hr equivalent sound level from traffic ranged from 53 to 71 dBA. The estimated average day-night average sound levels along this route were 68 dBA for summer and 67 dBA for winter (NUS 1990:3-2–3-6, app. C and F).

Most industrial facilities at SRS are far enough from the site boundary that noise levels from these sources at the boundary would not be measurable or would be barely distinguishable from background levels.

The States of Georgia and South Carolina, and the counties in which SRS is located, have not established any noise regulations that specify acceptable community noise levels, with the exception of a provision in the Aiken County Zoning and Development Standards Ordinance that limits daytime and nighttime noise by frequency band (DOE 1996a:F-33).

The EPA guidelines for environmental noise protection recommend an average day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (DOT 1995). It is expected that for most residences near SRS, the day-night average sound level is less than 65 dBA and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

3.5.1.2.2 Proposed Facility Locations

No distinguishing noise characteristics at F-Area have been identified. F-Area is far enough—7.9 km (4.9 mi)—from the site boundary that noise levels from the facilities are not measurable or are barely distinguishable from background levels.

No distinguishing noise characteristics at S-Area have been identified. Observations of sound sources during a summer sound level survey near the fence line of S-Area indicate that typical sources include vehicles, turbines, locomotives, paging systems, and fans (NUS 1990:app. B). S-Area is far enough—9.6 km (6 mi)—from the site boundary that noise levels from these facilities are not measurable or are barely distinguishable from background levels.

3.5.2 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed according to appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders.

3.5.2.1 Waste Inventories and Activities

SRS manages the following types of waste: HLW, TRU, mixed TRU, LLW, mixed LLW, hazardous, and nonhazardous. HLW would not be generated by surplus plutonium disposition activities at SRS, and therefore, will not be discussed further. Waste generation rates and the inventory of stored waste from activities at SRS are provided in Table 3–40. Table 3–41 summarizes the SRS waste management capabilities. More detailed descriptions of the waste management system capabilities at SRS are included in the *Storage and Disposition Final PEIS* (DOE 1996a:3-261–3-265, E-97) and the *Savannah River Site Waste Management Final EIS* (DOE 1995c:3-66).

Table 3–40. Waste Generation Rates and Inventories at SRS

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact handled	427	6,977
Remotely handled	4	0
LLW	10,043	1,616
Mixed LLW		
RCRA	1,135	6,940
TSCA	0	110
Hazardous	74	1,416[b]
Nonhazardous		
Liquid	416,100	NA[c]
Solid	6,670	NA[c]

[a] Includes mixed TRU wastes.
[b] Sessions 1997a.
[c] Generally, nonhazardous wastes are not held in long-term storage.
Source: DOE 1996d:15, 16, except for hazardous and nonhazardous solid waste (DOE 1996a:3-262, 3-263) and nonhazardous liquid waste (Sessions 1997a).

EPA placed SRS on the National Priorities List in December 1989. In accordance with CERCLA, DOE entered into an FFCA with EPA and the State of South Carolina to coordinate cleanup activities at SRS under one comprehensive strategy. The FFCA combines the RCRA Facility Investigation Program Plan with a CERCLA cleanup program titled the *RCRA Facility Investigation/Remedial Investigation Program Plan* (DOE 1996a:3-261). More information on regulatory requirements for waste disposal is provided in Chapter 5.

3.5.2.2 Transuranic and Mixed Transuranic Waste

TRU waste generated between 1974 and 1986 is stored on five concrete pads and one asphalt pad that have been covered with approximately 1.2 m (4 ft) of soil. TRU waste generated since 1986 is stored on 13 concrete pads that are not covered with soil. The TRU waste storage pads are in the Low-Level Radioactive Waste Disposal Facility (DOE 1995c:3-80, 3-81).

A TRU Waste Characterization and Certification Facility is planned and would provide extensive containerized waste certification capabilities. The facility is needed to prepare TRU waste for treatment and to certify TRU waste for disposal at WIPP. Drums that are certified for shipment to WIPP will be placed in interim storage on concrete pads in E-Area (DOE 1996a:3-264). LLW containing concentrations of TRU nuclides between 10 and 100 nCi (referred to as alpha-contaminated LLW) is managed like TRU waste because its physical and chemical properties are similar and similar procedures will be used to determine its final

Table 3–41. Waste Management Capabilities at SRS

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment Facility (m^3/yr)								
TRU Waste Characterization/ Certification Facility	1,720	Planned for 2007	X	X				
Consolidated Incineration Facility & Ashcrete Stabilization Facility	4,630 liquid 17,830 solid	Online			X	X	X	
F- and H-Area Effluent Treatment Facility	1,930,000	Online			X	X		
M-, L-, and H-Area Compactors	3,983	Online			X			
Non-Alpha Vitrification Facility	3,090	Planned			X	X	X	
M-Area Liquid Effluent Treatment Facility	999,000	Online				X		
M-Area Vendor Treatment Facility	2,470	Planned				X		
Savannah River Technology Center Ion Exchange Treatment Probe	11,200	Online				X		
E-Area Supercompactor	5,700	Planned			X			
Z-Area Saltstone Facility	28,400	Online				X		
Central Sanitary Wastewater Treatment Facility	1,030,000	Online						X
Storage Facility (m^3)								
TRU Storage Pads	34,400	Online	X	X				
DWPF Organic Waste Storage Tank	568	Online				X		
Liquid Waste Solvent Tanks	454	Planned				X		
M-Area Process Waste Interim Treatment/Storage Facility	8,300	Online				X		
Mixed Waste Storage Facilities (645-2N, -295, -43E)	1,905	Online				X		
Savannah River Technology Center Mixed Waste Storage Tanks	198	Online				X		
Long-Lived Waste Storage Building	1,064	Planned			X			
Solid Waste Storage Pads	2,657	Online				X	X	
Buildings 316-M, 710-B, 645-N, and 645-4N	2,515	Online				X	X	
M-Area Storage Pad	2,160	Online				X		
Disposal Facility (m^3)								
Intermediate-Level Waste Vaults	3,665	Online			X			
Low-Activity Waste Vaults	30,500	Online			X			
LLW Disposal Facility Slit Trenches	26,000	Planned			X			
Z-Area Saltstone Vaults	1,110,000	Online			X			

Key: DWPF, Defense Waste Processing Facility; Haz, hazardous; LLW, low-level waste; TRU, transuranic.
Source: DOE 1996a:E-108–E-112; Miles 1998; Rhoderick 1998; Sessions 1997a, 1997b.

disposition (DOE 1996a:3-264). WIPP is expected to begin receiving waste from SRS in 1999 (DOE 1997b:17).

3.5.2.3 Low-Level Waste

Both liquid and solid LLW are treated at SRS. Most aqueous LLW streams are sent to the F- and H-Area Effluent Treatment Facility and treated by filtration, reverse osmosis, and ion exchange to remove the radionuclide contaminants. After treatment, the effluent is discharged to Upper Three Runs Creek. The treatment residuals are concentrated by evaporation and stored in the H-Area tank farm for eventual treatment in the Z-Area Saltstone Facility. In that facility, wastes are immobilized with grout for onsite disposal (DOE 1996a:E-98).

After completion of a series of extensive readiness tests, the Consolidated Incinerator Facility began radioactive operations in 1997. The Consolidated Incinerator Facility is designed to incinerate both solid and liquid LLW, mixed LLW, and hazardous waste (WSRC 1997a).

Solid LLW is segregated into several categories to facilitate proper treatment, storage, and disposal. Solid LLW that radiates less than 200 mrem/hr at 5 cm (2 in) from the unshielded container is considered low-activity waste. If it radiates greater than 200 mrem/hr at 5 cm (2 in), it is considered intermediate-activity waste. Intermediate-activity tritium waste is intermediate-activity waste with more than 10 Ci of tritium per container. Long-lived waste is contaminated with long-lived isotopes that exceed the waste acceptance criteria for onsite disposal (DOE 1996a:E-99).

Four basic types of vaults and buildings are used for storing the different waste categories: low-activity waste vaults, intermediate-level nontritium vaults, intermediate-level tritium vaults, and the long-lived waste storage building. The vaults are below-grade concrete structures, and the storage building is a metal building on a concrete pad (DOE 1996a:E-99).

Currently, DOE places low-activity LLW in carbon steel boxes and deposits them in the low-activity waste vaults in E-Area. Intermediate-activity LLW is packaged according to waste form and disposed of in the intermediate-level waste vaults in E-Area. Long-lived wastes are stored in the Long-Lived Waste Storage Building in E-Area until treatment and disposal technologies are developed (DOE 1995c:3-75).

Saltstone generated in the solidification of LLW salts extracted from HLW is disposed of in the Z-Area Saltstone Vaults. Saltstone is solidified grout formed by mixing the LLW salt with cement, fly ash, and furnace slag. Saltstone is the highest volume of solid LLW disposed of at SRS. SRS disposal facilities are projected to meet solid LLW disposal requirements, including LLW from off the site, for the next 20 years (DOE 1996a:3-261, 3-264).

3.5.2.4 Mixed Low-Level Waste

The FFCA addresses SRS compliance with RCRA LDR. The FFCA requires DOE facilities storing mixed waste to develop site-specific treatment plans and to submit them for approval (DOE 1996a:3-264, 3-265). The site treatment plan for mixed waste specifies treatment technologies or technology development schedules for all SRS mixed waste (Arnett and Mamatey 1996:50). SRS is allowed to continue to generate and store mixed waste, subject to LDR. Schedules to provide compliance through treatment in the Consolidated Incinerator Facility are included in the FFCA (DOE 1996a:3-264).

The SRS mixed waste program consists primarily of safely storing waste until treatment and disposal facilities are available. Mixed LLW is stored in the A-, E-, M-, N-, and S-Areas in various tanks and buildings. These facilities include burial ground solvent tanks, the M-Area Process Waste Interim Treatment/Storage Facility, the Savannah River Technology Center Mixed Waste Storage Tanks, and the DWPF Organic Waste Storage Tank (DOE 1995c:3-81). These South Carolina Department of Health and Environmental Control permitted facilities will remain in use until appropriate treatment and disposal is performed on the waste (DOE 1996a:E-99).

3.5.2.5 Hazardous Waste

Hazardous waste is accumulated at the generating facility for a maximum of 90 days, or stored in DOT-approved containers in three RCRA-permitted hazardous waste storage buildings and on three interim status storage pads in B- and N-Areas. Most of the waste is shipped off the site to commercial RCRA-permitted treatment and disposal facilities using DOT-certified transporters. DOE plans to incinerate up to 9 percent of the hazardous waste (organic liquids, sludge, and debris) in the Consolidated Incinerator Facility (DOE 1996a:3-265). In 1995, 72 m^3 (2,538 ft^3) of hazardous waste were sent to onsite storage. Of this amount, 20 m^3 (712 ft^3) were shipped off the site for commercial treatment or disposal (Arnett and Mamatey 1996:48).

3.5.2.6 Nonhazardous Waste

In 1994, the centralization and upgrading of the sanitary wastewater collection and treatment systems at SRS were completed. The program included the replacement of 14 (of 20) aging treatment facilities scattered across the site with a new 3,975 m^3/day (1.1 million gal/day) central treatment facility and connecting them with a new 29 km (18 mi) sanitary sewer system. The central treatment facility treats sanitary wastewater by the extended aeration activated sludge process. The treatment facility separates the wastewater into two forms, clarified effluent and sludge. The liquid effluent is further treated by the nonchemical method of ultraviolet (UV) light disinfection to meet NPDES discharge limitations for the outfall to Fourmile Branch. The sludge is further treated to reduce pathogen levels to meet proposed land application criteria. The remaining sanitary wastewater treatment facilities are being upgraded as necessary by replacing existing chlorination treatment systems with nonchemical UV light disinfection systems to meet NPDES limitations (DOE 1996a:3-265).

SRS has privatized the collection, hauling, and disposal of its sanitary waste (Arnett and Mamatey 1996:48). SRS-generated solid sanitary waste is sent to a permitted disposal facility. SRS disposes of other nonhazardous waste that consists of scrap metal, powerhouse ash, domestic sewage, scrap wood, construction debris, and used railroad ties in a variety of ways. Scrap metal is sold to salvage vendors for reclamation. Powerhouse ash and domestic sewage sludge are used for land reclamation. Scrap wood is burned on the site or chipped for mulch. Construction debris is used for erosion control. Railroad ties are shipped off the site for disposal (DOE 1996a:E-100).

3.5.2.7 Waste Minimization

The total amount of waste generated and disposed of at SRS has been and continues to be reduced through the efforts of the pollution prevention and waste minimization program at the site. This program is designed to achieve continuous reduction of waste and pollutant releases to the maximum extent feasible and in accordance with regulatory requirements while fulfilling national security missions (DOE 1996a:E-97). The program focuses mainly on source reduction, recycling, and increasing employee participation in pollution prevention. For example, 1995 nonhazardous solid waste generation was 32 percent below that of 1994, and the disposal volume of other solid waste, including radioactive and hazardous wastes, was 38 percent below 1994 levels. In 1995, SRS achieved a 9 percent reduction in its radioactive waste generation volume compared with 1994. Total solid waste volumes have declined by more than 70 percent since 1991. Radioactive solid waste volumes have declined by about 63 percent, or more than 17,000 m^3 (600,000 ft^3) from 1991 through 1995. In 1995, more than 2,990 t (3,300 tons) of nonradioactive materials were recycled at SRS, including 963 t (1,062 tons) of paper and cardboard (Arnett and Mamatey 1996:16, 41).

3.5.2.8 Preferred Alternatives From the Final WM PEIS

Preferred alternatives from the WM PEIS (DOE 1997a:summary, 117) are shown in Table 3–42 for the four waste types analyzed in this SPD EIS. A decision on the future management of these wastes could result in the construction of new waste management facilities at SRS and the closure of other facilities. Decisions on the various waste types are expected to be announced in a series of RODs to be issued on this WM PEIS. In fact, the TRU waste ROD was issued on January 20, 1998 (DOE 1998a). The ROD states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ." More detailed information and DOE's alternatives for the future configuration of waste management facilities at SRS is presented in the WM PEIS, and the TRU waste ROD.

Table 3–42. Preferred Alternatives From the WM PEIS

Waste Type	Preferred Action
TRU and mixed TRU	DOE prefers the regionalized alternative for onsite treatment and storage of SRS contact-handled TRU waste. Under this alternative, some contact-handled TRU waste could be received from ORR for treatment and storage.[a]
LLW	DOE prefers to treat SRS LLW on the site. SRS could be selected as one of the regional disposal sites for LLW.
Mixed LLW	DOE prefers regionalized treatment at SRS. This includes the onsite treatment of SRS waste and could include treatment of some mixed LLW generated at other sites. SRS could be selected as one of the regional disposal sites for mixed LLW.
Hazardous	DOE prefers to continue to use commercial facilities for hazardous waste treatment.

[a] ROD for TRU waste (DOE 1998a) states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ."

Key: LLW, low-level waste; ORR, Oak Ridge Reservation; TRU, transuranic.

Source: DOE 1997a:summary, 117.

3.5.3 Socioeconomics

Statistics for employment and regional economy are presented for the REA, as defined in Appendix F.9 which encompasses 15 counties around SRS located in Georgia and South Carolina. Statistics for population, housing, community services, and local transportation are presented for the ROI, a five-county area in which 90.7 percent of all SRS employees reside as shown in Table 3–43. In 1997, SRS employed 15,032 persons (about 5.8 percent of the REA civilian labor force) (Knox 1997).

Table 3–43. Distribution of Employees by Place of Residence in the SRS Region of Influence, 1997

County	Number of Employees	Total Site Employment (Percent)
Aiken	6,981	53.9
Columbia	1,881	14.5
Richmond	1,755	13.5
Barnwell	932	7.2
Edgefield	210	1.6
ROI total	11,759	90.7

Source: Knox 1997.

3.5.3.1 Regional Economy Characteristics

Selected employment and regional economy statistics for the SRS REA are summarized in Figure 3–26. Between 1990 and 1996, the civilian labor force in the REA increased 4.4 percent to the 1996 level of 259,174. In 1996, the unemployment rate in the REA was 7.5 percent, which is greater than the unemployment rates for Georgia (4.6 percent) and South Carolina (6 percent) (DOL 1997a).

In 1995, manufacturing represented the largest sector of employment in the REA (25.6 percent). This was followed by government (20.9 percent) and service activities (19.9 percent). The total for these employment sectors in Georgia was 17.5 percent, 16.8 percent, and 23 percent, respectively. The total for these employment sectors in South Carolina was 23.3 percent, 17.3 percent, and 20.5 percent, respectively (DOL 1997b).

3.5.3.2 Population and Housing

In 1996, the ROI estimated population totaled 453,778. From 1990 to 1996, the ROI population increased by 8.6 percent, compared with a 13 percent increase in Georgia's population and a 5.7 percent increase in South Carolina's population (DOC 1997). Between 1980 and 1990, the number of housing units in the ROI increased by 25.1 percent, compared with the 30.1 percent increase in Georgia and the 23.5 percent increase in South Carolina. The total number of housing units within the ROI for 1990 was 165,443 (DOC 1994). The 1990 homeowner vacancy rate for the ROI was 2.2 percent, compared with the statewide rates of 2.5 percent for Georgia and 1.7 percent for South Carolina. The renter vacancy rate for the ROI counties was 10 percent compared with the statewide rates of 12.2 percent for Georgia and 11.5 percent for South Carolina (DOC 1990a). Population and housing trends are summarized in Figure 3–27.

3.5.3.3 Community Services

3.5.3.3.1 Education

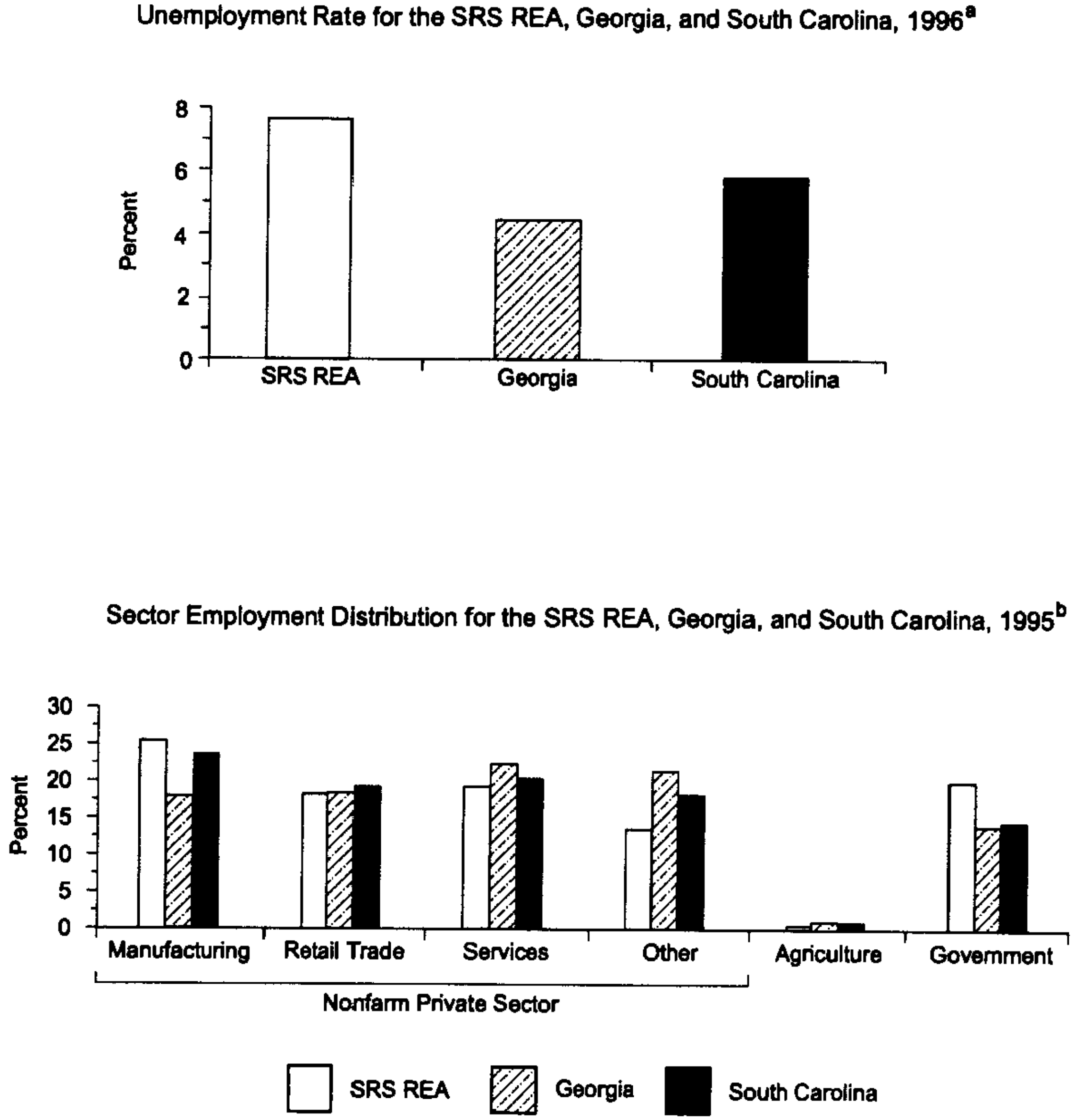
Seven school districts provided public education services and facilities in the SRS ROI. As shown in Figure 3–28, these school districts operated at between 85 percent (Barnwell County, District 19) and 100 percent (Richmond County School District) capacity in 1997. In 1997, the average student-to-teacher ratio for the SRS ROI was 17:1 (Nemeth 1997a). In 1990, the average student-to-teacher ratios were 10.8:1 for Georgia and 11.5:1 for South Carolina (DOC 1990b; 1994).

3.5.3.3.2 Public Safety

In 1997, a total of 973 sworn police officers were serving the five-county ROI. The average ROI officer-to-population ratio was 2.1 officers per 1,000 persons (Nemeth 1997b). This compares with the 1990 State averages of 2.0 officers per 1,000 persons for Georgia and 1.8 officers per 1,000 persons for South Carolina (DOC 1990b). In 1997, 1,712 paid and volunteer firefighters provided fire protection services in the SRS ROI. The average firefighter-to-population ratio in the ROI was 3.8 firefighters per 1,000 persons (Nemeth 1997b). This compares with the 1990 State averages of 1.0 firefighters per 1,000 persons for Georgia and 0.7 firefighters per 1,000 persons for South Carolina (DOC 1990b). Figure 3–29 displays the ratio of sworn police officers and firefighters to the population for all the counties in the ROI.

3.5.3.3.3 Health Care

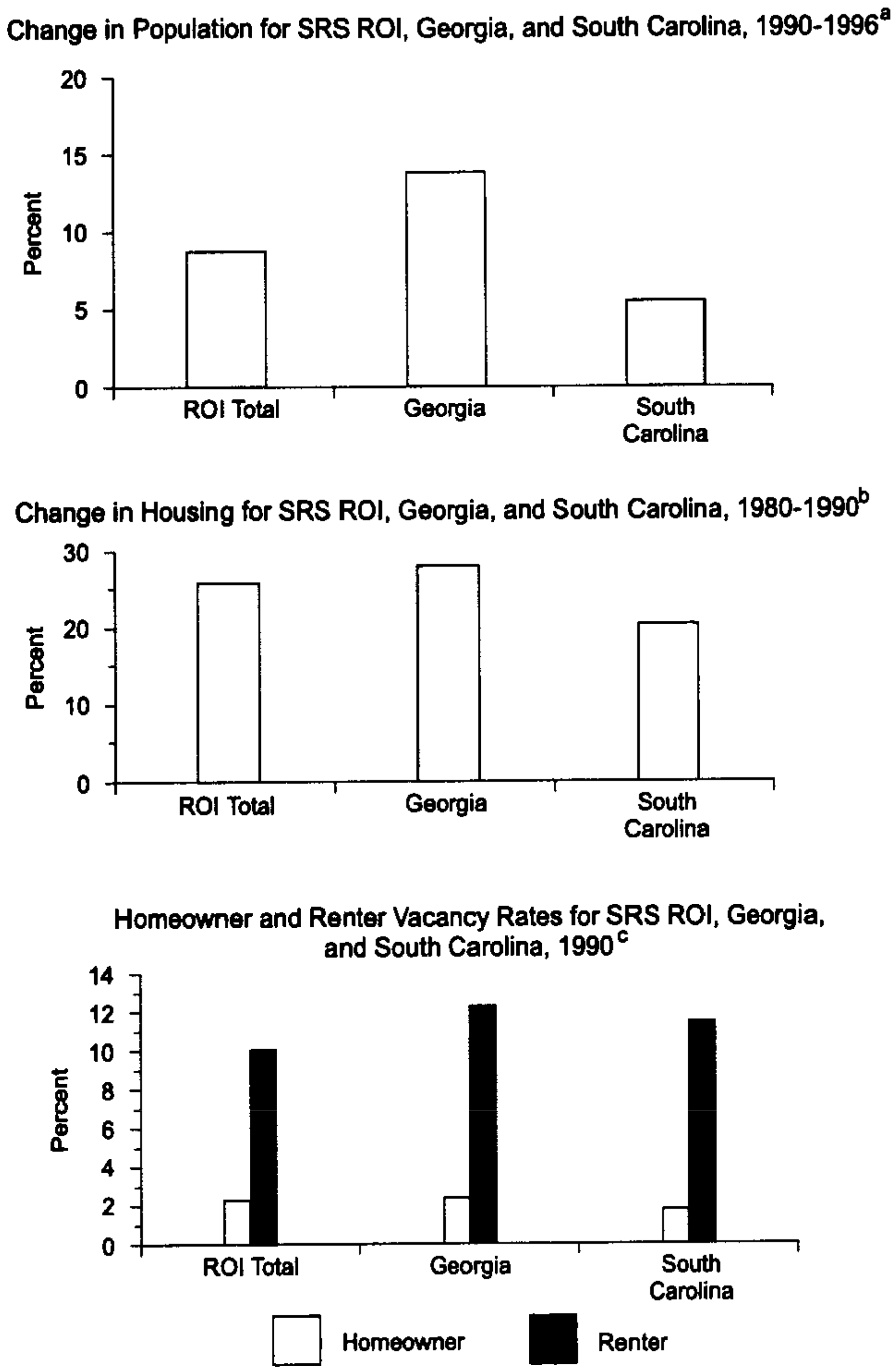
In 1996, a total of 1,722 physicians served the ROI. The average physician-to-population ratio in the ROI was 3.8 physicians per 1,000 persons. This compares with a 1996 State average of 2.3 physicians per



[a]DOL 1997a.
[b]DOL 1997b.

REA Regional economic area

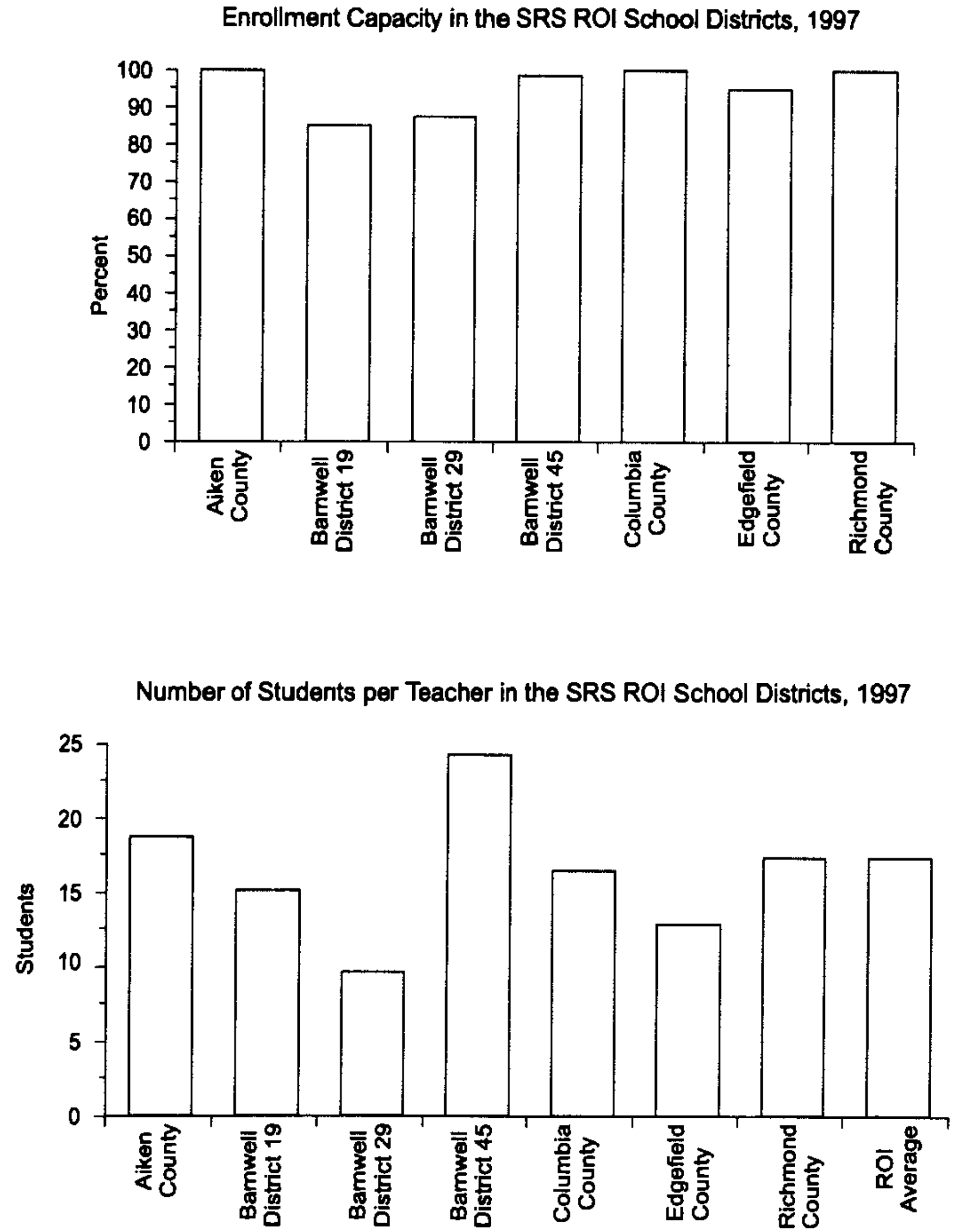
Figure 3–26. Employment and Local Economy for the SRS Regional Economic Area and the States of Georgia and South Carolina



[a]DOC 1997.
[b]DOC 1994.
[c]DOC 1990a.

ROI Region of influence

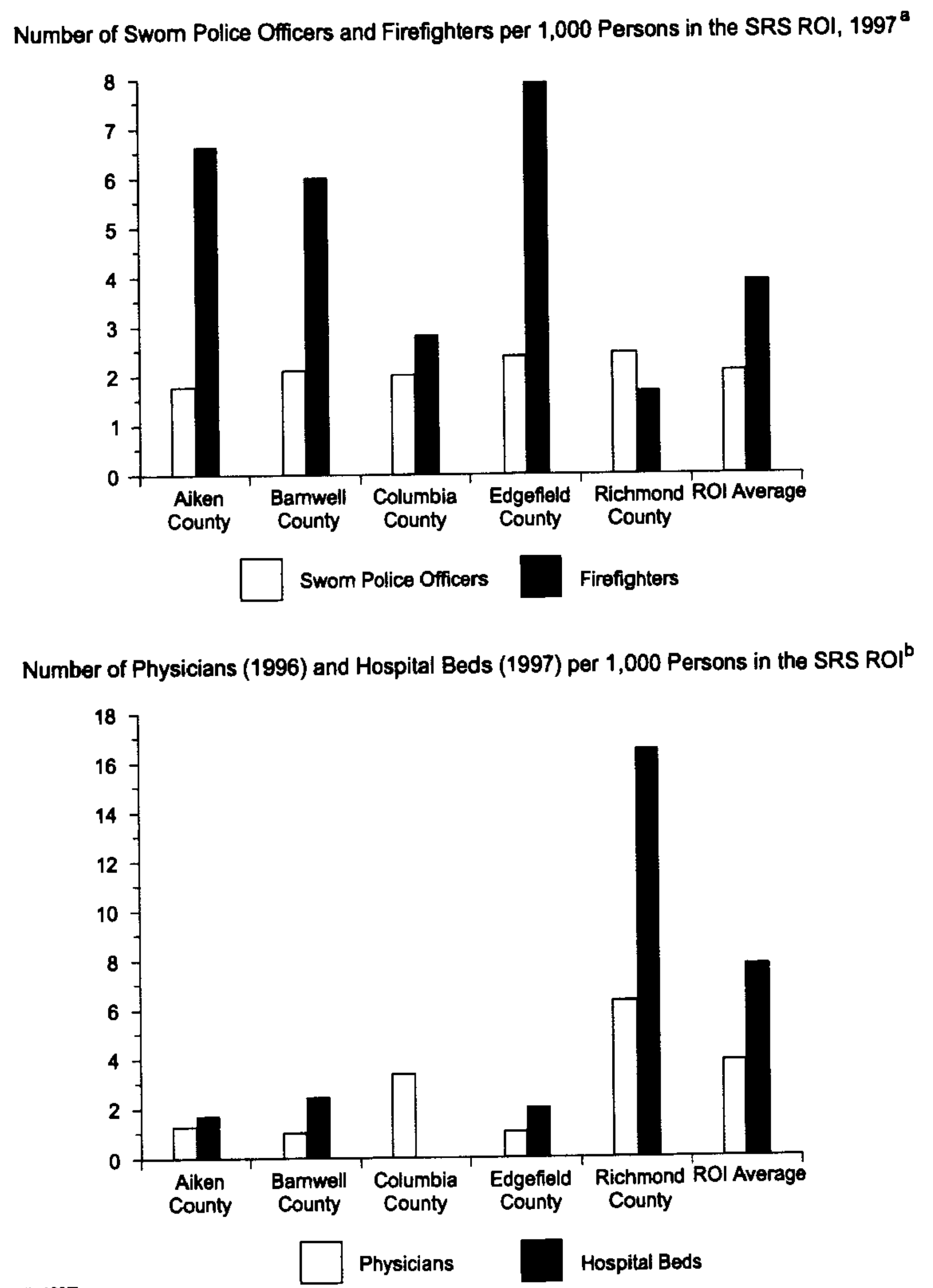
Figure 3–27. Population and Housing for the SRS Region of Influence and the States of Georgia and South Carolina



Source: Nemeth 1997a.

ROI Region of influence

Figure 3–28. School District Characteristics for the SRS Region of Influence



[a]Nemeth 1997b.
[b]Nemeth 1997c; Randolph 1997.

ROI Region of influence

Figure 3–29. Public Safety and Health Care Characteristics for the SRS Region of Influence

1,000 persons for Georgia and 2.2 physicians per 1,000 persons for South Carolina (Randolph 1997). In 1997, there were 10 hospitals serving the five-county ROI. The hospital bed-to-population ratio averaged 7.7 beds per 1,000 persons (Nemeth 1997c). This compares with a 1990 State average of 4.1 beds per 1,000 persons for Georgia and 3.3 beds per 1,000 persons for South Carolina (DOC 1996:128). Figure 3–29 displays the hospital bed-to-population and physician-to-population ratios for the SRS ROI counties.

3.5.3.4 Local Transportation

Vehicular access to SRS is provided by South Carolina State Routes 19, 64, and 125 (see Figure 2–5). Two road segments in the ROI could be affected by the disposition alternatives: South Carolina State Route 19 from U.S. I–78 at Aiken to U.S. 278 and South Carolina State Route 230 from U.S. 25 Business at North Augusta to U.S. I–25, I–78, and I–278. Three road improvement projects are planned that would alleviate traffic congestion leading into SRS.

The first improvement project is the widening of South Carolina State Route 302, Pine Log Road, from U.S. Route 78 and the construction of new segments to extend the route to South Carolina State Route 19. U.S. Route 25 is also being widened for one-half mile south of I–20. The widening project will be in conjunction with the second improvement project, the new construction of the Bobby Jones Expressway. The expressway will head in a southwest direction crossing South Carolina State Routes 126 and 125 and U.S. Route 1 and continue over the Savannah River to connect with the Georgia portion of the Bobby Jones Expressway, which is already constructed. The third improvement project is the completion of the South Carolina State Route 118 around Aiken. South Carolina State Route 118 will be widened with the construction of new segments to complete the by-pass (Sullivan 1997).

There is no public transportation to SRS. Rail service in the ROI is provided by the Norfolk Southern Corporation and CSX Transportation. SRS is provided rail access via Robbins Station on the CSX Transportation line.

Waterborne transportation is available via the Savannah River. Currently, the Savannah River is used primarily for recreation. SRS has no commercial docking facilities, but it has a boat ramp that has accepted large transport barge shipments.

Columbia Metropolitan Airport in the city of Columbia, South Carolina, and Bush Field in the city of Augusta, Georgia, receive jet air passenger and cargo service from both national and local carriers. Numerous smaller private airports are located in the ROI (DOE 1996a).

3.5.4 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.5.4.1 Radiation Exposure and Risk

3.5.4.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of SRS are shown in Table 3–44. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to SRS operations.

Table 3–44. Sources of Radiation Exposure to Individuals in the Vicinity Unrelated to SRS Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation[a]	
Cosmic radiation	27
External radiation	28
Internal terrestrial radiation	40
Radon in homes (inhaled)	200[b]
Other background radiation[c]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	360

[a] Arnett and Mamatey 1997a:116.
[b] An average for the United States.
[c] NCRP 1987:11, 40, 53.

Releases of radionuclides to the environment from SRS operations provide another source of radiation exposure to individuals in the vicinity of SRS. Types and quantities of radionuclides released from SRS operations in 1996 are listed in the *Savannah River Site Environmental Report for 1996* (Arnett and Mamatey 1997a:71–73). Doses to the public resulting from these releases are presented in Table 3–45. These doses fall within radiological limits per DOE Order 5400.5 (DOE 1993a:II-1–II-5) and are much lower than those of background radiation.

Table 3–45. Radiation Doses to the Public From Normal Operations at SRS in 1996 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard**[a]	**Actual**	**Standard**[a]	**Actual**[b]	**Standard**[a]	**Actual**
Maximally exposed individual (mrem)	10	0.06	4	0.14	100	0.20
Population within 80 km (person-rem)[c]	None	6.4	None	2.2	100	8.6
Average individual within 80 km (mrem)[d]	None	1.0×10^{-2}	None	3.2×10^{-3}	None	1.4×10^{-2}

[a] The standards for individuals are given in DOE Order 5400.5 (DOE 1993a:II-1–II-5). As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, as published in 58 FR 16268 (DOE 1993b:para. 834.7). If the potential total dose exceeds the 100 person-rem value, it is required that the contractor operating the facility notify DOE.
[b] Conservatively includes all water pathways, not just the drinking water pathway. The population dose includes contributions to Savannah River users downstream of SRS to the Atlantic Ocean.
[c] About 620,100 in 1996. For liquid releases, an additional 70,000 water users in Port Wentworth, Georgia, and Beaufort, South Carolina (about 160 km [98 mi] downstream), are included in the assessment.
[d] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site for atmospheric releases; for liquid releases the number of people includes water users who live more than 80 km (50 mi) downstream of the site.
Source: Arnett and Mamatey 1997a:108, 111, 112, 115.

Using a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from SRS operations in 1996 is estimated to be 1.0×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of SRS operations is 1 in 10 million. (It takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

According to the same risk estimator, 0.0043 excess fatal cancers are projected in the population living within 80 km (50 mi) of SRS from normal operations in 1996. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The 1995 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Famighetti 1998:964). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1996 in the population living within 80 km (50 mi) of SRS was 1,240. This expected number of fatal cancers is much higher than the 0.0043 fatal cancers estimated from SRS operations in 1996.

SRS workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in facilities with nuclear materials. Table 3–46 presents the average worker and cumulative worker dose to SRS workers from operations in 1996. These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995b:paragraph 835.202). According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers[8] (Appendix F.10), the number of projected fatal cancers to SRS workers from normal operations in 1996 is 0.095.

Table 3–46. Radiation Doses to Workers From Normal SRS Operations in 1996 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual**
Average radiation worker (mrem)	None[b]	19.0
Total workers (person-rem)[c]	None	237

[a] The radiological limit for an individual worker is 5,000 mrem/yr. However, DOE's goal is to maintain radiological exposure as low as reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.

[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

[c] About 12,500 (badged) in 1996.

Source: DOE 1995a:para. 835.202; WSRC 1997b.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Savannah River Site Environmental Report for 1996* (Arnett and Mamatey 1997a). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) are also presented in that report.

3.5.4.1.2 Proposed Facility Locations

External radiation doses and concentrations of gross alpha, plutonium, and americium in air have been measured in F- and S-Areas. In 1996, the annual doses in the F- and S-Areas were 106 and 111 mrem, respectively. Both are higher than the dose of 87 mrem measured at the offsite control location. In the same year, the concentrations of gross alpha were about 1.3×10^{-3} pCi/m^3 and 9.8×10^{-4} pCi/m^3 in the F- and S-Areas,

[8] The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

respectively, compared with the approximately 9.4×10^{-4} pCi/m^3 measured at the offsite control location. The concentrations of plutonium 239 in the F- and S-Areas were about 8.4×10^{-7} and 0 pCi/m^3, respectively. Offsite controls did not detect any plutonium 239 in the air in 1996 (Arnett and Mamatey 1997a:80; 1997b:31, 33, 40, 42).

3.5.4.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Section 3.5.1.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emissions and NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur via inhalation of air containing hazardous chemicals released to the atmosphere during normal SRS operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those via the inhalation pathway.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.5.1. The baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information on estimating the health impacts of hazardous chemicals is presented in Appendix F.10.

Exposure pathways to SRS workers during normal operations may include inhaling contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a detailed estimate of impacts. Workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. They are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals used in the operational processes ensures that these standards are not exceeded. Additionally, DOE requires that conditions in the workplace be as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, workplace conditions at SRS are substantially better than required by standards.

3.5.4.3 Health Effects Studies

One epidemiological study on the general population in communities surrounding SRS has been conducted and published. No evidence of excess cancer mortality, congenital anomalies, birth defects, early infancy deaths, strokes, or cardiovascular deaths was reported. The epidemiological literature on the facility reflects an excess of leukemia deaths among hourly workers; no other health effects for workers are reported. For a more detailed description of the studies reviewed and their findings, and for a discussion of the epidemiologic surveillance program implemented by DOE to monitor the health of current SRS workers, refer to Appendix M.4.7 of the *Storage and Disposition Final PEIS* (DOE 1996a:M-242, M-243).

Next Section

3.5.4.4 Accident History

Between 1974 and 1988, there were 13 inadvertent tritium releases from the SRS tritium facilities. These releases were attributed to aging equipment in the tritium-processing facility and are one of the reasons for the construction of the Replacement Tritium Facility at SRS. A detailed description and study of these incidents and the consequences thereof for the offsite population have been documented by SRS. The most significant were in 1981, 1984, and 1985, when, respectively, 32,934, 43,800, and 19,403 Ci of tritiated water vapor were released (Murphy et al. 1991). From 1989 through 1992, there were 20 inadvertent releases, all with little or no offsite dose consequences. The largest of the recent releases occurred in 1992 when 12,000 Ci of tritium were released (Arnett, Karapatakis, and Mamatey 1993:260).

In 1993, an inadvertent release of 0.18 microcurie (mCi) of plutonium 238 and plutonium 239 took place. Westinghouse Savannah River Company emergency response models estimated an exposure of 0.0019 mrem to a hypothetical person at the site boundary (Arnett, Karapatakis, and Mamatey 1994:178).

3.5.4.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, preparedness, and response.

The Emergency Preparedness Facility at SRS provides overall direction and control for onsite responses to emergencies and coordinates with Federal, State, and local agencies and officials on the technical aspects of the emergency. Emergency plans have been prepared for specific areas at SRS. Participating government agencies whose plans are interrelated with the SRS emergency plan for action include the States of South Carolina and Georgia, the City of Aiken, and the various counties in the general region of the site. Emergency response support, including firefighting and medical assistance, would be provided by these jurisdictions.

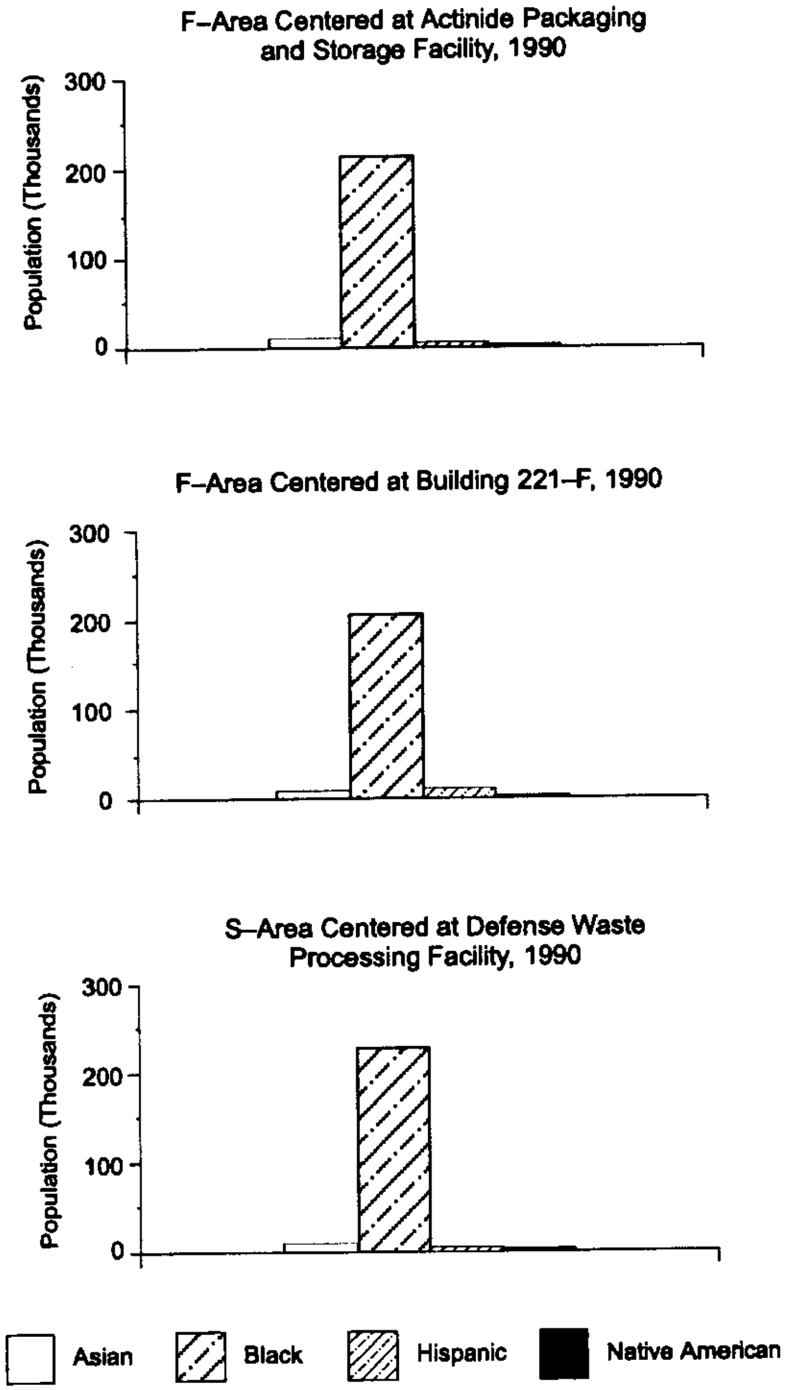
DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997. These actions and the timeframe in which they must be implemented are presented in Section 3.2.4.5.

3.5.5 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. In the case of SRS, the potentially affected area includes parts of Georgia and South Carolina.

The potentially affected area around the location of the proposed surplus plutonium disposition facilities in F-Area is defined by a circle with an 80-km (50-mi) radius centered at the planned APSF (lat. 33°17'22" N, long. 81°40'29" W). The total population residing within that area in 1990 was 599,099. The proportion of the population there that was considered minority was 37.9 percent.

Figure 3–30 illustrates the racial and ethnic composition of the minority population in the potentially affected area surrounding APSF. At the time of the 1990 census, Blacks were the largest minority group within that area, constituting 35.7 percent of the total population. Hispanics constituted about 1.1 percent, and Asians, about 1 percent. Native Americans comprised about 0.2 percent of the population (DOC 1992).



Source: DOC 1992.

Figure 3–30. Racial and Ethnic Composition of Minorities Around SRS

The potentially affected area around the proposed modification to existing facilities for plutonium in F-Area is defined by a circle with an 80-km (50-mi) radius centered at Building 221–F (lat. 33°17'11" N, long. 81°40'38" W). The total population residing within that area in 1990 was 596,224. The proportion of the population around this building that was considered minority was 37.9 percent.

Figure 3–30 illustrates the racial and ethnic composition of the minority population in the potentially affected area around the 221-F Building. At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 35.6 percent of the total population. Hispanics constituted about 1.1 percent, and Asians about 1 percent. Native Americans constituted about 0.2 percent of the population (DOC 1992).

The potentially affected area around S-Area is defined by a circle with an 80-km (50-mi) radius centered at DWPF (lat. 33°17'43" N, long. 81°38'25" W). The total population residing within that area in 1990 was 613,363. The proportion of the population around this facility that was considered minority was 38.6 percent.

Figure 3–30 illustrates the racial and ethnic composition of the minority population in the potentially affected area around the S-Area. At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 36.3 percent of the total population. Hispanics constituted about 1.1 percent, and Asians, about 1 percent. Native Americans constituted about 0.2 percent of the population (DOC 1992). The same census data show that the percentage of minorities for the contiguous United States was 24.1, and the percentages for the States of Georgia and South Carolina, 29.8 and 31.4, respectively (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 104,436 persons (17.4 percent of the total population) residing within the potentially affected area around F-Area at APSF reported incomes below the poverty threshold. The data also show that 104,014 persons (17.4 percent of the total population) residing within the potentially affected area around F-Area at Building 221–F reported incomes below the poverty threshold. The low-income population around S-Area at DWPF was 106,977 (17.4 percent of the total population).

Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that Georgia and South Carolina reported 14.7 and 15.4 percent, respectively.

3.5.6 Geology and Soils

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

3.5.6.1 General Site Description

Coastal Plain sediments beneath SRS overlie a basement complex composed of Paleocene crystalline and Triassic sedimentary formations of the Dunbarton Basin. Small and discontinuous zones of calcareous sand (i.e., sand containing calcium carbonate [calcite]), potentially subject to dissolution by water, are beneath some parts of SRS. If dissolution occurs in these zones, potential underground subsidence resulting in settling of the ground surface could occur. No settling as a result of dissolution of these zones has been identified. No economically viable geologic resources have been identified at SRS (DOE 1996a:3-241).

In the immediate region of SRS, there are no known capable faults. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years. Several faults have been identified from subsurface mapping and seismic surveys within the Paleozoic and Triassic basement beneath SRS. The largest of these is the Pen Branch Fault. There is no evidence of movement within the last 38 million years along this fault (DOE 1996a:3-241).

According to the Uniform Building Code, SRS is in Seismic Zone 2, meaning that moderate damage could occur as a result of an earthquake (DOE 1996a:3-241). Two earthquakes occurred during recent years inside the SRS boundary. On June 8, 1985, an earthquake with a local Richter scale magnitude of 2.6 and a focal depth of about 1 km (0.6 mi) occurred at SRS. Its epicenter was west of C- and K-Areas. The acceleration produced by the earthquake did not activate seismic monitoring instruments in the reactor areas. (These instruments have detection limits of 0.002g.) On August 5, 1988, another earthquake with a local Richter scale magnitude of 2.0 and a focal depth of about 2.7 km (1.7 mi) occurred at SRS. Its epicenter was northwest of K-Area. The seismic alarms in SRS facilities were not triggered. Existing information does not conclusively correlate the two earthquakes with any of the known faults on the site (DOE 1995c:3-7). Earthquakes capable of producing structural damage are not likely to occur in the vicinity of SRS (DOE 1996a:3-241).

Historically, two large earthquakes have occurred within 300 km (186 mi) of SRS. The largest of these, the Charleston earthquake of 1886, had an estimated Richter scale magnitude ranging from 6.5 to 7.5 (DOE 1996a:3-241). The SRS area experienced an estimated peak horizontal acceleration of 0.10g during this earthquake (DOE 1995c:3-6). An earthquake with a maximum horizontal acceleration of 0.19g is estimated to have an annual probability of occurrence of 1 in 5,000 at SRS (Barghusen and Feit 1995:2.13–2.16).

There are no volcanic hazards at SRS. The area has not experienced volcanic activity within the last 230 million years (DOE 1996a:3-241). Future volcanism is not expected because SRS is along the passive continental margin of North America (Barghusen and Feit 1995:2.13–2.16).

The soils at SRS are primarily sands and sandy loams. The somewhat excessively drained soils have a thick, sandy surface layer that extends to a depth of 2 m (6.6 ft) or more in some areas. Soil units that meet the soil requirements for prime farmland soils exist on SRS. However, the U.S. Department of Agriculture, Natural Resources Conservation Service, does not identify these lands as prime farmland due to the nature of site use; that is, the lands are not available for the production of food or fiber. The soils at SRS are considered acceptable for standard construction techniques (DOE 1996a:3-230, 3-241). Detailed descriptions of the geology and the soil conditions at SRS are included in the *Storage and Disposition Final PEIS* (DOE 1996a:3-241, 3-242) and the *Savannah River Site Waste Management Final EIS* (DOE 1995c:3-4–3-6).

3.5.6.2 Proposed Facility Locations

Soils in F-Area are predominantly of the Fuquay-Blanton-Dothan association, consisting of nearly level to sloping, well-drained soils. Other soils include the Troup-Pickney-Lucy association, consisting of nearly level soils formed along, and parallel to, the floodplains of streams (Barghusen and Feit 1995:2.13–2.16).

Several subsurface investigations conducted on SRS waste management areas encountered soft sediments classified as calcareous sands. These sands were encountered in borings in S-Area between 33 and 35 m (108 to 115 ft) below ground surface. Preliminary information indicates that these calcareous zones are not continuous over large areas, nor are they very thick. No settling as a result of dissolution of these zones has been identified (DOE 1995c:3-6). Soils in S-Area are predominantly the same as those in F-Area (Barghusen and Feit 1995:2.13–2.16).

3.5.7 Water Resources

3.5.7.1 Surface Water

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

3.5.7.1.1 General Site Description

The largest river in the area of SRS is the Savannah River, which borders the site on the southwest. Six streams flow through SRS and discharge into the Savannah River: Upper Three Runs Creek, Beaver Dam Creek, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek. Upper Three Runs Creek has two tributaries, Tims Branch and Tinker Creek; Pen Branch has one, Indian Grave Branch; and Steel Creek, one, Meyers Branch (DOE 1996a:3-236).

There are two manmade lakes at SRS: L-Lake, which discharges to Steel Creek, and Par Pond, which discharges to Lower Three Runs Creek. Also, about 299 Carolina bays—i.e., closed depressions capable of holding water—occur throughout the site. While these bays receive no direct effluent discharges, they do receive storm-water runoff (DOE 1996a:3-236; WSRC 1997a:6-124).

Water has historically been withdrawn from the Savannah River for use mainly as cooling water; some, however, has been used for domestic purposes (DOE 1996a:3-236). SRS currently withdraws about 140 billion l/yr (37 billion gal/yr) from the river. Most of this water is returned to the river through discharges to various tributaries (DOE 1996a:3-236).

The average flow of the Savannah River is 283 m^3/s (10,000 ft^3/s). Its lowest recorded flow is 184 m^3/s (6,500 ft^3/s), which occurred during the drought of 1985 to 1988. Three large upstream reservoirs, Hartwell, Richard B. Russell, and Strom Thurmond/Clarks Hill, regulate the flow in the Savannah River, thereby lessening the impacts of drought and flooding on users downstream (DOE 1995c:3-14).

Several communities in the area use the Savannah River as a source of domestic water. The nearest downstream water intake is the Beaufort-Jasper Water Authority in South Carolina, which withdraws about 0.23 m^3/s (8.1 ft^3/s) to service about 51,000 people. Treated effluent is discharged to the Savannah River from upstream communities and from treatment facilities at SRS. The average annual volume of flow discharged by the sewage treatment facilities at SRS is about 700 million l (185 million gal) (DOE 1996a:3-236).

It is clear that the surplus plutonium disposition facilities would not be located within a 100-year floodplain, but there is no information concerning 500-year floodplains (DOE 1996a:3-236; WSRC 1997c:sec. 2.3). No federally designated Wild and Scenic Rivers occur within the site (Barghusen and Feit 1995:2.13-2). A map showing the 100-year floodplain is presented as Figure 3–31 (Noah 1995:52).

The Savannah River is classified as a freshwater source that is suitable for primary and secondary contact recreation; drinking, after appropriate treatment; fishing; balanced indigenous aquatic community development and propagation; and industrial and agricultural uses. A comparison of Savannah River water quality upstream (river mile 160) and downstream (river mile 120) of SRS showed no significant differences for nonradiological parameters (Arnett and Mamatey 1996:73, 119, 120). A comparison of current and historical data shows that the coliform data are within normal fluctuations for river water in this area. For the different river locations, however, there has been an increase in the number of analyses in which standards were not met.

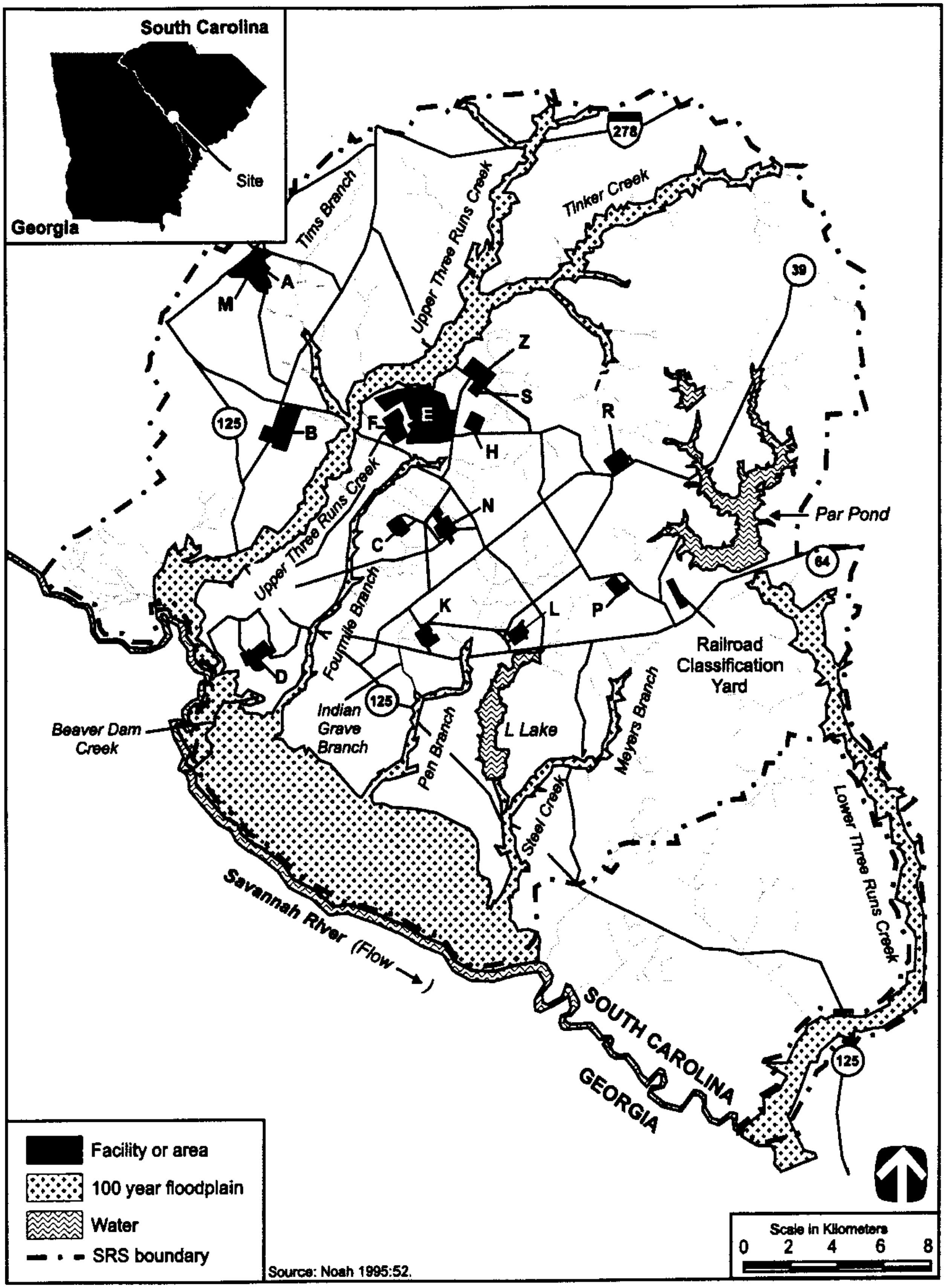


Figure 3–31. Locations of Floodplains at SRS

The data for the river's monitoring locations generally met the freshwater standards set by the State; a comparison of the 1995 and earlier measurements for river samples showed no abnormal deviations. As for radiological constituents, tritium is the predominant radionuclide detected above background levels in the Savannah River (DOE 1996a:3-236).

Surface water rights for SRS are determined by the Doctrine of Riparian Rights, which allows owners of land adjacent to or under the water to use the water beneficially (DOE 1996a:3-239). SRS has five NPDES permits, two (SC0000175 and SC0044903) for industrial wastewater discharges, two (SCR000000 and SCR100000) for general storm-water discharges, and one (ND0072125) for land application. Permit SC0000175 regulates 76 outfalls; permit SC0044903, another 7. The 1995 compliance rate for these outfalls was 99.8 percent. The 48 storm-water–only outfalls regulated by the storm-water permits are monitored as required, and a pollution prevention plan has been developed to identify where best available technology and best management practices must be used. For storm-water runoff from construction activities extending over 2 ha (5 acres), a sediment reduction and erosion plan is required (DOE 1996a:3-236).

3.5.7.1.2 Proposed Facility Locations

The land around F-Area drains to Upper Three Runs Creek and Fourmile Branch (DOE 1995c:3-17). Upper Three Runs Creek is a large, cool blackwater stream that flows into the Savannah River. It drains about 544 km^2 (210 mi^2), and during water year 1991, had a mean discharge of 6.8 m^3/s (240 ft^3/s) near its mouth. The 7-day, 10-year low flow, which is the lowest flow over any 7 days within any 10-year period, is about 2.8 m^3/s (100 ft^3/s). The stream is about 40 km (25 mi) long and only its lower reaches extend through SRS. It receives more water from underground sources than any other SRS stream, and therefore has lower dissolved solids, hardness, and pH values. It is the only major stream on the site that has not received thermal discharges. It receives permitted discharges from several areas at SRS, including F-Area, S-Area, S-Area sewage treatment plant, and treated industrial wastewater from the Chemical Waste Treatment Facility steam condensate. Flow from the sanitary wastewater discharge averages less than 0.001 m^3/s (0.035 ft^3/s or 16 gal/min). A comparison with the 7-day, 10-year low flow of 2.8 m^3/s (100 ft^3/s) in Upper Three Runs Creek shows that the present discharges are very small. The analytical results for the active outfalls show the constituents of concern are maintained within permit limitations (DOE 1994d:3-12–3-15; 1995c:3-15, 3-19).

Fourmile Branch is a blackwater stream affected by past operational practices at SRS. Its headwaters are near the center of the site, and it flows southwesterly before discharging into the Savannah River. The watershed is about 54 km^2 (21 mi^2) and receives permitted effluent discharges from F-Area and H-Area. This stream received cooling water discharges from C-Reactor while it was operating. Since those discharges ceased in 1985, the maximum recorded temperature in the stream has been 32 °C (90 °F), as opposed to ambient water temperatures that exceeded 60 °C (140 °F) when the reactor was operating. The average flow in the stream during C-Reactor operation was about 11.3 m^3/s (400 ft^3/s); since then flows have averaged about 1.8 m^3/s (64 ft^3/s) (DOE 1995c:3-19). In its lower reaches, this stream widens and flows via braided channels through a delta. Downstream of this delta area, it re-forms into one main channel, and most of the flow discharges into the Savannah River at river mile 152.1. When the Savannah River floods, water from Fourmile Branch flows along the northern boundary of the floodplain and joins with other site streams to exit the swamp via Steel Creek instead of flowing directly into the Savannah River (DOE 1995c:3-19).

The land surrounding S-Area also drains to Upper Three Runs Creek and Fourmile Branch. (Except for the differences noted in this section, stream information for F-Area is also relevant to S-Area.) Storm-water runoff from most of the area near DWPF is collected and discharged into a retention basin north of S-Area. Effluent from this basin is discharged at Outfall DW-005 to Crouch Branch, then to Upper Three Runs Creek (Arnett and Mamatey 1996:167; DOE 1994d:3-15). Analyses of samples from this outfall show a minimal impact of storm water on the water quality of Upper Three Runs Creek. Construction of DWPF adversely affected the water quality of Crouch Branch and McQueen Branch; however, enhanced erosion and sedimentation controls have been instituted at DWPF and in Z-Area. Also, startup of DWPF and the concurrent reduction in construction activities have assisted in reducing sediment loads to these streams (DOE 1994d:3-15).

3.5.7.2 Groundwater

Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

3.5.7.2.1 General Site Description

Although many different systems have been used to describe groundwater systems at SRS, for this SPD EIS the same system used in the *Storage and Disposition Final PEIS* has been adopted. The uppermost aquifer is referred to as the water table aquifer. It is supported by the leaky "Green Clay" aquitard, which confines the Congaree aquifer. Below the Congaree aquifer is the leaky Ellenton aquitard, which confines the Cretaceous aquifer, also known as the Tuscaloosa aquifer. In general, groundwater in the water table aquifer flows downward to the Congaree aquifer or discharges to nearby streams. Flow in the Congaree aquifer is downward to the Cretaceous aquifer or horizontal to stream discharge or the Savannah River, depending on the location within SRS (DOE 1996a:3-239).

Groundwater in the area is used extensively for domestic and industrial purposes. Most municipal and industrial water supplies are withdrawn from the Cretaceous or water table aquifer, while small domestic supplies are withdrawn from the Congaree or water table aquifer. It is estimated that about 13 billion l/yr (3.4 billion gal/yr) are withdrawn from the aquifers within a 16-km (10-mi) radius of the site, which is similar to the volume used by SRS (DOE 1996a:3-239). The Cretaceous aquifer is an important water resource for the SRS region. The water is generally soft, slightly acidic, and low in dissolved and suspended solids (DOE 1995c:3-11). Aiken, South Carolina, for example, uses the Cretaceous aquifer for drinking water.

Groundwater is the only source of domestic water at SRS (DOE 1995c:3-13). All groundwater at SRS is classified by EPA as a Class II water source, and depth to groundwater ranges from near the surface to about 46 m (150 ft). In 1993, SRS withdrew about 13 billion l/yr (3.4 billion gal/yr) of groundwater to support site operations (DOE 1996a:3-239). There are no designated sole source aquifers in the area (WSRC 1997c:sec. 2.3).

Groundwater ranges in quality across the site: in some areas it meets drinking water quality standards, while in areas near some waste sites it does not. The Cretaceous aquifer is generally unaffected except for an area near A-Area, where TCE has been reported. TCE has also been reported in the A- and M-Areas in the Congaree aquifer. Tritium has been reported in the Congaree aquifer in the Separations Area. The water table aquifer is contaminated with solvents, metals, and low levels of radionuclides at several SRS sites and facilities. Groundwater eventually discharges into onsite streams or the Savannah River (DOE 1996a:3-239), but groundwater contamination has not been detected beyond SRS boundaries (DOE 1995c:3-13).

Groundwater rights in South Carolina are associated with the absolute ownership rule. Owners of land overlying a groundwater source are allowed to withdraw as much water as they desire; however, the State requires users who withdraw more than 379,000 l/day (100,000 gal/day) to report their withdrawals. SRS is required to report because its usage is above the reporting level (DOE 1996a:3-239).

3.5.7.2.2 Proposed Facility Locations

Groundwater in the shallow, intermediate, and deep aquifers flows in different directions, depending on the depths of the streams that cut the aquifers. The shallow aquifer discharges to Upper Three Runs Creek and Fourmile Branch. Shallow groundwater in the vicinity of S-Area flows toward Upper Three Runs Creek, McQueen Branch, or Fourmile Branch. Groundwater in the intermediate and deep aquifers flows horizontally toward the Savannah River and southeast toward the coast (DOE 1994d:3-4, 3-6).

Groundwater also moves vertically. In the shallow aquifer, it moves downward until its movement is obstructed by impermeable material. Operating under a different set of physical conditions, groundwater in the intermediate and deep aquifers flows mostly horizontally. Near F-Area it moves upward due to higher water pressure below the confining unit between the upper and lower aquifers. This upward movement helps to protect the lower aquifers from contaminants found in the shallow aquifer. The depth to groundwater in F-Area varies from about 1 to 20 m (3.3 to 66 ft) (DOE 1994d:3-6).

Groundwater quality in F-Area is not significantly different from that for the site as a whole. It is abundant, usually soft, slightly acidic, and low in dissolved solids. High dissolved iron concentrations occur in some aquifers. Where needed, groundwater is treated to raise the pH and remove iron. Results of sampling in the shallow aquifer have indicated excursions from drinking water standards for lead, tetrachloroethylene, and tritium in S-Area wells (DOE 1994d:3-6).

F-Area groundwater quality can exceed drinking water standards for several contaminants. Near the F-Area seepage basins and inactive process sewer line, radionuclide contamination is widespread. Most of these wells contain tritium above drinking water standards. Other wells exhibit gross alpha, gross beta, strontium 90, and iodine 129 above their standards. Other radionuclides found above proposed standards in several wells include americium 241; curium 243 and 244; radium 226 and 228; strontium 90; total alpha–emitting radium; and uranium 233, 234, 235, and 238. Cesium 137, curium 245 and 246, and plutonium 238 were also found (Arnett and Mamatey 1996:143, 144).

Near the F-Area Tank Farm, tritium, mercury, nitrate-nitrite as nitrogen, cadmium, gross alpha, and lead were detected above drinking water standards in one or more wells. The pH exceeded the basic standard, and trichlorofluoromethane (Freon 11), which has no drinking water standard, was present in elevated levels (Arnett and Mamatey 1996:153).

At the F-Area Sanitary Sludge Land Application Site, tritium, specific conductance, lead, and copper were found to exceed their drinking water standards in one or more wells (Arnett and Mamatey 1996:154). Groundwater near the F-Area Acid/Caustic Basin consistently exceeded drinking water standards for gross alpha. Total alpha-emitting radium, alkalinity, gross beta, nitrate as nitrogen, and pH were above their respective standards in one or more wells (Arnett and Mamatey 1996:138). The groundwater near the F-Area Coal Pile Runoff Containment Basin did not exceed any chemical or radiological standard during 1995 (Arnett and Mamatey 1996:141).

Groundwater flow and conditions in S-Area are not significantly different from those in F-Area. Tritium, tetrachloroethylene, and TCE exceeded the drinking water standards near the S-Area facilities. The groundwater in one well near the S-Area Low-Point Pump Pit also contained tritium in excess of drinking water standards. No other radiological or chemical constituents have been detected above standards since 1989 (Arnett and Mamatey 1996:149). Near the S-Area vitrification building, also known as the S-Area Canyon, tritium exceeded drinking water standards, and specific conductance and alkalinity were elevated (Arnett and Mamatey 1996:149).

3.5.8 Ecological Resources

Ecological resources are defined as terrestrial (predominantly land) and aquatic (predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this SPD EIS, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special status species—that is, "nonsensitive" versus "sensitive" habitat.

3.5.8.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

3.5.8.1.1 General Site Description

At least 90 percent of the SRS land cover is composed of upland pine and bottomland hardwood forests (DOE 1997b:4-97). Five major plant communities have been identified at SRS: bottomland hardwood (most commonly sweetgum and yellow poplar); upland hardwood-scrub oak (predominantly oaks and hickories); pine/hardwood; loblolly, longleaf, and slash pine; and swamp. The loblolly, longleaf, and slash pine community covers about 65 percent of the upland areas of the site. Swamp forests and bottomland hardwood forests occur along the Savannah River and the numerous streams found on the site (Figure 3–32) (DOE 1995a:vol. 1, app. C, 4-47; 1996a:3-242).

The biodiversity of the region is extensive due to the variety of plant communities and the mild climate. Animal species known to inhabit SRS include 44 species of amphibians, 255 species of birds, 54 species of mammals, and 59 species of reptiles. Common species include the eastern box turtle, Carolina chickadee, common crow, eastern cottontail, and gray fox (DOE 1996a:3-242; WSRC 1997c:3-3). Game animals include a number of species, two of which, the white-tailed deer and feral hogs, are hunted on the site (DOE 1996d:3-56). Raptors, such as the Cooper's hawk and black vulture, and carnivores, such as the gray fox are ecologically important groups at SRS (DOE 1996a:3-242).

Aquatic habitat includes manmade ponds, Carolina bays, reservoirs, and the Savannah River and its tributaries. There are more than 50 manmade impoundments throughout the site that support populations of bass and sunfish. Carolina bays, a type of wetland unique to the southeastern United States, are natural shallow depressions that occur in interstream areas. These bays can range from lakes to shallow marshes, herbaceous bogs, shrub bogs, or swamp forests. Among the 299 Carolina bays found throughout SRS, fewer than 20 have permanent fish populations. Redfin pickerel, mud sunfish, lake chubsucker, and mosquito fish are present in these bays. Although sport and commercial fishing is not permitted at SRS, the Savannah River is used extensively for both. Important commercial species are the American shad, hickory shad, and striped bass, all of which are anadromous. The most important warm-water game fish are bass, pickerel, crappie, bream, and catfish (DOE 1996a:3-244; WSRC 1997c:6-124).

3.5.8.1.2 Proposed Facility Locations

F-Area and S-Area are situated on an upland plateau between the drainage areas of Upper Three Runs Creek and Fourmile Branch. These heavily industrialized areas are dominated by buildings, paved parking lots, graveled construction areas, and laydown yards; little natural vegetation remains inside the fenced areas. Grassed areas occur around the administration buildings, and some vegetation is present along drainage ditches, but most of the developed areas have no vegetation (DOE 1994d:3-24; 1995b:vol. 1, app. C, 4-47).

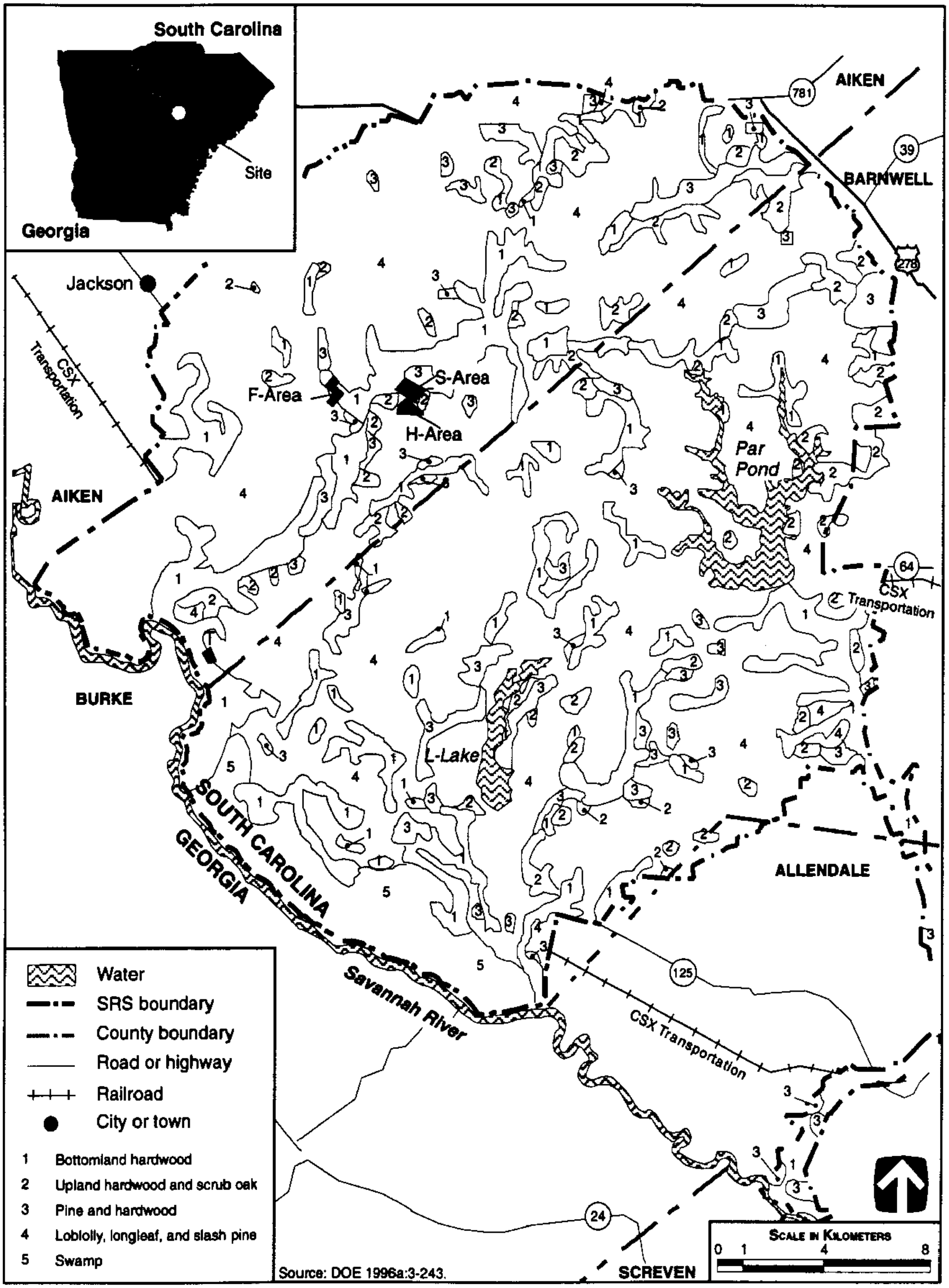


Figure 3–32. Major Plant Communities at SRS

The most common plant communities in the vicinities of F-Area and S-Area include loblolly, longleaf, and slash pine; upland hardwood-scrub oak; pine/hardwood; and bottomland hardwood (DOE 1995c:3-34, 3-35; DOE 1996a:3-242). Cleared fields are also common in F-Area, and a roughly 6-ha (15-acre) oak-hickory forest area designated as a National Environmental Research Park set aside is northwest of F-Area (DOE 1996a:3-242).

A recent (1994–1997) study was conducted to document the composition and diversity of urban wildlife, those species of amphibians, birds, mammals and reptiles that inhabit or temporarily use the developed areas on SRS. Results indicate that the use of the developed areas by wildlife species is more common than has been previously reported (Mayer and Wike 1997:8, 52). A total of 41 wildlife species were observed in and around F-Area, including 18 species of birds, 11 species of mammals, and 12 species of reptiles. Similarly, S-Area produced sightings of 36 wildlife species, including 19 species of birds, 9 species of mammals, and 8 species of reptiles. Bird species commonly seen include the bufflehead (F-Area only), turkey vulture, black vulture, killdeer, rock dove, mourning dove, chimney swift (F-Area only), great crested flycatcher (F-Area only), barn swallow, common crow, fish crow, northern mockingbird, American robin, loggerhead shrike (S-Area only), European starling, house sparrow (S-Area only), red-winged blackbird (S-Area only), and common grackle. Frequently sighted mammals include the Virginia opossum, eastern cottontail (F-Area only), house mouse, feral cat, striped skunk, and raccoon. The only reptile commonly observed is the banded water snake (Mayer and Wike 1997:9–14).

Upper Three Runs Creek and its tributaries and three Carolina bays constitute the aquatic habitat in the vicinity of F-Area and S-Area. Streams support largemouth bass, black crappie, and various species of pan fish. Upper Three Runs Creek has a rich fauna; more than 551 species of aquatic insects have been collected (DOE 1996a:3-244; WSRC 1997c:5-32). It is important as a spawning area for blueback herring, and as a seasonal nursery habitat for American shad, striped bass, and other Savannah River species. Aquatic resources information on the three Carolina bays is unavailable (DOE 1996a:3-244).

3.5.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including wetlands) areas of the site that support threatened and endangered, State-protected, and other special status plant and animal species.[9]

3.5.8.2.1 General Site Description

SRS wetlands, most of which are associated with floodplains, streams, and impoundments, include bottomland hardwood, cypress-tupelo, scrub-shrub, and emergent vegetation, as well as open water. Swamp forest along the Savannah River is the most extensive wetlands vegetation type (DOE 1996a:3-242).

Sixty-one threatened, endangered, and other special status species listed by the Federal Government or the State of South Carolina may be found in the vicinity of SRS, as shown in Table 3.7.6–1 in the *Storage and Disposition Final PEIS*. No critical habitat for threatened or endangered species exists on SRS (DOE 1996a:3-245).

3.5.8.2.2 Proposed Facility Locations

No federally listed threatened or endangered species are known to occur in F-Area or S-Area, but several species that may exist in the general vicinity of these areas are listed in Table 3–47. The American alligator, although listed as threatened (by virtue of similarity in appearance to the endangered crocodile) is fairly

[9] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

Table 3–47. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in the Vicinity of F-Area and S-Area

Common Name	Scientific Name	Federal Status	State Status
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Endangered
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered
Wood stork	*Mycteria americana*	Endangered	Endangered
Plants			
Oconee azalea	*Rhododendron flammeum*	Not listed	Species of Concern
Smooth purple coneflower	*Echinacea laevigata*	Endangered	Endangered
Reptiles			
American alligator	*Alligator mississippiensis*	Threatened (S/A)[a]	Not listed

[a] Protected under the Similarity of Appearance Provision of the Endangered Species Act.
Source: DOE 1996a:3-245–3-248; Mayer and Wike 1997:9–14, 42.

abundant on SRS. It was recently observed near F-Area, but its occurrence there is seen as uncommon. Furthermore, no State-listed protected species have been found in any developed area on SRS, and of the State-listed organisms known to occur, none would be expected to use any of the disturbed areas for extended periods (Mayer and Wike 1997:42).

The Pen Branch area, about 14 km (8.7 mi) southwest of the proposed sites, and an area south of Par Pond, about 12 km (7.5 mi) to the southeast, support active bald eagle nests. Wood storks have been observed about 21 km (13 mi) from the proposed site, near the Fourmile Branch delta. The closest colony of red-cockaded woodpeckers is about 5 km (3.1 mi) away, but suitable forage habitat exists on the proposed sites. The smooth purple coneflower, the only endangered plant species found on SRS, could be found on the proposed sites (DOE 1996a:3-245). Botanical surveys conducted by the Savannah River Forest Station in 1992 and 1994 identified three populations of Oconee azalea in the area northwest of F-Area. This State-listed rare plant species, was found on the steep slopes adjacent to the Upper Three Runs Creek floodplain (DOE 1995c:3-37).

3.5.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. Field studies conducted over the past two decades by the South Carolina Institute of Archaeology and Anthropology of the University of South Carolina have provided considerable information about the distribution and content of cultural resources at SRS. About 60 percent of SRS has been surveyed, and 858 archaeological (historic and prehistoric) sites have been identified (DOE 1995c). There are 67 sites considered potentially eligible for listing on the National Register; most of the sites have not yet been evaluated (DOE 1996a:3-249). No SRS nuclear production facilities have been nominated for the National Register, and there are no plans for nominations. Existing SRS facilities lack architectural integrity and do not contribute to the broad historic theme of the Manhattan Project and the production of World War II era nuclear materials (DOE 1995c:vol. I, 3-53, 3-54).

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

Cultural resources at SRS are managed under the terms of a programmatic memorandum of agreement among the DOE Savannah River Operations Office, the South Carolina State Historic Preservation Officer, and the Advisory Council on Historic Preservation, dated August 24, 1990 (WSRC 1997c:sec. 2.6). Guidance on the management of cultural resources at SRS is included in the *Archaeological Resources Management Plan of the Savannah River Archaeological Research Program* (SRARP 1989).

3.5.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.5.9.1.1 General Site Description

Prehistoric resources at SRS consist of villages, base camps, limited-activity sites, quarries, and workshops. An extensive archaeological survey program begun at SRS in 1974 includes numerous field studies such as reconnaissance surveys, shovel test transects, and intensive site testing and excavation. There is prehistoric evidence of more than 800 sites, some of which may fall in the vicinity of the proposed facilities. Fewer than 8 percent of these sites have been evaluated for National Register eligibility (DOE 1996a:3-249).

3.5.9.1.2 Proposed Facility Locations

Within F-Area, land areas have been disturbed over the past 46 years by activities associated with construction and operation of the extant facilities. Although no archaeological surveys have been conducted within the boundary of F-Area, no prehistoric cultural materials have been, or are expected to be, identified within this industrial area.

The proposed construction area adjacent to and northeast of F-Area has been surveyed for prehistoric and historic archaeological resources. Fourteen known archaeological resources containing prehistoric materials are considered potentially eligible for nomination to the National Register (Cabak, Sassaman, and Gillam 1996:199–312). Prior to any activity with potential impact on the sites in this area, a consultation process would be initiated with the South Carolina State Historic Preservation Officer to formally determine the eligibility of specific sites and to determine necessary and appropriate mitigation measures.

A survey of S-Area prior to construction of DWPF revealed no archaeological resources potentially eligible for nomination to the National Register.

3.5.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.5.9.2.1 General Site Description

Types of historic sites include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farm dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. About 400 historic sites or sites with historic components have been identified within SRS, and some of these may fall within the locations of the proposed facilities. To date, about 10 percent of the historic sites have been evaluated for National Register eligibility. Most pre-SRS era historic structures were demolished during the initial establishment of SRS in 1950. Two SRS era buildings built in 1951 remain in use. From a Cold War perspective, SRS has been involved in tritium operations and other nuclear material production for more than 40 years; therefore, some existing facilities and engineering records may have significant historical and scientific content (DOE 1996a:3-249).

3.5.9.2.2 Proposed Facility Locations

Within F-Area, land areas have been disturbed over the past 46 years by activities associated with the construction and operation of the extant facilities. Although no surveys have been conducted within the boundary of F-Area, no historic resources are expected to be identified with the possible exception of surviving facilities and engineering records from the Cold War era (DOE 1996a:3-249).

The proposed construction area adjacent to and northeast of F-Area has been surveyed for prehistoric and historic archaeological resources. Four known archaeological resources containing historic materials are considered potentially eligible for nomination to the National Register (Cabak, Sassaman, and Gillam 1996:199–312). Prior to any activity with potential impact on the sites in this area, a consultation process would be initiated with the South Carolina State Historic Preservation Officer to formally determine the eligibility of specific sites and to determine necessary and appropriate mitigation measures.

A survey of S-Area in conjunction with the 1982 DWPF EIS revealed no archaeological resources potentially eligible for nomination to the National Register (DOE 1994d:3–37).

3.5.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts.

3.5.9.3.1 General Site Description

Native American groups with traditional ties to the area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. At different times, each of these groups was encouraged by the English to settle in the area to provide protection from the French, Spanish, or other Native American groups. Main villages of both the Cherokee and Creek were located southwest and northwest of SRS, respectively, but both groups may have used the area for hunting and gathering activities. During the early 1800s, most of the remaining Native Americans residing in the region were relocated to the Oklahoma Territory (DOE 1996a:3-249).

Native American resources in the region include remains of villages or townsites, ceremonial lodges, burials, cemeteries, and natural areas containing traditional plants used in religious ceremonies. Literature reviews and consultations with Native American representatives have revealed concerns related to the American Indian Religious Freedom Act within the central Savannah River valley, including some sensitive Native American resources and several plants traditionally used in ceremonies (DOE 1996a:3-249).

3.5.9.3.2 Proposed Facility Locations

In 1991, DOE conducted a survey of Native American concerns about religious rights in the central Savannah River valley. During this study, three Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, and the Indian People's Muskogee Tribal Town Confederacy, expressed continuing interest in the SRS region with regard to the practice of their traditional religious beliefs. The Yuchi Tribal Organization and the National Council of Muskogee Creek have expressed concerns that several plant species—for example, redroot (*Lachnanthese carolinianum*), button snakeroot (*Eryngium yuccifolium*), and American ginseng (*Panax quinquefolium*)—traditionally used in tribal ceremonies could exist on SRS. Redroot and button snakeroot are known to occur on SRS, but are typically found in wet, sandy areas such as evergreen shrub bogs and savannas. Neither species is likely to be found in F-Area or S-Area due to clearing prior to the establishment of SRS in the 1950s (DOE 1994d:3-37). Consultations (see Chapter 5 for discussion) would be initiated with appropriate American Indian Tribal Governments upon publication of this draft SPD EIS to determine any concerns associated with the actions evaluated in this SPD EIS.

3.5.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.5.9.4.1 General Site Description

Paleontological materials from the SRS area date largely from the Eocene Age (54 to 39 million years ago) and include fossil plants, numerous invertebrate fossils, giant oysters (*Crassostrea gigantissima*), other mollusks, and bryozoa. With the exception of the giant oysters, all other fossils are fairly widespread and common; therefore, the assemblages have low research potential or scientific value (DOE 1996a:3-249).

3.5.9.4.2 Proposed Facility Locations

No paleontological resources have been recorded for either F-Area or S-Area.

3.5.10 Land Use and Visual Resources

3.5.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

Located in southwestern South Carolina, SRS occupies an area of about 800 km^2 (310 mi^2) in a generally rural area about 40 km (25 mi) southeast of Augusta, Georgia, and 19 km (12 mi) south of Aiken, South Carolina, the nearest population centers (DOE 1996a:3-228). The site is owned by the Federal Government and is administered, managed, and controlled by DOE (DOE 1996a:3-230). It is bordered by the Savannah River to the southwest and includes portions of three South Carolina counties: Aiken, Allendale, and Barnwell (DOE 1996a:3-230).

3.5.10.1.1 General Site Description

Forest and agricultural land predominate in the areas bordering SRS. There are also significant open water and nonforested wetlands along the Savannah River Valley. Incorporated and industrial areas are the only other significant land uses. There is limited urban and residential development bordering SRS. The three counties in which SRS is located have not zoned any of the site land. The only adjacent area with any zoning is the town of New Ellenton, which has lands in two zoning categories bordering SRS: urban development and residential development. The closest residences are to the west, north, and northeast, within 60 m (200 ft) of the site boundary (DOE 1996a:3-230).

Various industrial, manufacturing, medical, and farming operations are conducted in areas around the site. Major industrial and manufacturing facilities in the area include textile mills, plants producing polystyrene foam and paper products, chemical processing plants, and a commercial nuclear power plant. Farming is diversified in the region; it includes crops such as peaches, watermelon, cotton, soybeans, corn, and small grains (DOE 1995b:vol. 1, app. C, 4-2).

Outdoor public recreation facilities are plentiful and varied in the SRS region. Included are the Sumter National Forest, 75 km (47 mi) to the northwest; Santee National Wildlife Refuge, 80 km (50 mi) to the east; and Clarks Hill/Strom Thurmond Reservoir, 70 km (43 mi) to the northwest. There are also a number of State, county, and local parks in the region, most notably Redcliffe Plantation, Rivers Bridge, Barnwell and Aiken County State Parks in South Carolina, and Mistletoe State Park in Georgia (DOE 1995b:vol. I, app. C, 4-2). The Crackerneck Wildlife Management Area, which extends over 1,930 ha (4,770 acres) of SRS adjacent to the Savannah River, is open to the public for hunting and fishing. Public hunts are allowed under DOE Order 4300.1C, which states that "all installations having suitable land and water areas will have programs for the harvesting of fish and wildlife by the public" (Noah 1995:48). SRS is a controlled area, public access being limited to through traffic on South Carolina Highway 125 (SRS Road A), U.S. Highway 278 (SRS Road 1), and the CSX railway line (DOE 1995b:vol. 1, app. C, 4-2).

Land use at SRS can be classified into three major categories: forest/undeveloped, water/wetlands, and developed facilities. Generalized land uses at SRS and vicinity are shown on Figure 3–33. Approximately 585 km^2 (226 mi^2) of SRS—i.e., 73 percent of the area—is undeveloped (DOE 1996a:3-230). Wetlands, streams, and lakes account for 180 km^2 (70 mi^2) or 22 percent of the site, while developed facilities including production and support areas, roads, and utility corridors only make up approximately 5 percent or 40 km^2 (15 mi^2) of SRS (DOE 1996a:3-230). The woodlands area is primarily in revenue-producing, managed timber production. The U.S. Forest Service, under an interagency agreement with DOE, harvests about 7.3 km^2 (2.8 mi^2) of timber from SRS each year (DOE 1997f:4-57). Soil map units that meet the requirements for prime farmland soils exist on the site. However, the U.S. Department of Agriculture, Natural Resources Conservation Service, does not identify these as prime farmlands because the land is not available for agricultural production (DOE 1996a:3-230).

In 1972, DOE designated all of SRS as a National Environmental Research Park. The National Environmental Research Park is used by the national scientific community to study the impacts of human activities on the cypress swamp and hardwood forest ecosystems (DOE 1996a:3-230). DOE has set aside approximately 57 km^2 (22 mi^2) of SRS exclusively for nondestructive environmental research (DOE 1997f:4-57). A portion of SRS is open to the public for hunting and fishing.

Decisions on future land uses at SRS are made by DOE through the site development, land use, and future planning processes. SRS has established a Land Use Technical Committee composed of representatives from DOE, Westinghouse Savannah River Company, and other SRS organizations. DOE prepared the *FY 1994 Draft Site Development Plan*, which describes the current SRS mission and facilities, evaluates possible future missions and requirements, and outlines a master development plan that is now being prepared. In January 1996a, DOE published the *SRS Future Use Project Report*, which summarizes stakeholder-preferred future use recommendations that DOE considers throughout future planning and decisionmaking activities (DOE 1997f:4-57).

The State of South Carolina, through Act 489, as amended in 1994, requires local jurisdictions to undertake comprehensive planning. Regional-level planning also occurs within the State, with the State divided into 10 planning districts guided by regional advisory councils (DOE 1996a:3-230). The counties of Aiken, Allendale, and Barnwell together constitute part of the Lower Savannah River Council of Governments. Private lands bordering SRS are subject to the planning regulations of these three counties.

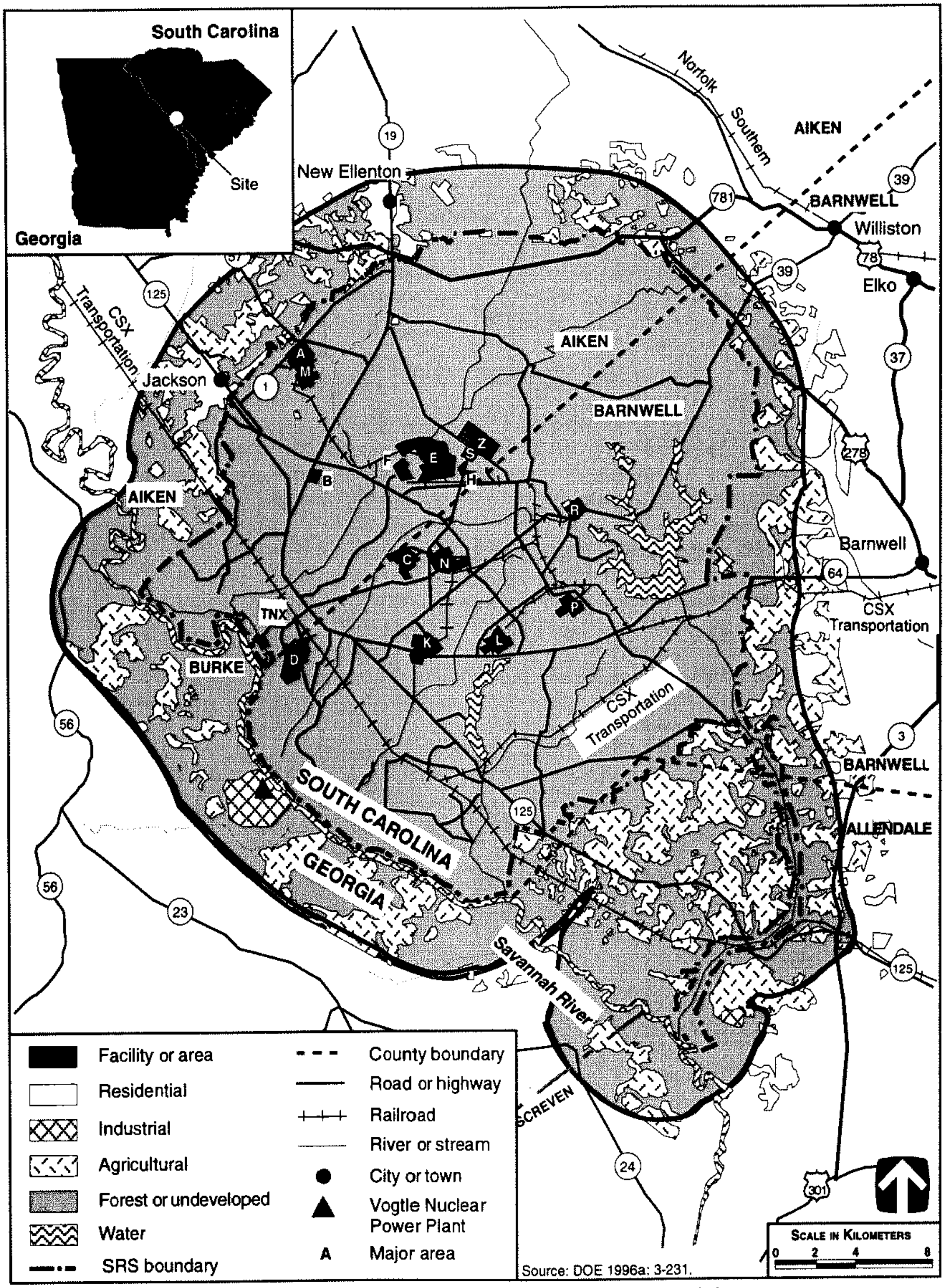


Figure 3–33. Generalized Land Use at SRS and Vicinity

No onsite areas are subject to Native American Treaty Rights. However, five Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, the Indian Peoples Muskogee Tribal Town Confederacy, the Pee Dee Indian Association, and the Ma Chis Lower Alabama Creek Indian Tribe, have expressed concern over sites and items of religious significance on SRS. DOE routinely notifies these organizations about major planned actions at SRS and asks them to comment on SRS documents prepared in accordance with NEPA.

3.5.10.1.2 Proposed Facility Locations

Many buildings are situated within F-Area. Included is Building 221–F, one of the so-called canyons where plutonium was recovered from targets during DOE's plutonium production phase. Land use at Building 221–F in F-Area is classified as heavy industrial. This 30-m (100-ft) concrete structure is designed for plutonium immobilization. F-Area occupies approximately 160 ha (395 acres) of the site; S-Area, 110 ha (272 acres). These areas are about 14 km (8.7 mi) and 10 km (6.2 mi), respectively, from the site boundary.

Also within F-Area is the Actinide Packaging and Storage Facility (APSF), a below-grade facility currently being constructed for receiving and storing Category I quantities of special nuclear material (UC 1998). For those alternatives that involve installing the plutonium conversion and immobilization facilities at SRS, DWPF in S-Area would provide the second-stage immobilization services (DOE 1994d:3-29).

3.5.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.5.10.2.1 General Site Description

The dominant viewshed in the vicinity of SRS consists mainly of agricultural land and forest, with some limited residential and industrial areas. The SRS landscape is characterized by wetlands and upland hills. Vegetation is composed of bottomland hardwood forests, scrub oak and pine woodlands, and wetland forests. DOE facilities are scattered throughout SRS and are brightly lit at night. These facilities are generally not visible offsite, as views are limited by rolling terrain, normally hazy atmospheric conditions, and heavy vegetation. The only areas visually impacted by the DOE facilities are those within the view corridors of State Highway 125 and SRS Road 1.

The developed areas and utility corridors (transmission lines and aboveground pipelines) of SRS are consistent with a VRM Class 5 designation. The remainder of SRS generally ranges in VRM designation from Class 3 to Class 4 (DOE 1996a:3-230).

3.5.10.2.2 Proposed Facility Locations

Industrial facilities within F-Area consist of large concrete structures, smaller administrative and support buildings, and parking lots (DOE 1994d:3-38). The structures range in height from 3 to 30 m (10 to 100 ft), with a few stacks and towers that reach 60 m (200 ft). The facilities in this area are brightly lit at night and visible when approached via SRS access roads. Visual resource conditions in F-Area hold a VRM Class 5 designation (WSRC 1997b:sec. 2.1, table 2-1). F-Area is about 7 km (4.3 mi) from State Highway 125 and 8.5 km (5.3 mi) from SRS Road 1. Public view of F-Area facilities is restricted by heavily wooded areas bordering segments of the SRS Road 1 system and site-crossing State Highway 125. Moreover, those facilities are not visible from the Savannah River, which is about 10 km (6.2 mi) to the west.

Industrial facilities within S-Area consist of large concrete buildings, smaller administrative and support buildings, and parking lots (DOE 1994d:3-38). The facilities in this area are brightly lit at night and visible when approached via SRS access roads. Visual resource conditions in S-Area hold a VRM Class 5 designation (WSRC 1997b:sec. 2.1, table 2-1). S-Area is about 10 km (6.2 mi) from State Highway 125 and 11 km (6.8 mi) from SRS Road 1. Public view of S-Area facilities is restricted by heavily wooded areas bordering segments of the SRS Road 1 system and site-crossing State Highway 125. Moreover, those facilities are not visible from the Savannah River, which is about 15 km (9.3 mi) to the west.

3.5.11 Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various alternative actions.

3.5.11.1 General Site Description

SRS comprises numerous research, processing, and administrative facilities. An extensive infrastructure system supports these facilities, as shown in Table 3–48.

Table 3–48. SRS Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	230	230
Railroads (km)	103	103
Electricity		
Energy consumption (MWh/yr)	420,000	5,200,000
Peak load (MW)	70	330
Fuel		
Natural gas (m^3/yr)	NA	NA
Oil (l/yr)	28,400,000	NA[a]
Coal (t/yr)	210,000	NA[a]
Water (l/yr)	1,780,000,000	3,870,000,000

[a] As supplies get low, more can be supplied by truck or rail.
Key: NA, not applicable.
Source: Sessions 1997a:2.

3.5.11.1.1 Transportation

SRS has an extensive network—230 km (143 mi)—of roads to meet its onsite intrasite transportation requirements. The railroad infrastructure, which consists of 103 km (64 mi) of track, provides for deliveries of large volumes of coal and oversized structural components (Table 3–48).

3.5.11.1.2 Electricity

The SRS electrical grid is a 115-kV system in a ring arrangement that supplies power to operating areas, administrative areas, and independent and support function areas. That system includes about 160 km (100 mi) of transmission lines. Power is supplied to the grid by three South Carolina Electric & Gas Company (SCE&G) transmission lines. SRS is situated in, and draws its power from, the Virginia-Carolina Sub-Region, an electric power pool area that is a part of the Southeastern Electrical Reliability Council. Most of that power comes from offsite coal-fired and nuclear-powered generating plants (WSRC 1997c:sec. 2.8).

Current site electricity consumption is about 420,000 MWh/yr. Site capacity is about 5.2 million MWh/yr. The peak load capacity is 330 MW; the peak load usage, 70 MW (WSRC 1997c:sec. 2.8).

3.5.11.1.3 Fuel

Coal and oil are used are used at SRS primarily to power the steam plants. Steam generation facilities at SRS include coal-fired powerhouses at A-, D-, and H-Areas and two package steam boilers, which use number 2 fuel oil, in K-Area. Coal is delivered by rail and is stored in coal piles in A-, D- and H-Areas. Oil is delivered by truck to K-Area. Coal is used to fuel A-Area powerhouse that provides process and heating steam for the main administrative area at SRS. D-Area powerhouse provides most of the steam for the SRS process area (Sessions 1998a). Natural gas is not used at SRS.

3.5.11.1.4 Water

A new central domestic water system serves the majority of the site. The system includes three wells and a 17-million-l/day (4.5-million-gal/day) water treatment plant in A-Area; two wells and an 8.3-million-l/day (2.2-million-gal/day) backup water treatment plant in B-Area; three elevated storage tanks; and a 43-km (27-mi) piping loop. This central loop system has an estimated 1,680 l/min (444 gal/min) of excess capacity that could be increased by the installation of an additional elevated storage tank (WSRC 1997c:sec. 2.8). Process water is provided to individual site areas. See Section 3.5.11.2.3 for more information.

3.5.11.1.5 Site Safety Services

The SRS fire department operates under a 12-hr rotational shift schedule, with three fire stations. Among the firefighters and officers are members of the SRS Hazardous Materials Response Team and the Rescue Team, responsible for rescues of all types. The fire department is supported by a fleet of 20 vehicles, including six pumpers, one pumper-tanker, one tanker, one aerial platform ladder truck, one light duty rescue vehicle, one mini-pumper for grass fires, one specially prepared emergency response step van and trailer for hazardous materials response, and two boats for waterway spill response and control. Inspections are performed periodically according to National Fire Protection Codes and Standards (WSRC 1994).

3.5.11.2 Proposed Facility Locations

A summary of the infrastructure characteristics for F-Area and S-Area is provided in Table 3–49.

3.5.11.2.1 Electricity

Electric power for F-Area is provided by the 200–F Power Loop. The Power Loop is supplied by the 251–F electrical substation. This substation consists of two 115/13.8-kV, 24/32-MVA transformers and associated switchgear. The 13.8-kV power is distributed through a 2,000-A–rated bus (WSRC 1997c:sec. 2.8). F-Area electrical energy consumption is about 78,300 MWh/yr; F-Area electrical capacity, about 561,000 MWh/yr (Sessions 1997a:2).

Electric power for the S-Area is provided by two 13.8-kV feeders supplied by the 251–H electrical substation. This substation consists of two 115/13.8-kV, 24/32-MVA transformers and associated switchgear. The 13.8-kV power is distributed through two 2,000-A–rated buses. The 13.8-kV bus tie breaker is normally closed. S-Area electrical energy consumption is about 37,400 MWh/yr; electrical capacity in S-Area, about 385,000 MWh/yr (WSRC 1997c:sec. 2.8).

Table 3–49. SRS Infrastructure Characteristics for F-Area and S-Area

	F-Area		S-Area	
Resource	**Current Usage**	**Capacity**	**Current Usage**	**Capacity**
Electricity				
Energy consumption (MWh/yr)	78,300	561,000	37,400	385,000
Peak load (MW)	14.5	64.0	6.0	14.5
Fuel				
Natural gas (m^3/yr)	NA	NA	NA	NA
Oil (l/yr)	NA	NA	NA	NA
Coal (t/yr)	NA	NA	NA	NA
Water (l/yr)	374,000,000	1,590,000,000	49,800,000	797,000,000

Key: NA, not applicable.
Source: Sessions 1997a:2.

3.5.11.2.2 Fuel

Coal and oil are not required in F- or S-Area because steam is supplied from the central facility, and electricity is supplied from the site electrical grid system (Sessions 1998b).

3.5.11.2.3 Water

F-Area water usage of domestic water is about 374 million l/yr (100 million gal/yr) from the new central domestic water system. Currently available capacity for F-Area is about 1.6 billion l/yr (420 million gal/yr) (WSRC 1997c:sec. 2.8).

S-Area has managed its supply of water until recently and has used an average of 50 million l/yr (13 million gal/yr). Now that it is connected to the new central domestic water system, the area has access to the system's excess capacity of 797 million l/yr (211 million gal/yr) (WSRC 1997c:sec. 2.8).

Process and service water are supplied through deep-well systems within site areas. Wells 905-100F and 905-102F supply process and service water to F-Area; wells 905-1S and 905-2S to S-Area's DWPF. These wells are screened in the McQueen Branch (Lower Tuscaloosa) aquifer (WSRC 1997c:sec. 2.8).

Next Section

3.6 LEAD ASSEMBLY FABRICATION SITES

3.6.1 Hanford Overview

Hanford is located in the southeast portion of Washington State, occupying about 1,450 km^2 (560 mi^2). The 400 Area occupies 0.6 km^2 (0.2 km^2). Additional information on Hanford and the 400 Area is provided in Section 3.2.

The Fuel Assembly Area portion of FMEF, located within Hanford's 400 Area, has been proposed to support all activities related to the lead assembly program (see Figures 2–2 and 2–17).

FMEF consists of several connected buildings. Building 427, the main part of FMEF, is a six-level processing building with an attached mechanical wing on the west side and an emergency power wing on the northwest corner. The Fuel Assembly Area (Building 4862) is appended to the southeastern end of FMEF. FMEF was planned to support the manufacture and examination of irradiated fuels and materials removed from FFTF, the Clinch River Breeder Reactor, and the High-Performance Fuels Laboratory. FMEF has never been operated and is free of contamination. The Fuel Assembly Area was originally designed to house the fuel assembly activities for FFTF (DOE 1996a:3-20; O'Connor et al. 1998a).

The Fuel Assembly Area is divided into two sections, the entry wing (administrative) and the lower level operations portion, which was designed as the fuel assembly area for fabrication of fuel assemblies for FFTF. The lower level of the Fuel Assembly Area provides space for fuel pin, target pin, and assembly fabrication. The upper level contains independent ventilation equipment. Category I quantities of plutonium feed materials could be stored in the operating vaults of Building 427 or in reconfigured below-grade storage tubes in the Fuel Assembly Area. In 1991, the Fuel Assembly Area underwent an extensive engineering study to address possible use of the facility for fabrication of MOX for FFTF (O'Connor et al. 1998a).

The options proposed for lead assembly fabrication at Hanford would use existing employees and buildings; therefore, major facility modifications would not be required. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not required for the 400 Area. For additional information on the resource areas that could be impacted by lead assembly fabrication activities in the 400 Area, refer to Sections 3.2.1, 3.2.2, 3.2.4, and 3.2.11.

3.6.2 ANL–W Overview

Located in the southeast portion of INEEL is ANL–W. ANL–W is about 328 ha (820 acres). Atomic City, 29 km (18 mi) southwest, is the closest populated area to ANL–W; it has a population of 25. Idaho Falls, population of about 45,000, is 63 km (39 mi) east of ANL–W (see Figure 2–3). In 1997, about 700 employees worked at ANL–W (O'Connor et al. 1998b).

Established in the mid-1950s, the primary mission of the ANL–W was to support advanced liquid metal reactor research (DOE 1996h:Idaho 4). In 1995, ANL–W began a Redirected Nuclear Research and Development Program to conduct research in the treatment of DOE spent nuclear fuel and reactor decontamination and decommissioning technologies (O'Connor et al. 1998b).

The Zero Power Physics Reactor (ZPPR) workroom and vault would be the location for the receipt and inspection of the plutonium dioxide and uranium dioxide (see Figure 2–24). The plutonium dioxide would be stored in the ZPPR vault, and the uranium dioxide would be stored in the ZPPR Mock-up Building. Plutonium dioxide and uranium dioxide would be moved to the Fuel Manufacturing Facility (FMF) for fuel fabrication operations. Blending, pre-pressing, pellet pressing, sintering, and grinding would be performed in gloveboxes arranged in a serial fashion and connected through transfer ports. The rod loading operations would also take place in FMF. The rod inspection and NDA procedures would be carried out in the north room of FMF. Supporting analytical processes would be performed in FMF and in the ANL–W analytical laboratories. Section 3.6.2.2 describes proposed waste management facilities at ANL–W that would be used to support the lead assembly mission (O'Connor et al. 1998b).

ZPPR began operation at ANL–W in 1969 and was placed in standby in 1989. The facility is large enough to enable core-physics studies of full-scale breeder reactors that would produce up to 100 megawatts. ZPPR has also been used for mockups of metallic cores and space reactor cores. All of the space in the ZPPR Workroom (Building 775) is proposed for lead assembly fabrication, fuel manufacturing, and storage activities. The ZPPR Reactor Cell (Building 776) is proposed for the high bay fuel assembly and inspection area. The space within FMF would be used for fuel storage and IAEA inspection (O'Connor et al. 1998b).

The FMF (Building 704), adjacent to the ZPPR facility, is buried under an earthen mound similar to ZPPR. For much of the operating life of the EBR-II, all of its fuel was manufactured in FMF. The facility is currently supporting a furnace and glovebox operation, used to dismantle damaged ZPPR fuel plates, and the packaging of recovered plutonium oxide for shipment. The FMF is also used as a test site for development of safeguards and security systems (O'Connor et al. 1998b).

The Fuel Assembly and Storage Building, Building 787, would also be used for lead assembly fabrication. The facility was constructed to provide space, equipment, and services for manufacturing EBR-II fuel elements; driver and experimental subassemblies; and standard in-core components. The Fuel Assembly and Storage Building also provides controlled vault storage for spent nuclear material, fuel materials, and subassemblies. The west end of the Fuel Assembly and Storage Building houses a metallurgical laboratory (O'Connor et al. 1998b).

The ZPPR and FMF complex is within a common security area surrounded by security fences, perimeter intrusion detection, and alarm systems. ZPPR and the FMF are both hardened material access area buildings currently approved for handling and storing Category I quantities of spent nuclear material (O'Connor et a l. 1998b).

The options proposed for lead assembly fabrication at ANL–W are in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For more information on these resource areas, refer to Section 3.3. The resource areas that could be impacted by lead assembly fabrication activities are air quality, infrastructure, waste management, and existing human health risk. These resource areas are described below.

3.6.2.1 Air Quality

The meteorological conditions at INEEL are considered to be representative for ANL–W. Emissions of criteria pollutants at ANL–W result from the ongoing operation of onsite boilers used to produce steam for heating. Existing ambient air pollutant concentrations at INEEL are in compliance with applicable guidelines and regulations. See Section 3.3.1 for additional information on air quality for areas surrounding INEEL.

3.6.2.2 Waste Management

ANL–W analyzes, stores, and ships TRU waste, hazardous waste, mixed waste, LLW, and nonhazardous waste generated by the numerous research and support facilities at INEEL (O'Connor et al. 1998b).

The Waste Characterization Area, in the ANL–W Hot Fuels Examination Facility, is a glovebox facility used for characterization of TRU. The Radioactive Scrap and Waste Facility, in the northeast corner of ANL–W, provides underground vault storage for remote-handled LLW, mixed LLW, and TRU waste. The Radioactive Scrap and Waste Facility is a State of Idaho RCRA-permitted facility (O'Connor et al. 1998b).

The Radioactive Sodium Storage Facility is in an ANL–W controlled access area. The Radioactive Sodium Storage Facility is a RCRA-permitted storage facility used to store radioactive and heavy metal contaminated debris along with sodium and sodium-potassium alloy mixed waste (O'Connor et al. 1998b).

The sanitary wastewater treatment facility, 6,057-m^3/yr (21,390-ft^3/yr) capacity, is the only waste treatment facility at ANL–W. Other forms of waste generated at ANL–W are treated and disposed of at INEEL waste facilities or shipped off the site (O'Connor et al. 1998b). More information on waste management activities at INEEL can be found in Section 3.3.2.

3.6.2.3 Existing Human Health Risk

See Section 3.3.4 for major sources and levels of background radiation, mean concentrations of radiological releases, and offsite estimated dose rates to individuals within the vicinity of INEEL. Site worker radiological exposure data at ANL–W for 1994–1996 is provided in Table 3–50. Worker exposure limits at ANL–W remain within applicable limits.

Table 3–50. Worker Exposure Data for ANL–W, 1994–1996

	Radiation Worker Dose		All Workers	
Year	(mrem)	(person-rem)	(mrem)	(person-rem)
1994	34	28	19	34
1995	50	41	27	43
1996	56	45	31	45

Key: ANL–W, Argonne National Laboratory–West.
Source: O'Connor et al. 1998b.

3.6.2.4 Infrastructure

The site infrastructure at ANL–W includes those utilities and other resources required to support construction and continued operation of mission-related facilities. Table 3–51 shows facility infrastructure information for the proposed facility location. An adequate infrastructure exists at ANL–W to support current activities. See Section 3.3.11 for more detailed information on INEEL's infrastructure.

3.6.3 LLNL Overview

LLNL is composed of two sites: Livermore Site and Site 300 (see Figure 2–28). Livermore Site is about 80 km (50 mi) east of San Francisco and 6.4 km (4 mi) from downtown Livermore. It occupies about 332 ha (821 acres) of flat terrain in the Livermore Valley. Site 300 is about 24 km (15 mi) southeast of the Livermore Site (DOE 1996h:California 67; 1996i:4-328).

Originally used as a naval air training station, Livermore Site was established in 1952 to conduct nuclear weapons research. Site 300 is a remote high-explosives testing facility. The current mission of LLNL is research, testing, and development that focuses on national defense and security, energy, the environment, and biomedicine (DOE 1996h:California 69). Within recent years, LLNL's mission has broadened to include global security, ecology, and mathematics and science education. In early 1998, LLNL had about 7,700 employees (O'Connor et al. 1998c).

Table 3–51. ANL–W Infrastructure Characteristics

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	4,200
Peak load (MWe)	5,088
Fuel	
Natural gas (m^3/yr)	0
Liquid (m^3)	0
Coal (t/yr)	0
Steam (kg/h)	690
Water	
Annual (l/yr)	1,500,000
Peak (l/yr)	2,000,000

Key: ANL–W, Argonne National Laboratory–West.
Source: O'Connor et al. 1998b.

Buildings 332, 334, and 335, located on the Livermore Site, are the three primary facilities (known as the Superblock) proposed to support the lead assembly fabrication program. The Plutonium Facility (Building 332) is located inside Livermore Site's Superblock, a 500-ft by 700-ft protected area surrounded by an alarmed double security fence (see Figure 2–29). Building 332 is composed of several buildings constructed over the past three decades, they include: the Plenum Building, an office structure, plutonium-handling laboratories, mechanical shops, office space, a small nonradioactive material's laboratory, two plutonium storage vaults, and an expanded cold machine shop. The Plenum Building contains dual plenum chambers, each with water sprinklers, two-stage HEPA filters, exhaust fans, motors, and in-stack monitoring equipment. The Plutonium Facility is a Hazard Category II facility (O'Connor et al. 1998c).

The Plutonium Facility currently provides the following activities in support of the ongoing programmatic mission: receipt, storage, and shipping of Category I quantities of spent nuclear material; plutonium and fissile uranium operations and experiments; spent nuclear material control and accountability; scrap recovery; and waste operations. For the lead assembly fabrication program, the Plutonium Facility would store and receive bulk plutonium dioxide powder, fabricate MOX pellets, and assemble fuel rods (O'Connor et al. 1998c).

Building 334 is also in the Superblock, adjacent to Building 332, and can handle Category I quantities of encapsulated spent nuclear material. This three-floor facility comprises the Engineering Test Bay and the Radiation Measurements Facility. The Engineering Test Bay is used to conduct thermal and dynamic tests on weapon components. The Radiation Measurements Facility is used to make intrinsic radiation measurements of various components, and is located in the Intrinsic Radiation Bay. The Intrinsic Radiation Bay and Engineering Test Bay provide primary and secondary confinement barriers against the release of radioactive material. For the lead assembly fabrication program, the Engineering Test Bay would be used for fuel rod bundling, bundle storage, and fuel bundle packaging and shipping. Building 334 also contains analytical, metallography, scrap recovery, and waste processing laboratories and equipment for supporting a lead assembly testing mission (O'Connor et al. 1998c).

Building 335, also adjacent to Building 332 in the Superblock, is used as a staging area for equipment and systems being readied to move into Building 332. There is also a training area for fissile material handlers, an office area, and another area for storage of documents. The lobby serves as an entry area into Building 332 alternate change rooms. For the lead assembly fabrication effort, Building 335 would be used for assembly and testing of equipment, storage of spare parts and supplies, and electrical and mechanical shop areas.

The options proposed for lead assembly fabrication at LLNL are in existing facilities that would not require major modifications, and would use existing employees. For this reason, detailed descriptions of environmental resources such as land use, geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For a detailed discussion of these resource areas, refer to the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i). The resource areas that could be impacted by lead assembly fabrication activities are air quality, infrastructure, waste management, and existing human health risk. These resource areas are described below.

3.6.3.1 Air Quality

The Livermore Site is in the San Francisco Bay Area Air Quality Management District. This area is designated as attainment for all criteria pollutants with respect to attainment of NAAQS, however, EPA has recently proposed to redesignate the area as nonattainment for ozone (EPA 1997i). The emissions of criteria air pollutants at the Livermore Site result from the ongoing operation of numerous boilers for heating; solvent cleaning operations; emergency generators; and various experimental, testing, and process sources. The Bay Area Air Quality Management District and the San Joaquin Valley Unified Air Pollution Control District requested that the Livermore Site assess the impact of toxic air emissions on the surrounding area. The risks at the Livermore Site were found to be below the threshold values used to determine the need for additional evaluation (DOE 1996i:4-334). For a detailed discussion of this resource area, refer to Section 4.7.2.3 of the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i:4-333).

3.6.3.2 Waste Management

Through its research and operation activities, LLNL stores, treats, packages, and prepares TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes for transport. Waste is treated and stored on the site, and then shipped off the site for additional treatment and disposal. No disposal of waste occurs at the Livermore Site (DOE 1996h:California 78). LLNL waste generation rates and inventories are shown in Table 3–52. Table 3–53 provides information on waste management facilities at LLNL.

Table 3–52. Waste Generation Rates and Inventories at LLNL

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a] Contact-handled	27	257
LLW	124	644
Mixed LLW[b]	353	454
Hazardous	579	NA[c]
Nonhazardous		
Liquid	456,000	
Solid	4,280	NA[c]

[a] Includes mixed TRU waste.
[b] Includes TSCA mixed LLW.
[c] Generally, hazardous and nonhazardous wastes are not held in long-term storage.

Key: LLNL Lawrence Livermore National Laboratory; LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996i:4-400 for hazardous and nonhazardous waste; DOE 1996d:15, 16 for all other wastes.

Table 3–53. Waste Management Facilities at LLNL

Facility Name Description	Capacity	Status	Applicable Waste Types				
			TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment facilities (m^3/yr)							
LLW size reduction	771	Online		X			
Building 513 and 514 Waste Treatment Facility[a]	1,000	Online		X	X	X	X
Decontamination and waste treatment facility	Not determined	Planned	X	X	X	X	X
Storage facilities (m^3)							
Building 233, 625	217	Online	X	X	X	X	X
Building 280	513	Online	X	X			X
Building 513, 514, area 612–2	222	Online		X	X	X	X
Area 612–1	1,086	Online	X	X	X	X	X
Area 612–4	169	Online	X	X	X	X	X
Area 612–5	760	Online	X	X	X	X	X
Area 612 tanks	57	Online		X	X	X	X
Building 612 lab packaging unit	16	Online				X	X
Building 614, 693	298	Online	X	X	X	X	X
612 yard, area 612–3	1,327	Online		X			X
Building 696	590	Planned for 1998	X	X			X
Disposal facilities (m^3/yr)							
LLNL sanitary sewer	2,763,271	Online					X

[a] Treatment methods employed in Building 513 are solidification and shredding. Methods used in Building 514 are evaporation, blending, separation, gas adsorption, silver recovery, and wastewater treatment (Kielusiak 1998).
Key: Haz, hazardous; LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste.
Source: O'Connor et al. 1998c.

For a more detailed discussion of waste management activities at the Livermore Site, refer to Section 4.7.2.10 of the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i:4-358) or Section 4.15.2 of the *Final EIS and Environmental Impact Report for Continued Operation of LLNL and Sandia National Laboratories, Livermore* (DOE 1992:4-239).

3.6.3.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of LLNL are shown in Table 3–54. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to LLNL operations.

Release of radionuclides to the environment from LLNL operations provides another source of radiation exposure to the population in the vicinity. Doses to the public resulting from these releases are shown in Table 3–55. These doses fall within regulatory limits and are small when compared with background radiation exposure.

Based on a dose-to-risk conversion factor of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from LLNL operations in 1996 is estimated to be 4.7×10^{-8}. That is, the

Table 3–54. Sources of Radiation Exposure to Individuals in the Vicinity Unrelated to LLNL

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Internal terrestrial radiation	40
Cosmic radiation	30
External terrestrial radiation	30
Radon in homes (inhaled)	200
Other background radiation	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Nuclear fuel cycle	<1
Total	354

Key: LLNL, Lawrence Livermore National Laboratory.
Note: Values for radon and weapons test fallout are averages for the United States.
Source: Harrach et al.:12-18.

Table 3–55. Radiation Doses to the Public From Normal Operations at LLNL, 1996 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)[a]	10	0.093	4	0	100	0.093
Population within 80 km (person-rem)[b]	None	1.1	None	0	100	1.1
Average exposed individual within 80 km (mrem)[c]	None	0.000175	None	0	None	0.000175

[a] The standard for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10 mrem/yr limit for airborne emissions is required by the Clean Air Act. The 4 mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all combined pathways. The 100 person-rem value for the population is given in proposed 10 CFR 834 (DOE 1993b).
[b] In 1996, this population was about 6.3 million.
[c] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Key: LLNL, Lawrence Livermore National Laboratory.
Source: Harrach et al.:12-18.

estimated probability of this person dying from cancer from radiation exposure from one year of LLNL operations is slightly less than 5 chances in 100 million.

Based on the same conversion factor, 5.5×10^{-4} excess fatal cancers per year are projected in the population living within 80 km (50 mi) of LLNL. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire population was 0.2 percent per year. Based on this national rate, the number of fatal cancers from all causes expected during 1996 in the population living within 80 km (50 mi) of LLNL was 13,000. This number of expected fatal cancers is much higher than the estimated 5.5×10^{-4} fatal cancers that could result from LLNL operations in 1996. Workers at LLNL receive the same dose as the general public from background radiation; however, they also receive an additional dose from normal operations. Table 3–56 includes average, maximum, and total occupational doses to LLNL workers from operations in 1997. These doses fall within radiological limits.

Table 3–56. Radiation Doses to Onsite Workers From Normal Operations at LLNL, 1997 (Total Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard	Actual
Average radiation worker (mrem)[a]	None[b]	2.5
Maximally exposed worker (mrem)	5,000	1,144
Total workforce (person-rem)[c]	None	18.2

[a] The radiological limit for an individual worker is 5,000 mrem/yr; however, DOE's goal is to maintain radiological exposures as low as is reasonably achievable. Therefore, DOE has established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.
[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."
[c] The total number of badged workers at the site in 1997 was 7,300.
Key: LLNL, Lawrence Livermore National Laboratory.
Source: Zahn 1998.

Based on a dose-to-risk conversion factor of 400 fatal cancers per 1 million person-rem (4×10^{-4} fatal cancers per person-rem) among workers (see Appendix F), the number of excess fatal cancers to LLNL workers from operations in 1997 is estimated to be 0.0073.

More detailed information of the radiation environment, including background exposures and radiological releases and doses, is presented in the *LLNL Environmental Report for 1996* (Harrach et al. 1997). Concentrations of radioactivity in various environmental media (e.g., air and water) and animal tissues in the site region are also presented in the same reference.

3.6.3.4 Infrastructure

A summary of the infrastructure characteristics of LLNL is presented in Table 3–57. An adequate infrastructure exists at LLNL to support current activities.

Table 3–57. LLNL Infrastructure Characteristics

Resource	Current Usage[a]	Site Capacity
Electricity		
Energy consumption (MWh/yr)	295,919	100 MW peak
Fuel		
Natural gas (m^3/yr)	13,017,173	4,400 m^3/hr peak
Liquid (l/yr)	1,257,699	NA[b]
Coal (t/yr)	0	0
Water		
Annual (l/yr)	874,138,983	10,977,660 l/day peak

[a] Five-year average for FY93–97.
[b] As supplies get low, more can be supplied by truck.
Key: LLNL, Lawrence Livermore National Laboratory.
Source: O'Connor et al. 1998c.

3.6.4 LANL Overview

LANL occupies 11,300 ha (28,000 acres) of land in northern New Mexico (see Figure 2–26). Situated on the Pajarito plateau in the Jemez mountains, the closest population centers are the city of Los Alamos (population 12,000) and White Rock (population 8,000). The closest metropolitan area is Santa Fe, (population 50,000), located about 40 km (25 mi) southeast of LANL. In 1997, LANL had about 9,200 workers (DOE 1996a:3-304).

The laboratory was established in 1943 to design, develop, and test nuclear weapons. LANL's mission has expanded from the primary task of designing nuclear weapons to include non-nuclear defense programs and a broad array of non-defense programs. Current programs include research and development of nuclear safeguards and security, space nuclear systems, biomedicine, computational science, and lasers (DOE 1996a:3-304).

LANL consists primarily of Technical Areas (TAs), of which 49 are actively in use (DOE 1997a:1). The proposed lead assembly fabrication program is proposed to take place at several different facilities; however, most of the activities for the lead assembly fabrication effort are proposed to take place in the Plutonium Facility (PF–4) within Technical Area 55 (TA–55). Most of TA–55, including the main complex, is situated inside a restricted area surrounded by a double security fence. In addition to PF–4, the TA–55 main complex consists of the Administration Building (PF–1), the Support Office Building (PF–2), the Support Building (PF–3), Warehouse (PF–5), and other miscellaneous support buildings (see Figure 2–27) (O'Connor et al. 1998d).

PF–4 became operational in 1978 for conducting state-of-the-art plutonium processing. It is the only DOE facility designed to simultaneously handle plutonium and uranium. It is classified as a Safeguards Category I and Hazard Category II non-reactor facility. Ongoing activities at PF–4 include plutonium recovery, fabrication of plutonium components, weapons disassembly, actinide processing, processing of plutonium 238, and fabrication of ceramic-based reactor fuels (O'Connor et al. 1998d).

Fuel fabrication and rod loading activities are proposed to occur in PF–4. Bundle assembly and inspection could be performed at several facilities at LANL, including the Radioactive Materials Research, Operations, and Demonstration (RAMROD) Facility, the Chemistry and Metallurgy Research Building in TA–3, or the Critical Assembly Building Kivas at TA–18. Bundle storage is proposed to take place either in PF–4 or RAMROD (O'Connor et al. 1998d).

The options proposed for lead assembly fabrication at LANL are in existing facilities that would not require major modifications, and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and envionmental justice are not provided. For more information on these resource areas, please refer to the *Storage and Disposition Final PEIS* (DOE 1996a). The resource areas that could be impacted by lead assembly fabrication activities are air quality, infrastructure, waste management, and existing human health risk. These resource areas are described below.

3.6.4.1 Air Quality

LANL is within the New Mexico Intrastate AQCR 157. None of the areas within LANL and its surrounding communities are designated as nonattainment areas with respect to any of the NAAQS (EPA 1997j). The criteria pollutants, nitrogen dioxide, carbon monoxide, volatile organic hydrocarbons, particulate matter, and sulphur dioxide make up about 79 percent of the stationary source emissions at LANL. The sources of these criteria pollutants are power plants, steam plants, asphalt plants, and space heaters. Toxic and other hazardous pollutants comprise the remaining 21 percent of emissions from stationary sources at LANL. These emissions are generated by equipment cleaning, coating processes, and acid baths. Concentrations of criteria and hazardous and toxic air pollutants are in compliance with applicable guidelines and regulations (DOE 1996a:3-310). For a detailed discussion of this resource area, refer to Section 3.9.3 of the *Storage and Disposition Final PEIS* (DOE 1996a:3–310).

3.6.4.2 Waste

Through its research and operation activities, LANL manages the following waste categories generated at 33 technical areas: TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes (DOE 1996h:New Mexico 38; 1996i:4-272). LANL waste generation rates and inventories are presented in Table 3–58.

Table 3–58. Waste Generation Rates and Inventories at LANL

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact-handled	262	11,262
LLW	1,585	NA[c]
Mixed LLW[b]	90	6,801
Hazardous	942	NA[c]
Nonhazardous		
Liquid	692,857	
Solid	5,453	NA[c]

[a] Includes mixed TRU Waste.
[b] Includes TSCA mixed LLW.
[c] Generally, LLW, hazardous, and nonhazardous wastes are not held in long-term storage.

Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.
Source: DOE 1996a:3-339 for hazardous and nonhazardous waste; DOE 1996d:15, 16 for all other wastes.

LANL currently stores TRU waste on the site pending shipment to WIPP for disposal. The site also treats and disposes of LLW on the site. Mixed LLW is stored on the site pending treatment at a combination of onsite and offsite facilities. Hazardous waste is treated and stored on the site for offsite disposal. Nonhazardous wastes are shipped off the site for treatment and disposal. Nonhazardous liquid wastes are treated and disposed of on the site (DOE 1996a:3-337, 3-340, 3-341). See Table 3–59 for information on selected treatment, storage, and disposal facilities at LANL.

For a more detailed description of this resource area, see Section 3.9.10 of the *Storage and Disposition Final PEIS* (DOE 1996a).

3.6.4.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals within the vicinity of LANL are shown in Table 3–60. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to LANL operations.

Release of radionuclides to the environment from LANL operations provides another source of radiation exposure to populations within the vicinity of the laboratory. The doses to the public resulting from these

Table 3–59. Selected Waste Management Facilities at LANL

Facility Name Description	Capacity	Status	Applicable Waste Types: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-haz
Treatment Facilities (m^3/yr)								
TRU waste volume reduction	1,080	Online	X	X				
LLW compaction	76	Online			X			
Sanitary Wastewater Treatment Plant	1,060,063	Online						X
Storage Facilities (m^3)								
TA–54 TRU waste storage	24,355	Online	X	X				
LLW storage	663	Online			X			
Mixed LLW storage	583	Online				X		
Hazardous waste storage	1,864	Online					X	
Disposal Facilities (m^3)								
TA–54 Area G LLW Disposal	252,500 [a]	Online			X			
Sanitary tile fields	567,750	Online						X

[a] Current inventory of 250,000 m^3 (8.8 million ft^3), therefore, capacity will be exhausted in the next 2 to 5 years (O'Connor et al. 1998d). The *LANL Sitewide Draft EIS* will evaluate alternatives for LLW disposal.

Key: EIS, environmental impact statement; Haz, hazardous; LANL, Los Alamos National Laboratory; LLW, low-level waste; TRU, transuranic.

Source: DOE 1996a:3-337–3-341.

Table 3–60. Sources of Radiation Exposure to Individuals in the Vicinity Unrelated to LANL Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic radiation	48
External terrestrial radiation	44
Neutron cosmic radiation	10
Internal terrestrial	40
Radon in homes (inhaled)	200
Other background radiation	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	407

Key: LANL, Los Alamos National Laboratory.

Note: Value for radon is an average for the United States.

Source: DOE 1996a:3-333.

releases are shown in Table 3–61. These doses fall within regulatory limits (DOE 1993a) and are small when compared with background radiation exposure. Background radiation doses are unrelated to LANL operations (DOE 1996a:3-334).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancers per person-rem) to the public, the fatal cancer risk to the maximally exposed member of the public due to radiological releases from LANL operations in 1995 is estimated to be 2.9×10^{-6}. That is, the estimated probability of this person

Table 3–61. Radiation Doses to the Public from Normal Operations at LANL, 1995 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual[b]**	**Standard[a]**	**Actual[b]**
Maximally exposed individual (mrem)	10	5.1	4	0.58	100	5.7
Population within 80 km (person-rem)[c]	None	3.2	None	Negligible	None	3.2
Average individual within 80 km (mrem)[d]	None	0.013	None	Negligible	None	0.013

[a] The standard for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the Clean Air Act. The 4 mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all combined pathways. The 100 person-rem value for the population is given in proposed 10 CFR 834 (DOE 1993b).
[b] Actual dose values given in this column conservatively include all water pathways, not just drinking water.
[c] In 1995, this population was about 241,000.
[d] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Key: LANL, Los Alamos National Laboratory.
Source: DOE 1997g:3-67.

dying from cancer from radiation exposure from 1 year of LANL operations is about three chances in one million (DOE 1997g:3-67).

Based on the same risk estimator, 1.6×10^{-3} excess fatal cancers are projected in the population living within 80 km (50 mi) of LANL in 1995. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire population was 0.2 percent per year. Based on this national rate, the number of fatal cancers from all causes expected during 1995 in the population living within 80 km (50 mi) of LANL was 482. This number of expected fatal cancers is much higher than the estimated 1.6×10^{-3} fatal cancers that could result from LANL operations in 1995 (DOE 1997g:3-67).

Workers at the LANL receive the same dose as the general public from background radiation, however, they receive an additional dose from normal operations at the site. Table 3–62 includes average, maximally exposed, and total occupational doses to LANL workers from operations in 1991–1995. Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (4×10^{-4} fatal cancers per person-rem), the average annual number of fatal cancers to LANL workers from normal operations during the 1991–1995 timeframe is estimated to be 0.066 (DOE 1997g:3-68).

More detailed information of the radiation environment at LANL is presented in *Environmental Surveillance at LANL During 1995* (UC 1996). Concentrations of radioactivity in various environmental media (e.g., air and water) and animal tissues in the site region are also presented in the same reference.

3.6.4.4 Infrastructure

A summary of the infrastructure characteristics of LANL is presented in Table 3–63. An adequate infrastructure exists at LANL to support current activities.

3.6.5 SRS Overview

SRS occupies about 806 km^2 (310 mi^2) in the southern portion of South Carolina, about 19 km (12 mi) south of Aiken, South Carolina (see Figure 2–5) (DOE 1996a:3-228). Additional information on SRS is presented in Section 3.5.

Table 3–62. Radiation Doses to Onsite Workers From Normal Operations at LANL, 1991–1995 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual[b]**
Average radiation worker (mrem)	None[c]	16
Maximally exposed worker (mrem)	5,000	2,000
Total workers (person-rem)	None	165

[a] The radiological limit for an individual worker is 5,000 mrem/yr; however, DOE's goal is to maintain radiological exposures as low as is reasonably achievable. Therefore, DOE has established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.
[b] Annual doses are averaged over the 5-year period.
[c] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."
Key: LANL, Los Alamos National Laboratory.
Source: DOE 1997g:3-68.

Table 3–63. LANL Infrastructure Characteristics

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	381,425
Fuel	
Natural gas (m^3/yr)	43,414,560
Fuel oil (l/yr)	0
Steam (kg/h)	33,554
Water	
Annual (l/yr)[a]	5,519,000

[a] In 1993 LANL's water system had an annual demand of 81 percent of its current allotment of 6.8 million l/yr (26 gal/yr).
Key: LANL, Los Alamos National Laboratory.
Source: DOE 1996a:3-308, 3-317.

Chemical processing canyons are in the F- and H-Areas at SRS. The primary mission of these facilities was to separate special nuclear materials from spent nuclear reactor fuels and irradiated targets. A portion of H-Canyon (Building 221–H) has been proposed to support activities related to the lead assembly fabrication program. The proposed space (see Figure 2–25) is the former location of the Uranium Solidification Facility. Areas within the Uranium Solidification Facility section of Building 221–H proposed to support the lead assembly fabrication program includes laboratory space, existing utilities, access control, administrative space, and waste management systems (O'Connor et al. 1998e).

The options proposed for lead assembly fabrication at SRS would use existing employees and buildings, therefore, major facility modifications would not be required. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not required. The resource areas that could be impacted by lead assembly fabrication activities are air quality, infrastructure, waste management, and existing human health risk. These resource areas are described below.

3.6.5.1 Air Quality

The meteorological conditions at H-Area are considered to be representative for SRS. Existing ambient air pollutant concentrations at SRS are in compliance with applicable guidelines and regulations. See Section 3.5.1 for additional information on air quality for areas surrounding SRS.

3.6.5.2 Waste Management

TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes are generated by R&D, production, and decontamination activities in H-Area. These wastes are managed at SRS facilities and at offsite locations, as appropriate. The total quantities of waste generated and the inventories in storage at the SRS are presented in Section 3.5.2. Three of the major waste management facilities located in H-Area are described below. Additional SRS waste management facilities are described in Section 3.5.2.

The Consolidated Incinerator Facility is designed to incinerate solid and liquid LLW, mixed LLW, and hazardous waste. This H-Area facility has a capacity of 4,630 m^3/yr (6,056 yd^3/yr) of liquid waste and 17,830 m^3/yr (23,322 yd^3/yr) of solid waste (DOE 1996a:E-109).

Liquid LLW and mixed LLW generated in H–Area are conveyed to the F- and H-Area Effluent Treatment Facility for treatment. This facility has a capacity of 1,930,000 m^3/yr (2,524,000 yd^3/yr). Treated effluents are discharged to Upper Three Runs Creek in compliance with permit limits. Treatment residuals are concentrated by evaporation and stored in the H-Area tank farm for eventual treatment in the Z-Area Saltstone Facility. In that facility, wastes are immobilized with grout for onsite disposal (DOE 1996a:E-98, E-109).

Sanitary wastewater from H-Area is conveyed to the Central Sanitary Wastewater Treatment Facility for treatment and disposal. The H-Area sanitary sewer has a capacity of 136,274 m^3/yr (178,246 yd^3/yr) (O'Connor et al. 1998e), and the Central Sanitary Wastewater Treatment Facility has a capacity of 1,030,000 m^3/yr (1,347,000 yd^3/yr) (Sessions 1997a). More information on waste management activities at SRS is presented in Section 3.5.2.

3.6.5.3 Existing Human Health Risk

See Section 3.5.4 for major sources and levels of background radiation, mean concentrations of radiological releases, and offsite estimated dose rates to individuals within the vicinity of SRS.

3.6.5.4 Infrastructure

The site infrastructure at Building 221–H includes those utilities and other resources required to conduct mission-related activities. A summary of the infrastructure characteristics at Building 221–H is presented in Table 3–64. An adequate infrastructure exists at this facility to support current activities. See Section 3.5.11 for more detailed information on the infrastructure at SRS.

Table 3–64. Building 221–H at SRS Infrastructure Characteristics

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	120,000
Fuel	
Natural gas (m^3/yr)	NA
Fuel oil (l/yr)	NA
Coal (t/yr)	0
Water (l/yr)	380,000,0000

Key: NA., not applicable.
Source: O'Connor et al. 1998e.

3.7 REFERENCES

Abbott, D.G., 1998, Lockheed Martin Idaho Technologies Company, Idaho Falls, ID, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *SPD EIS - Additional Questions on Affected Environment,* January 28.

Abbott, D.G., A.B. Crockett, and K.S. Moor, 1997, *INEEL Affected Environment: Supplemental Data Report in Support of the Preparation of the Surplus Plutonium Disposition Environmental Impact Statement (Predecisional Draft),* INEL/EXT-97-00563, Lockheed Martin Idaho Technologies Company, Idaho Falls, ID, June.

Abbott, M.L., J.M. Brooks, and K.L. Martin, 1991, *NPR Environmental Impact at the INEL: Air Quality, Cooling Towers, and Noise,* rev. A, NPRD-90-059, EG&G Idaho, Inc., Idaho Falls, ID, March.

Arnett, M.W., and A.R. Mamatey, eds., 1996, *Savannah River Site Environmental Report for 1995,* WSRC-TR-96-0075, Westinghouse Savannah River Company, Aiken, SC.

Arnett, M.W., and A.R. Mamatey, eds., 1997a, *Savannah River Site Environmental Report for 1996,* WSRC-TR-97-0171, Westinghouse Savannah River Company, Aiken, SC.

Arnett, M.W., and A.R. Mamatey, eds., 1997b, *Savannah River Site Environmental Data for 1996,* WSRC-TR-97-0077, Westinghouse Savannah River Company, Aiken, SC.

Arnett, M.W., L.K. Karapatakis, and A.R. Mamatey, eds., 1993, *Savannah River Site Environmental Report for 1992,* WSRC-TR-075, Westinghouse Savannah River Company, Aiken, SC.

Arnett, M.W., L.K. Karapatakis, and A.R. Mamatey, eds., 1994, *Savannah River Site Environmental Report for 1993,* WSRC-TR-94-075, Westinghouse Savannah River Company, Aiken, SC.

Bala, E., 1997, Idaho Transportation Department, Rigby, ID, personal communication to D.M. Nemeth, Science Applications International Corporation, Germantown, MD, *Transportation Improvements in Idaho,* September 11.

Barghusen, J., and R. Feit, 1995, *Technical Report on Affected Environment for the DOE Sites Considered in the DOE Waste Management Programmatic Environmental Impact Statement,* META/Berger-SR-01, META/Berger, Gaithersburg, MD, July.

Battelle (Battelle Memorial Institute), 1989, *Hanford Cultural Resources Management Plan,* PNL-6942, Pacific Northwest National Laboratory, Richland, WA, June.

Battelle and M&H (Battelle Pantex and Mason & Hanger Corporation), 1996, *Biological Assessment of Continued Operation of Pantex Plant and Associated Storage of Nuclear Weapon Components,* Amarillo, TX, April 26.

Cabak, M.A, K.E. Sassaman, and J.C. Gillam, 1996, "Distributional Archaeology in the Aiken Plateau: Intensive Survey of E Area, Savannah River Site, Aiken County, South Carolina," *Savannah River Archaeological Research Papers 8, Occasional Papers of the Savannah River Archaeological Research Program,* South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Aiken, SC.

CEQ (Council on Environmental Quality), 1986, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act,* "Human Environment," 40 CFR 1508.14, Washington, DC, July 1.

Clawson, K.L., G.E. Start, and N.R. Ricks, eds., 1989, *Climatography of the Idaho National Engineering Laboratory*, 2nd ed., DOE/ID-12118, U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID, December.

Dirkes, R.L., and R.W. Hanf, eds., 1996, *Hanford Site 1995 Environmental Report*, PNNL-11139, Battelle, Pacific Northwest National Laboratory, Richland, WA, June.

Dirkes, R.L., and R.W. Hanf, eds., 1997, *Hanford Site 1996 Environmental Report*, PNNL-11472, Battelle, Pacific Northwest National Laboratory, Richland, WA, August.

DOC (U.S. Department of Commerce), 1990a, *1990 Census Look Up,* Summary Tape File 1C, Bureau of the Census, Washington, DC.

DOC (U.S. Department of Commerce), 1990b, *1990 EEO File: Detailed Occupations by Sex by Hispanic Origin and Race,* Bureau of the Census, Housing and Household Economic Statistics Division, Washington, DC.

DOC (U.S. Department of Commerce), 1992, *Census of Population and Housing, 1990: Summary Tape File 3 on CD-ROM*, Bureau of the Census, May.

DOC (U.S. Department of Commerce), 1994, *County and City Data Book: 1994, Washington, DC,* Bureau of the Census, Washington, DC, 1994.

DOC (U.S. Department of Commerce), 1996, *Statistical Abstract of the United States: 1996,* 116th Edition, Bureau of the Census, Washington, DC.

DOC (U.S. Department of Commerce), 1997, *Estimates of the Population of Counties and Demographic Components of Population Change: Annual Time Series, July 1, 1990 to July 1, 1996,* CO-96-01, Bureau of the Census, Population Estimates Program, Population Division, Washington, DC.

DOE (U.S. Department of Energy), 1983, *Final Environmental Impact Statement Pantex Plant Site, Amarillo, Texas*, DOE/EIS-0098, Washington, DC, October.

DOE (U.S. Department of Energy), 1992, *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore,* DOE/EIS-0157, San Francisco Field Office, Oakland, CA, August.

DOE (U.S. Department of Energy), 1993a, *Radiation Protection of the Public and the Environment,* DOE Order 5400.5, Office of Environment, Safety and Health, January 7.

DOE (U.S. Department of Energy), 1993b, *Radiation Protection of the Public and the Environment,* proposed rule 10 CFR 834, 58 FR 16268, Office of the Federal Register, Washington, DC, March 23.

DOE (U.S. Department of Energy), 1994a, *Radiological Control Manual*, rev. 1, DOE/EH-0256T, Office of Environment, Safety and Health, Washington, DC, June.

DOE (U.S. Department of Energy), 1994b, *INEL Institutional Plan, FY 1994–1999,* Idaho Operations Office, Idaho Falls, ID, June.

DOE (U.S. Department of Energy), 1994c, *Memorandum of Agreement Between the United States Department of Energy Idaho Operations Office and the Shoshone-Bannock Tribes*, OID-OC-RAK-94-11, Idaho Operations Office, Idaho Falls, ID, February 2.

DOE (U.S. Department of Energy), 1994d, *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility*, DOE/EIS-0082-S, Savannah River Operations Office, Aiken, SC, November.

DOE (U.S. Department of Energy), 1995a, *Occupational Radiation Protection*, 10 CFR 835, Washington, DC, January 1.

DOE (U.S. Department of Energy), 1995b, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, Office of Environmental Management, Idaho Operations Office, Idaho Falls, ID, April.

DOE (U.S. Department of Energy), 1995c, *Savannah River Site Waste Management Final Environmental Impact Statement*, DOE/EIS-0217, Savannah River Operations Office, Aiken, SC, July.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*, DOE/EIS-0222D, Richland Operations Office, Richland, WA, August.

DOE (U.S. Department of Energy), 1996c, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, Richland Operations Office, Richland, WA, August.

DOE (U.S. Department of Energy), 1996d, *Integrated Data Base Report - 1995: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics*, rev. 12, DOE/RW-0006, Office of Environmental Management, Germantown, MD, December.

DOE (U.S. Department of Energy), 1996e, *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, DOE/EIS-0218F, Office of Environmental Management, Washington, DC, February.

DOE (U.S. Department of Energy), 1996f, *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*, DOE/EIS-0225, Albuquerque Operations Office, Albuquerque, NM, November.

DOE (U.S. Department of Energy), 1996g, *Programmatic Agreement Among the U.S. Department of Energy/Amarillo Area Office, the Texas State Historic Preservation Officer, and the Advisory Council on Historic Preservation*, Amarillo Area Office, Amarillo, TX, October.

DOE (U.S. Department of Energy), 1996h, *The 1996 Baseline Environmental Management Report*, DOE/EM-0290, Office of Environmental Management, Washington, DC, June.

DOE (U.S. Department of Energy), 1996i, *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236, Office of Fissile Materials Disposition, Washington, DC, September.

DOE (U.S. Department of Energy), 1997a, *The National TRU Waste Management Plan*, rev. 1, DOE/NTP-96-1204, Carlsbad Area Office, Carlsbad, NM, December.

DOE (U.S. Department of Energy), 1997b, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1997c, *Idaho National Engineering and Environmental Laboratory, Comprehensive Facility and Land Use Plan*, DOE/ID-10514, Idaho Operations Office, Idaho Falls, ID, April 30.

DOE (U.S. Department of Energy), 1997d, *1996 Environmental Report for Pantex Plant*, DOE/AL/65030-9704, Albuquerque Operations Office, Amarillo Area Office, Amarillo, TX, May.

DOE (U.S. Department of Energy), 1997e, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, NM, September.

DOE (U.S. Department of Energy), 1997f, *Shutdown of the River Water System at the Savannah River Site Final Environmental Impact Statement*, DOE/EIS-0268, Savannah River Operations Office, Aiken, SC, May.

DOE (U.S. Department of Energy), 1997g, *Draft Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site*, DOE/EIS-0277D, Office of Environmental Management, Washington, DC, November.

DOE, (U.S. Department of Energy), 1998a, *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste*, 63 FR 3629, Office of the Federal Register, Washington, DC, January 23.

DOE (U.S. Department of Energy), 1998b, *Accelerating Cleanup, Paths to Closure, Draft*, DOE/EM-0342, Office of Environmental Management, Washington, DC, February.

DOL (U.S. Department of Labor), 1997a, *Local Area Unemployment Statistics, 1996*, Bureau of Labor Statistics, Office of Employment and Unemployment Statistics, Local Area Unemployment Statistics Division, Washington, DC.

DOL (U.S. Department of Labor), 1997b, *Employment and Wages, Annual Averages, 1995*, Bureau of Labor Statistics, Office of Employment and Unemployment Statistics, Washington, DC.

DOT (U.S. Department of Transportation), 1995, *Airport Noise Compatibility Planning*, 14 CFR 150, July 18.

EPA (U.S. Environmental Protection Agency), 1974, *Information on Levels of Environmental Noise Requisite To Protect Public Health and Welfare With an Adequate Margin of Safety*, EPA/550/9-74-004, Office of Noise Abatement and Control, Washington, DC, March.

EPA (U.S. Environmental Protection Agency), 1997a, *Designation of Areas for Air Quality Planning Purposes*, "Washington," 40 CFR 81.348, March 31.

EPA (U.S. Environmental Protection Agency), 1997b, *National Primary and Secondary Ambient Air Quality Standards*, 40 CFR 50, March 31.

EPA (U.S. Environmental Protection Agency), 1997c, *National Ambient Air Quality Standards for Ozone*, 62 FR 38855, Office of the Federal Register, Washington, DC, July 18.

EPA (U.S. Environmental Protection Agency), 1997d, *National Ambient Air Quality Standards for Particulate Matter*, 62 FR 38652, Office of the Federal Register, Washington, DC, July 18.

EPA (U.S. Environmental Protection Agency), 1997e, *Designation of Areas for Air Quality Planning Purposes,* "Idaho," 40 CFR 81.313, March 31.

EPA (U.S. Environmental Protection Agency), 1997f, *Designation of Areas for Air Quality Planning Purposes*, "Texas," 40 CFR 81.344, March 31.

EPA (U.S. Environmental Protection Agency), 1997g, *Designation of Areas for Air Quality Planning Purposes*, "Georgia," 40 CFR 81.311, March 31.

EPA (U.S. Environmental Protection Agency), 1997h, *Designation of Areas for Air Quality Planning Purposes*, "South Carolina," 40 CFR 81.341, March 31.

EPA (U.S. Environmental Protection Agency), 1997i, *Designation of Areas for Air Quality Planning Purposes, State of California: Redesignation of the San Francisco Bay Area to Nonattainment for Ozone,* proposed rule, 62 FR 66578, Office of the Federal Register, Washington, DC, December 19.

EPA (U.S. Environmental Protection Agency), 1997j, *Designation of Areas for Air Quality Planning Purposes,* "New Mexico," 40 CFR 81.332, March 31.

ERDA (U.S. Energy Research Development Administration), 1976, *Evaluation of Impact of Potential Flooding Criteria on the Hanford Project,* RLO-76-4, Richland Operations Office, Richland, WA.

Famighetti, R., ed., 1998, *The World Almanac and Book of Facts 1998*, K-III Reference Corporation, Mahwah, NJ.

Harrach, R.J., et al., 1997, *Environmental Report 1996, Lawrence Livermore National Laboratory,* UCRL-50027-26, Lawrence Livermore National Laboratory, Livermore, CA, September 1.

Hartman, M.J., and P.F. Dresel, eds., 1997, *Hanford Site Groundwater Monitoring for Fiscal Year 1996*, PNNL-11470, Battelle, Pacific Northwest National Laboratory, Richland, WA, February.

Hoitink, D.J., and K.W. Burk, 1996, *Hanford Site Climatological Data Summary 1995 With Historical Data*, PNNL-11107, Battelle, Richland, WA, May.

ID DHW (Idaho Department of Health and Welfare), 1995, *Rules for the Control of Air Pollution in Idaho:* 577, "Ambient Standards for Specific Air Pollutants"; 585, "Toxic Air Pollutants Non-Carcinogenic Increments"; 586, "Toxic Air Pollutants Carcinogenic Increments," IDAPA 16, Title 01, Chapter 01, Boise, ID.

Kielusiak, C., 1998, Lawrence Livermore National Laboratory, Livermore, CA, personal communication with J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Additional Waste Treatment Information,* April 21.

King, H.H., 1997a, Mason & Hanger Corporation, Amarillo, TX, personal communication (electronic mail) to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Additional Information for Pantex AE Data Call*, August 1.

King, H.H., 1997b, Mason & Hanger Corporation, Amarillo, TX, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Waste Management Information for Pantex*, October 21.

Knox, J., 1997, U.S. Department of Energy, Savannah River Operations Office, personal communication (fax) to K. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, July 2.

Kovacs, J. 1997, B&W Hanford Company, Richland, WA, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Waste Management Facilities at the Hanford Site,* October 23.

Lemming, J.F., 1998, Mason & Hanger Corporation, Amarillo, TX, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *SPD EIS - Additional Questions on Affected Environment,* January 30.

Lyon, M., 1997, Battelle, Pacific Northwest National Laboratory, personal communication to J. Teal, Science Applications International Corporation, Richland, WA, *Hanford Calendar Year Manrem Data for 1996, 1995, and 1994*, April 30.

M&H (Mason & Hanger Corporation), 1996a, *Environmental Information Document: The Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components Environmental Impact Statement*, ES:96:0156, Amarillo, TX, September.

M&H (Mason & Hanger Corporation), 1996b, *Safety Information Document: The Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components Environmental Impact Statement*, ES:96:0155, Amarillo, TX, September.

M&H (Mason & Hanger Corporation), 1996c, *Integrated Plan for Playa Management at Pantex Plant*, Environmental Protection Department, Environmental, Safety and Health, Pantex Plant, Amarillo, TX, December.

M&H (Mason & Hanger Corporation), 1997, *Pantex Plant Affected Environment Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, Amarillo, TX, June 12.

MacNeil, R., 1997, Washington Department of Transportation, Union Gap, WA, personal communication to D.M. Nemeth, Science Applications International Corporation, Germantown, MD, *Transportation Improvements in Washington,* September 9.

Mayer, J.J., and L.D. Wike, 1997, *SRS Urban Wildlife: Environmental Information Document*, WSRC-TR-97-0093, Westinghouse Savannah River Company, Aiken, SC, May.

Mecca, J.E., 1997a, U.S. Department of Energy, Richland Operations Office, Richland, WA, personal communication to K.R. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Hanford Site Response to Site Environmental Data Call for Preparation of the Draft Surplus Plutonium Disposition Environmental Impact Statement*, June 11.

Mecca, J.E., 1997b, U.S. Department of Energy, Richland Operations Office, Richland, WA, personal communication to K.R. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Affected Environment Data Reports for the Surplus Plutonium Disposition EIS*, July 31.

Miles, M., 1998, U.S Department of Energy, Savannah River Operations Office, Aiken, SC, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Volume Capacities for SRS,* May 28.

Miller, S., 1995, *Idaho National Engineering Laboratory Management Plan for Cultural Resources (Final Draft)*, rev. 1, DOE/ID-10361, Lockheed Martin Idaho Technologies Company, Idaho Falls, ID, July.

Mitchell, R.G., D. Peterson, and D.L. Hoff, 1996, *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1995*, DOE/ID-12082(95), U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID, August.

Mitchell, R.G., D. Peterson, D. Roush, R.W. Brooks, L.R. Paulus, and D.B. Martin, 1997, *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1996*, DOE/ID-12082(96), U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID, August.

Moor, K., 1998, Lockheed Martin Idaho Technologies Company, Idaho Falls, ID, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Waste Management Facilities at the Idaho National Engineering and Environmental Laboratory*, January.

Murphy, Jr., C.E., L.R. Bauer, D.W. Hayes, W.L. Marter, C.C. Ziegler, E.E. Stephenson, D.D. Hoel, and D.M. Hamby, 1991, *Tritium in the Savannah River Site Environment (U)*, rev. 1, WSRC-RP-90-424-1, Westinghouse Savannah River Company, Aiken, SC, May.

Nava, B., 1998, Battelle-Pantex, Amarillo, TX, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Administrative Order for Pantex*, May 28.

NCRP (National Council on Radiation Protection and Measurements), 1987, *Ionizing Radiation Exposure of the Population of the United States*, NCRP Report No. 93, Pergamon Press, Elmsford, NY, September 1.

Neitzel, D.A., ed., 1996, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, rev. 8, PNL-6415, Battelle, Pacific Northwest National Laboratory, Richland, WA, August.

Nemeth, D.M., 1997a, *List of School Districts Contacted for Current Operating Capacities, Student Enrollment, and Number of Teachers Employed Within the Hanford, INEEL, Pantex, and SRS ROIs*, Memorandum to SPD EIS Administrative Record, December 15.

Nemeth, D.M., 1997b, *List of Sheriff Offices, Police Departments, and Fire Departments Contacted for Number of Sworn Police Officers Employed and Firefighters (Both Employed and Volunteer) in the Hanford, INEEL, Pantex, and SRS ROIs*, Memorandum to SPD EIS Administrative Record, December 15.

Nemeth, D.M., 1997c, *List of Hospitals and Hospital Associations Contacted for Current Number of Hospitals and Hospital Beds Located in Hanford, INEEL, Pantex, and SRS ROIs*, Memorandum to SPD EIS Administrative Record, December 17.

Nipp, B., 1997, Texas Department of Transportation, Amarillo, TX, personal communication to D.M. Nemeth, Science Applications International Corporation, Germantown, MD, *Transportation Improvements in Texas*, September 10.

NOAA (National Oceanic and Atmospheric Administration), 1994a, *Local Climatological Data, Annual Summary With Comparative, Data, 1993*, "Amarillo, Texas (AMA)" National Environmental Satellite, Data, and Information Service, National Climatic Data Center, Asheville, NC, November.

NOAA (National Oceanic and Atmospheric Administration), 1994b, *Local Climatological Data, Annual Summary With Comparative Data, 1993*, "Augusta, Georgia" National Environmental Satellite, Data, and Information Service, National Climatic Data Center, Asheville, NC, November.

Noah, J.C., compiler, 1995, *Land-Use Baseline Report, Savannah River Site*, WSRC-TR-95-0276, Westinghouse Savannah River Company, Aiken, SC, June.

NPS (U.S. National Park Service), 1994, *Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement*, Final, Pacific Northwest Regional Office, Seattle, WA, June.

NUS (NUS Corporation), 1990, *Sound-Level Characterization of the Savannah River Site*, NUS-5251, Aiken, SC, August.

O'Connor, D.G., et al., 1998a, *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13481, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998b, *ANL–W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13478, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998c, *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13480, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998d, *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13482, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998e, *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13483, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

Peña, F., 1997, U.S. Department of Energy, personal communication to Secretarial Officers and Heads of Field Elements, U.S. Department of Energy, *Lessons Learned From the Emergency Management of the May 14, 1997 Explosion at Hanford's Plutonium Reclamation Facility*, August.

Randolph, L., 1997, American Medical Association, Chicago, IL, personal communication to D.M. Nemeth, Science Applications International Corporation, Germantown, MD, *Information on Physicians by State and County, 1996*, August.

Rhoderick, J., 1998, U.S. Department of Energy, Office of Environmental Management, Washington, DC, personal communication to M. Jones, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Review of Waste Management Facilities for Surplus Plutonium Disposition (SPD) EIS*, April 30.

Rohl, D.A., 1994, *Hanford Site Water Systems Plan, Site Utilities Program*, RL-WSP-94-01, U.S. Department of Energy, Richland Operations Office, Richland, WA, April.

Sandberg, D., 1993, *No Action Data Package*, PEIS request for information provided by Strategic Planning and Systems Integration, Westinghouse Hanford Company, Richland, WA, October 8.

Sandberg, D., 1998a, B&W Hanford Company, Richland, WA, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Some Answers to Additional Questions of the Affected Environments at the Sites*, April 29.

Sandberg, D., 1998b, B&W Hanford Company, Richland, WA, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *300 Area Treated Effluent Disposal Facility,* April 2.

Sandberg, D., 1998c, B&W Hanford Company, Richland, WA, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *200 Area Fuel Usage,* February 25.

SCDHEC (South Carolina Department of Health and Environmental Control), 1995, *South Carolina Air Quality Annual Report,* vol. XV.

SCDHEC (South Carolina Department of Health and Environmental Control), 1996, *Regulation 61-62, Air Pollution Control Regulations and Standards,* Standard 2, "Ambient Air Quality Standards"; Standard 8, "Toxic Air Pollutants," Air Pollution Control, Columbia, SC.

Sessions, J., 1997a, Westinghouse Savannah River Company, Aiken, SC, personal communication to K. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Surplus Pu Disposition EIS Savannah River Site Affected Environment,* August 4.

Sessions, J., 1997b, Westinghouse Savannah River Company, Aiken, SC, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Request for Waste Management Information,* October 1.

Sessions, J., 1998a, Westinghouse Savannah River Company, Aiken, SC, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Coal & Oil,* February 2.

Sessions, J., 1998b, Westinghouse Savannah River Company, Aiken, SC, personal communication to John DiMarzio, Science Applications International Corporation, Germantown, MD, *Reply to Additional Questions on Affected Environment,* January 26.

SRARP (Savannah River Archaeological Research Program), 1989, *Archaeological Resource Management Plan of the Savannah River Archaeological Research Program,* South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, SC, December.

Sullivan, M., 1997, South Carolina Highway Administration, Columbia, SC, personal communication to D.M. Nemeth, Science Applications International Corporation, Germantown, MD, *Transportation Improvements in South Carolina,* September 11.

Teal, J., 1997, Science Applications International Corporation, Richland, WA, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *Reply to "Hanford Infrastructure – Unresolved Issues,"* September 24.

TNRCC (Texas Natural Resource Conservation Commission), 1997a, *TNRCC Rules*: 101, "General Rules (Air Quality)"; 112, "Control of Air Pollution from Sulfur Compounds (Reg. II)"; 113, "Control of Air Pollution from Toxic Materials (Reg. III)," Austin, TX.

TNRCC (Texas Natural Resource Conservation Commission), 1997b, Toxicology and Risk Assessment (TARA) Section Staff, memo to Interested Parties, *Effects Screening Levels (ESLs) List,* Austin, TX, September 5.

TNRCC (Texas Natural Resource Conservation Commission), 1997c, *Pantex Nuclear Weapons Facility Ambient Air Monitoring Annual 1995 Report,* AS-70, Monitoring Operations Division, Austin, TX, January.

UC (Regents of the University of California), 1996, *Environmental Surveillance at Los Alamos During 1995*, LA-13210-ENV, October.

UC (Regents of the University of California), 1998, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site*, UCRL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

WDEC (Washington Department of Ecology), 1994, *Washington Administrative Code, Title 173*: Chapter 173-460, "Controls for New Sources of Toxic Air Pollutants"; Chapter 173-470, "Standards for Particulate Matter"; Chapter 173-474, "Ambient Air Quality Standards for Sulfur Oxide"; Chapter 173-475, "Ambient Air Quality Standards for Carbon Monoxide, Ozone, and Nitrogen Dioxide"; Chapter 173-481, "Ambient Air Quality and Environmental Standards for Fluorides."

Weinreich, W.A., 1998, Mason & Hanger Corporation, Amarillo, TX, personal communication to J.S. Johnson, U.S. Department of Energy, Amarillo Area Office, Amarillo, TX, *Visual Examination of Storm Water Runoff per the Multi-Sector Permit; WAD Deliverable No. 10-13d*, December 30.

Werner, J., 1997, U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID, personal communication to K. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Data Call for the INEEL Affected Environments*, August 4.

WSRC (Westinghouse Savannah River Company), 1994, *Fact Sheet on Savannah River Site Fire Department*, www.srs.gov/general/aboutsrs/pub_rel/factsheets/fact_sheet_27.html, Administration and Infrastructure Division, Aiken, SC, May 3.

WSRC (Westinghouse Savannah River Company), 1997a, *SRS News Highlights, This Month's Top Stories, CIF: Starting a New Era of Waste Management at SRS*, from www.srs.gov/general/aboutsrs/pub_rel/srsnews.html#STORYONE, Public Relations Department, Aiken, SC, September 2.

WSRC (Westinghouse Savannah River Company), 1997b, *Surplus Pu Disposition EIS Savannah River Site Affected Environmental Data Call*, Aiken, SC, June 9.

WSRC (Westinghouse Savannah River Company), 1997c, *SRS Ecology Environmental Information Document*, WSRC-TR-0223, Aiken, SC.

Zahn, K.C., 1998, Lawrence Livermore National Laboratory, Livermore, CA, personal communication to C. Groome, Science Applications International Corporation, Germantown, MD, *Revisions to March 1998 Preliminary Draft Surplus Plutonium Disposition EIS*, April 3.

Office of
Fissile Materials Disposition

United States Department of Energy

Surplus Plutonium Disposition Draft Environmental Impact Statement

Volume I - Part B

July 1998

For Further Information Contact:
U.S. Department of Energy
Office of Fissile Materials Disposition, P.O. Box 23786, Washington, DC 20026-3786

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Attention: Surplus Plutonium Disposition
Draft Environmental Impact Statement

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Cover Sheet

Responsible Agency: United States Department of Energy (DOE)

Title: *Surplus Plutonium Disposition Draft Environmental Impact Statement* (SPD EIS) (DOE/EIS-0283-D)

Locations of Candidate Sites: California, Idaho, New Mexico, South Carolina, Texas, and Washington

Contacts:

For further information on the SPD EIS contact:

Mr. G. Bert Stevenson, NEPA Compliance Officer
Office of Fissile Materials Disposition
U.S. Department of Energy
P.O. Box 23786
Washington, DC 20026-3786
Voice: (202) 586–5368

For further information on the DOE National Environmental Policy Act (NEPA) process contact:

Ms. Carol Borgstrom, Director
Office of NEPA Policy and Assistance
Office of Environment, Safety and Health
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585
Voice: (202) 586–4600 or (800) 472–2756

Abstract: On May 22, 1997, DOE published a Notice of Intent (NOI) in the Federal Register (62 Federal Register 28009) announcing its decision to prepare an environmental impact statement (EIS) that would tier from the analysis and decisions reached in connection with the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS (Storage and Disposition PEIS).* DOE's disposition strategy allows for both the immobilization of surplus plutonium and its use as mixed oxide (MOX) fuel in existing domestic, commercial reactors. The disposition of surplus plutonium would also involve disposal of the immobilized plutonium and MOX fuel (as spent nuclear fuel) in a geologic repository.

The *Surplus Plutonium Disposition Environmental Impact Statement* analyzes alternatives that would use the immobilization approach (for some of the surplus plutonium) and the MOX fuel approach (for some of the surplus plutonium); alternatives that would immobilize all of the surplus plutonium; and the No Action Alternative. The alternatives include three disposition facilities that would be designed so that they could collectively accomplish disposition of up to 50 metric tons (55 tons) of surplus plutonium over their operating lives: 1. The pit disassembly and conversion facility would disassemble pits (a weapons component) and convert the recovered plutonium, as well as plutonium metal from other sources, into plutonium dioxide suitable for disposition. 2. The immobilization facility would include a collocated capability for converting nonpit plutonium materials into plutonium dioxide suitable for immobilization and would be located at either Hanford or SRS. DOE has identified SRS as the preferred site for an immobilization facility. 3. The MOX fuel fabrication facility would fabricate plutonium dioxide into MOX fuel.

Public Involvement: Comments on the SPD Draft EIS may be submitted: by mail to DOE, Office of Fissile Materials Disposition, c/o SPD EIS, P.O. Box 23786, Washington, DC 20026–3786; by calling DOE at 1–800–820–5156; or by sending a facsimile (fax) message to DOE at 1–800–820–5156. To ensure consideration in the SPD Final EIS, these comments should be submitted within 60 days after the U.S. Environmental Protection Agency Notice of Availability is published in the Federal Register. Comments received after the end of the comment period will be considered to the extent possible. Public meetings will be held on the dates and times specified in a DOE Federal Register notice and announced in local media. Comments on the SPD Draft EIS can also be submitted at these meetings. Preregistration for the public meetings is available by calling 1–800–820–5134 or by fax at 1–800–820–5156. Additional information can be obtained by calling the contacts listed above, or by visiting the Office of Fissile Materials Disposition web site at http://www.doe-md.com.

DOE/EIS-0283-D

Surplus Plutonium Disposition Draft Environmental Impact Statement

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United States Department of Energy
Office of Fissile Materials Disposition

July 1998

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List of Acronyms

AEA	Atomic Energy Act of 1954
AECL	Atomic Energy of Canada Limited
AIRFA	American Indian Religious Freedom Act
ALARA	as low as is reasonably achievable
ANL–W	Argonne National Laboratory–West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARF	airborne release fraction
BEA	Bureau of Economic Analysis
BEIR–V	Report V of the Committee on the Biological Effects of Ionizing Radiations
BIO	Basis for Interim Operation
BLM	Bureau of Land Management
BWR	boiling water reactor
CAA	Clean Air Act
CANDU	Canadian Deuterium Uranium (reactors)
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CPP	Chemical Processing Plant
CWA	Clean Water Act of 1972, 1987
D&D	decontamination and decommissioning
DBA	design-basis accident
DNFSB	Defense Nuclear Facilities Safety Board
DOC	U.S. Department of Commerce
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DR	damage ratio
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor (I or II)
EIS	environmental impact statement

EPA	U.S. Environmental Protection Agency
ES&H	environment, safety, and health
ETB	Engineering Test Bay
FAA	U.S. Federal Aviation Administration
FDP	fluorinel dissolution process
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFF	Uranium Fuel Fabrication Facility
FFTF	Fast Flux Test Facility
FI	field investigation
FM	Farm-to-Market (road)
FMF	Fuel Manufacturing Facility
FMEA	failure modes and effects analysis
FMEF	Fuels and Materials Examination Facility
FONSI	finding of no significant impact
FPF	Fuel Processing Facility
FPPA	Farmland Protection Policy Act
GDP	gaseous diffusion plant
GE	General Electric Company
GENII	Generation II, Hanford Environmental Radiation Dosimetry Software System
GPS	global positioning satellite
HE	high explosive
HEPA	high-efficiency particulate air (filter)
HEU	highly enriched uranium
HFEF	Hot Fuel Examination Facility
HIGHWAY	(computer code: distances and populations along U.S. highways)
HLW	high-level waste
HLWVF	high-level-waste vitrification facility
HWTPF	Hazardous Waste Treatment and Processing Facility
HYDOX	hydride oxidation
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission on Radiological Protection
ID DHW	Idaho Department of Health and Welfare
INEEL	Idaho National Engineering and Environmental Laboratory
INRAD	Intrinsic Radiation

I

INTEC	Idaho Nuclear Technology and Engineering Center
ISC3	Industrial Source Complex Model, Version 3
ISCST3	Industrial Source Complex Model, Short-Term, Version 3
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LDR	Land Disposal Restrictions
LEU	low-enriched uranium
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LPF	leak path factor
LWR	light-water reactor
M&H	Mason & Hanger Corporation
MACCS2	Melcor Accident Consequence Code System (computer code)
MAR	material at risk
MEI	maximally exposed individual
MMI	Modified Mercalli Intensity
MOX	mixed oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NCRP	National Council on Radiation Protection and Measurements
NDA	nondestructive analysis
NEPA	National Environmental Policy Act of 1969
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPH	natural phenomena hazard
NPS	U.S. National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRU	National Research Universal
NTS	Nevada Test Site
NWCF	New Waste Calcining Facility
NWS	National Weather Service

ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
ORNL	Oak Ridge National Laboratory
PBF	Power Burst Facility
PEIS	programmatic environmental impact statement
PFP	Plutonium Finishing Plant
PIE	postirradiation examination
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 microns
PNNL	Pacific Northwest National Laboratory
PRA	probabilistic risk assessment
PSD	prevention of significant deterioration
PUREX	Plutonium-Uranium Extraction (Facility)
PWR	pressurized water reactor
R&D	research and development
RADTRAN4	(computer code: risks and consequences of radiological materials transport)
RAMOD	Radioactive Materials Research, Operations, and Demonstration
RCRA	Resource Conservation and Recovery Act, as amended
REA	regional economic area
RF	respirable fraction
RfC	reference concentration
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System II (computer code)
RISKIND	(computer code: risks and consequences of radiological materials transport)
ROD	Record of Decision
ROI	region of influence
RMF	Radiation Measurements Facility
RWMC	Radioactive Waste Management Complex
S/A	Similarity of Appearance (provision of Endangered Species Act)
SAR	safety analysis report
SARA	Superfund Amendments and Reauthorization Act of 1986
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric & Gas Company
SCSHPO	South Carolina State Historic Preservation Officer
SDWA	Safe Drinking Water Act, as amended
SHPO	State Historic Preservation Officer

SMC	Specific Manufacturing Complex
SNF	spent nuclear fuel
SNM	special nuclear material
SPD	surplus plutonium disposition
SPD EIS	*Surplus Plutonium Disposition Environmental Impact Statement*
SPERT	Special Power Excursion Reactor Test
SRS	Savannah River Site
SST	safe, secure trailer
SWMU	solid waste management unit
SWP 1	Service Waste Percolation Pond 1
TA	Technical Area
TCE	trichloroethylene
TNRCC	Texas Natural Resource Conservation Commission
TPBAR-LTA	tritium-producing burnable absorber rod lead test assembly
TRU	transuranic
TRUPACT	TRU waste package transporter
TSCA	Toxic Substances Control Act
TSP	total suspended particulates
TWRS	tank waste remediation system
TWRS EIS	*Tank Waste Remediation System Final Environmental Impact Statement*
UC	Regents of the University of California
USACE	U.S. Army Corps of Engineers
USEC	United States Enrichment Corporation
USFWS	U.S. Fish and Wildlife Service
UV	ultraviolet
VOC	volatile organic compounds
VORTAC	Very High Frequency Omnidirection Radio Tactical Air Navigation Device
VRM	Visual Resource Management
WAG 3	Waste Area Grouping 3
WERF	Waste Experimental Reduction Facility
WIPP	Waste Isolation Pilot Plant
WM PEIS	*Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WNP–2	Washington Nuclear Plant–2

WPPSS	Washington Public Power Supply System
WROC	Waste Reduction Operations Complex
WSRC	Westinghouse Savannah River Company
ZPPR	Zero Power Physics Reactor

Chemicals and Units of Measure

μCi	microcurie
μg	microgram
μm	micrometer (micron)
46°26'07"	46 degrees, 26 minutes, 7 seconds
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
dB	decibel
dBA	decibel, A-weighted
ft	foot
ft^2	square foot
ft^3	cubic foot
g	gram
g	gravitational acceleration
gal	gallon
ha	hectare
hr	hour (in compound units)
in	inch
kg	kilogram
km	kilometer
km^2	square kilometers
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mg	milligram
mi	mile
min	minute
mph	miles per hour

mrem	millirem
MVA	megavolt-ampere
MW	megawatt
MWe	megawatt electric
MWh	megawatt-hour
N_2	nitrogen
nCi	nanocurie
NO_2	nitrogen dioxide
pCi	picocurie
person-rem	person-rem
$PM_{2.5}$	particulate matter less than or equal to 2.5 μm in diameter
PM_{10}	particulate matter less than or equal to 10 μm in diameter
rad	radiation absorbed dose
rem	roentgen equivalent man
s	second
SO_2	sulfur dioxide
t	metric ton
ton	short ton
UF_6	uranium hexafluoride
UO_2	uranium dioxide
yd	yard
yd^3	cubic yard
yr	year (in compound units)
°C	degrees Celsius (Centigrade)
°F	degrees Fahrenheit

Metric Conversion Chart

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

Metric Prefixes

Prefix	Symbol	Multiplication Factor
exa-	E	1 000 000 000 000 000 000 = 10^{18}
peta-	P	1 000 000 000 000 000 = 10^{15}
tera-	T	1 000 000 000 000 = 10^{12}
giga-	G	1 000 000 000 = 10^{9}
mega-	M	1 000 000 = 10^{6}
kilo-	k	1 000 = 10^{3}
hecto-	h	100 = 10^{2}
deka-	da	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001= 10^{12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001= 10^{-18}

Next Section

Citation

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Chapter 4
Environmental Consequences

4.1 INTRODUCTION

In this U.S. Department of Energy (DOE) *Surplus Plutonium Disposition Draft Environmental Impact Statement* (SPD EIS), each of the major disposition alternatives, including the No Action Alternative, is discussed separately in Sections 4.2 through 4.25. To focus the impact analyses on those areas where the greatest potential exists for effects on the environment, the following areas are discussed in detail: air quality and noise, waste management, socioeconomics, human health risk, facility accidents, transportation, and environmental justice.

Environmental justice and transportation impacts of constructing facilities for surplus plutonium disposition are not discussed. Construction would not involve the release of any appreciable quantities of radionuclides or other hazardous constituents, and therefore would not be expected to cause adverse impacts on the offsite areas that are the focus of the environmental justice analysis. Likewise, construction would not involve the offsite transport of radioactive materials, and therefore would not appreciably contribute to adverse transportation impacts.

For the remaining resource areas (i.e., geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and infrastructure), it has been determined that the proposed disposition activities would have minimal or no impacts at the candidate sites regardless of the disposition alternative being considered. Therefore, impacts on these resources were evaluated in terms of the alternative that would have the greatest impact on the resource. The alternative analyzed is generally that which would locate the largest number of surplus plutonium disposition facilities at a given site. For example, the maximum impact on these resource areas at Pantex would be Alternative 9A, 9B, or 10, all of which consider building both a pit conversion facility and a mixed oxide (MOX) facility on the site. In another example, at Savannah River Site (SRS), the alternative having the greatest impact would be Alternative 3A or 3B depending on whether the resource would likely have greater impacts from new construction (e.g., cultural resources) or from modification of Building 221–F (e.g., water). The analysis of impacts allows a comparison among alternatives and among sites that are candidates for surplus plutonium disposition facilities.

The environmental consequences of alternatives for surplus plutonium disposition were generally estimated by comparing facility characteristics and requirements from Chapter 2 and Appendix E with affected environment information from Chapter 3. The two sets of information were analyzed following the impact assessment methods described in Appendix F. The results of the assessment of environmental consequences are presented in this chapter. For some of the resource areas, more detailed descriptions of the development of the impacts are presented in Appendixes G through M as follows:

- Appendix G, Air Quality
- Appendix H, Waste Management
- Appendix I, Socioeconomics
- Appendix J, Human Health Risks
- Appendix K, Facility Accidents
- Appendix L, Transportation
- Appendix M, Environmental Justice

Portions of some alternatives are equivalent. For example, under Alternatives 4A and 4B, the pit conversion facility is located in Zone 4 at Pantex. Therefore, the activities at Pantex are the same for these two alternatives. The organization of Chapter 4 takes advantage of these equivalencies. When the impacts at a site have already been described under a previous alternative, the later impacts discussion provides a reference to the previous location rather than repeating the information.

4.2 ALTERNATIVE 1: NO ACTION

The No Action Alternative for this SPD EIS includes implementation of the storage decisions made in the Record of Decision (ROD) for the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement (Storage and Disposition Final PEIS)* (January 14, 1997). Therefore, under the No Action Alternative in this SPD EIS, surplus weapons-usable plutonium materials in storage at various DOE sites would remain at those locations. The vast majority of pits would continue to be stored at Pantex, and the remaining plutonium in various forms would continue to be stored at the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory (LANL), Rocky Flats Environmental Technology Site (RFETS), and SRS. At Hanford, nonpit plutonium materials would continue to be stored at the Plutonium Finishing Plant (PFP). At INEEL, nonpit plutonium materials would continue to be stored in the Zero Power Physics Reactor (ZPPR) and Fuel Manufacturing Facility (FMF) at Argonne National Laboratory–West (ANL–W). At LANL, surplus plutonium materials would continue to be stored in the Nuclear Materials Storage Facility (NMSF) in Technical Area 55 (TA–55). At Pantex, surplus plutonium pits would be stored in Zone 4 until upgraded facilities are available in Zone 12 in 2004. At RFETS, nonpit plutonium material would continued to be stored in existing facilities. The surplus pits at RFETS are in the process of being transferred to Pantex (DOE 1997a). At SRS, surplus nonpit plutonium would continue to be stored at various locations until the Actinide Packaging and Storage Facility (APSF) is completed in 2001. The No Action Alternative at Lawrence Livermore National Laboratory (LLNL) involves the continuation of current activities without a surplus plutonium disposition mission at the site. There would be no impacts of continued storage of surplus plutonium at LLNL because no surplus plutonium exists at the site.

4.2.1 Air Quality and Noise

4.2.1.1 Hanford

Activities associated with the No Action Alternative at Hanford would generate criteria, hazardous, and toxic air pollutants. The sources of air pollutants associated with operations include natural gas–fired package boilers, diesel generators that are periodically tested and operated, tank farm emissions, various process emissions, and vehicle emissions. No Action activities would include the conversion to natural gas and electricity for heating and process steam (DOE 1996a:4-34). To evaluate the air quality impacts, criteria, hazardous, and toxic pollutant concentrations from the No Action Alternative were compared with the applicable Federal and State standards and guidelines. This comparison is presented as Table 4–1.

Maximum air pollutant concentrations from operations at Hanford are well under the applicable standards and guidelines for pollutants of concern. Natural pollutant sources should continue to produce occasional exceedances of the standards for particulate matter with an aerodynamic diameter less than or equal to 10 microns (μm) (PM_{10}) and total suspended particulates. Vehicle emissions associated with No Action activities at Hanford would likely decrease somewhat because of a decrease in overall site employment during this timeframe. Site employment at Hanford is expected to increase significantly over the period 2005–2010 to support construction of the tank waste remediation system. After this construction is completed, site employment is expected to drop again.

Impacts of operational noise would be similar to those described for existing conditions in Section 3.2.1.2. Noise from traffic associated with operation of facilities at Hanford is expected to decrease until 2005, when

Table 4–1. Evaluation of Hanford Air Pollutant Concentrations Associated With Alternative 1: No Action; Continued Storage of Plutonium at the Site

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	No Action Concentration ($\mu g/m^3$)[b]	Percent of Standard or Guideline
Criteria pollutants				
Carbon monoxide	8 hours	10,000	34.1	0.34
	1 hour	40,000	48.3	0.12
Nitrogen dioxide	Annual	100	0.25	0.25
PM_{10}	Annual	50	0.0179	0.036
	24 hours	150	0.77	0.51
Sulfur dioxide	Annual	50	1.63	3.1
	24 hours	260	8.91	3.4
	3 hours	1,300	29.6	2.3
	1 hour	700	32.9[c]	5.0
Other regulated pollutants				
Total suspended particulates	Annual	60	0.0179	0.03
	24 hours	150	0.77	0.51
Hazardous and other toxic compounds				
Ethylene glycol	24 hours	420	0	0
Benzene	Annual	0.12	0.000006	0.01

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Total site contribution, including plutonium storage operations and other approved facilities projected to be in operation in 2005.
[c] Estimated from 3-hr concentration.
Source: EPA 1997a; WDEC 1994.

it could again increase owing to a projected increase in employment unrelated to surplus plutonium disposition activities. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from operations activities would not be expected to annoy the public. Nontraffic noise sources are far enough away from offsite areas that the contribution to offsite noise levels would continue to be small.

4.2.1.2 INEEL

Activities associated with the No Action Alternative at INEEL would generate criteria, hazardous, and toxic air pollutants. The sources of air pollutants associated with operations include calcination of high-level radioactive liquid waste, coal-fired boilers, diesel generators that are periodically tested and operated, various process emissions, waste burial activities, and vehicle emissions. To evaluate the air quality impacts, criteria, hazardous, and toxic pollutant concentrations under the No Action Alternative were compared with the applicable Federal and State standards and guidelines. This comparison is presented as Table 4–2.

Maximum air pollutant concentrations from operations at INEEL would be in compliance with the applicable standards and guidelines for these pollutants of concern. Vehicle emissions associated with No Action activities at INEEL would likely decrease somewhat because of a decrease in overall site employment during this timeframe.

Impacts of operational noise would be similar to those described for existing conditions in Section 3.3.1.2. Noise from traffic associated with the operation of facilities at INEEL would likely decrease as site employment decreases. Given the distance to the site boundary (about 12 km [7.5 mi]), noise emissions from operations activities would not be expected to annoy the public. Nontraffic noise sources are far enough away from offsite areas that the contribution to offsite noise levels would continue to be small.

Table 4–2. Evaluation of INEEL Air Pollutant Concentrations Associated With Alternative 1: No Action; Continued Storage of Plutonium at the Site

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	No Action Concentration ($\mu g/m^3$)[b]	Percent of Standard or Guideline
Criteria pollutants				
Carbon monoxide	8 hours	10,000	302	3.0
	1 hour	40,000	1,220	3.1
Nitrogen dioxide	Annual	100	11	11
PM_{10}	Annual	50	3	6
	24 hours	150	39	26
Sulfur dioxide	Annual	80	6	7.5
	24 hours	365	137	38
	3 hours	1,300	591	45
Hazardous and other toxic compounds				
Ethylene glycol	24 hours	6,350	0[c]	0
Benzene	Annual	0.12	0.029	24

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Total site contribution, including current plutonium storage operations and other approved facilities projected to be in operation in 2005.
[c] No sources of this pollutant have been identified at the site.
Source: EPA 1997a; ID DHW 1995.

4.2.1.3 Pantex

Activities associated with the No Action Alternative at Pantex would generate criteria, hazardous, and toxic air pollutants. The types of sources associated with operations include steam boilers, diesel generators that are periodically tested and operated, explosives burning, high-explosive synthesis, and vehicle emissions. To evaluate the air quality impacts, criteria, hazardous, and toxic pollutant concentrations from the No Action Alternative were compared with the applicable Federal and State standards and guidelines. This comparison is presented as Table 4–3.

Maximum air pollutant concentrations from operations at Pantex would likely continue to be in compliance with the applicable standards of the pollutants of concern, but natural pollutant sources could continue to produce occasional exceedances of the PM_{10} standard. The maximum 1-hr air pollutant concentrations for hydrogen chloride and benzene are below the Texas Natural Resource Conservation Commission's (TNRCC's) effects-screening levels; however, the 24-hr concentrations for these pollutants are above those levels. Evaluation of these pollutants for the *Final EIS for the Continued Operation of Pantex Plant and Associated Storage of Nuclear Weapons Components* (DOE 1996b:4-140–4-146) was based on previous effects-screening levels using an annual average. The levels at that time were not exceeded. The concentrations for 24-hr averaging were based on the 1-hr average concentrations using U.S. Environmental Protection Agency's (EPA's) suggested screening analysis conversion factors (EPA 1988:4-17), which overestimate the concentration. Vehicle emissions associated with No Action activities at Pantex would likely decrease somewhat because of a decrease in overall site employment during this timeframe.

Impacts of operational noise would be similar to those described for existing conditions in Section 3.4.1.2. Noise from traffic associated with the operation of facilities at Pantex would likely decrease as site employment decreases. Given the distance to the site boundary (about 1.6 km [1.0 mi]), noise emissions from operations activities would not be expected to annoy the public. Most nontraffic noise sources are far enough away from

Table 4–3. Evaluation of Pantex Air Pollutant Concentrations Associated With Alternative 1: No Action; Continued Storage of Plutonium at the Site

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	No Action Concentration ($\mu g/m^3$)[b]	Percent of Standard or Guideline
Criteria pollutants				
Carbon monoxide	8 hours	10,000	620	6.2
	1 hour	40,000	2,990	7.5
Nitrogen dioxide	Annual	100	1.94	1.9
PM_{10}	Annual	50	8.79	18
	24 hours	150	89.4	60
Sulfur dioxide	Annual	80	0	0
	24 hours	365	0.00002	<0.001
	3 hours	1,300	0.00008	<0.001
	30 minutes	1,048	0.00016	<0.001
Other regulated pollutants				
Total suspended particulates	3 hours	200	(c)	0
	1 hour	400	(c)	0
Hazardous and other toxic compounds				
Ethylene glycol	24 hours	26[d]	0	0
	1 hour	260[d]	0	0
Benzene	24 hours	3[d]	7.8[e]	260
	1 hour	75[d]	19.4	26

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Total site contribution, including current plutonium storage operations and other approved facilities projected to be in operation in 2005.
[c] Three- and 1-hr concentrations for total suspended particulates are not listed in the source documents (see Table G–43).
[d] Effects-screening level of the Texas Natural Resource Conservation Commission. Such levels are not ambient air standards, but merely "tools" used by the Toxicology and Risk Assessment staff to evaluate impacts of air pollutant emissions. Thus, exceedance of the screening levels by ambient air contaminants does not necessarily indicate a problem. That circumstance, however, would prompt a more thorough evaluation.
[e] Estimated from the 1-hr concentration.
Source: EPA 1997a; TNRCC 1997a, 1997b.

offsite areas that the contribution to offsite noise levels would continue to be small. Noise from explosives detonation and small arms firing would continue to be heard off the site.

4.2.1.4 SRS

Activities associated with the No Action Alternative at SRS would generate criteria, hazardous, and toxic air pollutants. The sources of air pollutants associated with operations include coal-fired boilers, diesel generators that are periodically tested and operated, various process emissions, groundwater air strippers, the consolidated incineration facility, and vehicle emissions. To evaluate the air quality impacts, criteria, hazardous, and toxic pollutant concentrations from the No Action Alternative were compared with the applicable Federal and State standards and guidelines. This comparison is presented as Table 4–4.

Maximum air pollutant concentrations from operations at SRS are in compliance with the applicable standards and guidelines for these pollutants of concern. Vehicle emissions associated with No Action activities at SRS would likely decrease somewhat from current emissions because of a decrease in overall site employment during this timeframe.

Table 4–4. Evaluation of SRS Air Pollutant Concentrations Associated With Alternative 1: No Action; Continued Storage of Plutonium at the Site

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	No Action Concentration ($\mu g/m^3$)[b]	Percent of Standard or Guideline
Criteria pollutants				
Carbon monoxide	8 hours	10,000	64	0.64
	1 hour	40,000	279	0.70
Nitrogen dioxide	Annual	100	9.3	9.30
PM_{10}	Annual	50	4.14	8.3
	24 hours	150	56.4	38
Sulfur dioxide	Annual	80	15.1	19
	24 hours	365	219	60
	3 hours	1,300	962	74
Other regulated pollutants				
Total suspended particulates	Annual	75	14.7	20
Hazardous and other toxic compounds				
Ethylene glycol	24 hours	650	0.195	0.03
Benzene	24 hours	150	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Total site contribution, including current plutonium storage operations and other approved facilities projected to be in operation in 2005.
Source: EPA 1997a; SCDHEC 1996.

Impacts of operational noise would be similar to those described for existing conditions in Section 3.5.1.2. Noise from traffic associated with the operation of facilities at SRS is expected to decrease as site employment decreases. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from operations activities would not be expected to annoy the public. Nontraffic noise sources are far enough away from offsite areas that the contribution to offsite noise levels would continue to be small.

4.2.1.5 LANL

Activities associated with the No Action Alternative at LANL would generate criteria, hazardous, and toxic air pollutants. The types of sources associated with operations include boilers, diesel generators that are periodically tested and operated, various processes, and vehicle emissions. No Action activities would include the continuation of plutonium storage, as discussed in the *Storage and Disposition Final PEIS* (DOE 1996a:4-366). To evaluate the air quality impacts, criteria, hazardous and toxic pollutant concentrations from the No Action Alternative were compared with the applicable Federal and State standards and guidelines. This comparison is presented as Table 4–5. Maximum air pollutant concentrations from operations at LANL are in compliance with the applicable guidelines and regulations for the pollutants of concern. Vehicle emissions associated with No Action activities at LANL would likely be unchanged.

The continuing operations at LANL would result in no appreciable change from current levels of traffic noise and onsite operational noise. Nontraffic noise sources are far enough away from offsite areas that the contribution to offsite noise levels would continue to be small. Given the size of the site, noise emissions from operations activities would not be expected to cause annoyance to the public. However, some noise sources could be close enough to onsite noise-sensitive areas to result in impacts, such as the disturbance of wildlife.

Table 4–5. Evaluation of LANL Air Pollutant Concentrations Associated With Alternative 1: No Action; Continued Storage of Plutonium at the Site

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	No Action Concentration ($\mu g/m^3$)[b]	Percent of Standard or Guideline
Criteria pollutants				
Carbon monoxide	8 hours	7,689	115	1.5
	1 hour	11,578	630	5.4
Nitrogen dioxide	Annual	73	3.8	5.4
	24 hour	145	30.4[c]	22
PM_{10}	Annual	50	8	16
	24 hours	150	21	14
Sulfur dioxide	Annual	40	1.3	3.3
	24 hours	202	10[c]	5
	3 hours	1,300	23[c]	1.8
Other regulated pollutants				
Hydrogen sulfide	1 hour	11	(d)	(d)
Total reduced sulfur	30 minutes	3	(d)	(d)
Total suspended particulates	Annual	60	8	13
	30 days	90	<21	<23
	7 days	<110	<21	<19
	24 hours	150	21	14

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Total concentration, including plutonium storage operations and other approved facilities projected to be in operation in 2005.
[c] No monitoring data available; estimated from annual concentration.
[d] No monitoring data available.
Source: DOE 1996a; EPA 1997a.

4.2.1.6 RFETS

Activities associated with the No Action Alternative at RFETS would generate criteria, hazardous, and toxic, air pollutants. The types of sources associated with operations include boilers, diesel generators that are periodically tested and operated, various processes, and vehicle emissions. No Action activities would include the continuation of plutonium storage, as discussed in the *Storage and Disposition Final PEIS* (DOE 1996a:4-346). To evaluate the air quality impacts, criteria, hazardous, and toxic pollutant concentrations from the No Action Alternative were compared with the applicable Federal and State standards and guidelines. This comparison is presented as Table 4–6. During dry and windy conditions, increased PM_{10} and total suspended particulate concentrations could be expected from ongoing construction associated with activities outside the scope of this SPD EIS. Nevertheless, the site should remain in compliance with applicable Federal and State regulations for the air pollutants of concern.

Vehicle emissions associated with No Action activities at RFETS would likely be unchanged.

The continuing operations at RFETS would result in no appreciable change from current levels of traffic noise and onsite operational noise. Nontraffic noise sources are far enough away from offsite areas that the contribution to offsite noise levels would continue to be small. Given the size of the site, noise emissions from operations activities would not be expected to annoy the public. However, some noise sources could be close enough to onsite noise-sensitive areas to result in impacts, such as the disturbance of wildlife.

Section 176(c) of the 1990 Clean Air Act amendments requires that all Federal actions conform with the applicable State implementation plan. EPA has implemented rules governing determination of the conformity

Table 4–6. Evaluation of RFETS Air Pollutant Concentrations Associated With Alternative 1: No Action; Continued Storage of Plutonium at the Site

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	No Action Concentration ($\mu g/m^3$)[b]	Percent of Standard or Guideline
Criteria pollutants				
Carbon monoxide	8 hours	10,000	145	1.5
	1 hour	40,000	534	1.3
Nitrogen dioxide	Annual	100	4.14	4.1
PM_{10}	Annual	50	0.235	0.5
	24 hours	150	17.4	12.0
Sulfur dioxide	Annual	80	0.295	0.37
	24 hours	365	21.8	6.0
	3 hours	700	64.6	9.2
Other regulated pollutants				
Hydrogen sulfide	1 hour	142	<0.01	0.007
Total suspended particulates	Annual	75	0.284	0.38
	24 hours	150	21.0	14.0

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Total site contribution, including plutonium storage operations and other approved facilities projected to be in operation in 2005.
Source: Adapted from DOE 1996a; EPA 1997a.

of all Federal actions in nonattainment and maintenance areas. Because the RFETS area is considered a nonattainment area for ozone, PM_{10}, and carbon monoxide, proposed actions at this site must be evaluated for applicability of the conformity regulations. The No Action Alternative would effect no change in direct or indirect emissions from RFETS. Accordingly, there is no need for an RFETS conformity determination relative to this alternative.

4.2.2 Waste Management

4.2.2.1 Hanford

Wastes generated by activities associated with storage of surplus plutonium at Hanford are a portion of the existing site waste generation rates presented in Section 3.2.2.1. Because the rates of waste generation from continued storage of surplus plutonium at Hanford should not appreciably change from current rates, impacts on waste management facilities would not change from those currently experienced. Because the current waste generation rates from storage of surplus plutonium at Hanford are part of the planning basis for Hanford, continued storage should not have a major impact on waste management activities at the site.

Depending in part on decisions in the RODs for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (WM PEIS), wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for transuranic (TRU) waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current Waste Isolation Pilot Plant (WIPP) waste acceptance criteria and shipped to WIPP for disposal. Shipment of TRU waste from Hanford to WIPP is expected to begin in 1999 (DOE 1997b:17). This SPD EIS also assumes that low-level waste (LLW), mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford are being evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* that is being prepared by the DOE Richland Operations Office (DOE 1997c).

4.2.2.2 INEEL

Wastes generated by activities associated with storage of surplus plutonium at INEEL are a portion of the existing site waste generation rates presented in Section 3.3.2.1. Because the rates of waste generation from continued storage of surplus plutonium at INEEL should not appreciably change from current rates, impacts on waste management facilities would not change from those currently experienced. Because the current waste generation rates from storage of surplus plutonium at INEEL are part of the planning basis for INEEL, continued storage should not have a major impact on waste management activities at the site.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Shipment of TRU waste from INEEL to WIPP is expected to begin in 1998 (DOE 1997b:17). This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at INEEL are described in the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final EIS* (DOE 1995a).

4.2.2.3 Pantex

Wastes generated by activities associated with storage of surplus plutonium pits at Pantex are a portion of the existing site waste generation rates presented in Section 3.4.2.1. Because the rates of waste generation from continued storage of surplus plutonium at Pantex should not appreciably change from current rates, impacts on waste management facilities would not change from those currently experienced. Because the current waste generation rates from storage of surplus plutonium at Pantex are part of the planning basis for Pantex, continued storage should not have a major impact on waste management activities at the site.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated onsite, or treated and disposed offsite in DOE or commercial facilities. This SPD EIS assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. TRU waste would not be routinely generated. Impacts of treatment and storage of radioactive, hazardous, mixed, and nonhazardous wastes at Pantex are described in the *Final EIS for the Continued Operation of Pantex and Associated Storage of Nuclear Weapon Components* (DOE 1996b). LLW from Pantex is currently shipped to the Nevada Test Site (NTS) for disposal. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996c).

4.2.2.4 SRS

The No Action Alternative at SRS involves the continued storage of surplus plutonium in existing facilities, with materials moved to APSF when completed. Impacts on the waste management infrastructure associated with construction and operation of APSF are described in the *Final EIS Interim Management of Nuclear Materials* (DOE 1995b:2-60). This SPD EIS indicates that there would be no major impacts on SRS waste management systems from the storage of plutonium at APSF.

Wastes generated by activities associated with storage of surplus plutonium at SRS are a portion of the existing site waste generation rates presented in Section 3.5.2.1. Because the rates of waste generation from continued storage of surplus plutonium at SRS should not appreciably change from current rates, impacts on waste management facilities would not change from those currently experienced. Because the current waste generation rates from storage of surplus plutonium at SRS are part of the planning basis for SRS, continued storage should not have a major impact on waste management activities at the site.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Shipment of TRU waste from SRS to WIPP is expected to begin in 1999 (DOE 1997b:17). This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

4.2.2.5 LANL

Waste generated by activities associated with storage of surplus plutonium at LANL are a portion of the existing site waste generation rates presented in Section 3.6.4.2 of Chapter 3. Because the rates of waste generation from continued storage of surplus plutonium at LANL are not expected to appreciably change from current rates, impacts on waste management facilities would not change from those currently experienced. Because the current waste generation rates from storage of surplus plutonium at LANL are part of the planning basis for LANL, continued storage would not be expected to have a major impact on waste management activities at the site.

Depending in part on decisions in the RODs for the Waste Management PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste (issued on January 20, 1998), TRU and mixed TRU waste would be certified onsite to current WIPP waste acceptance criteria, and shipped to WIPP for disposal. Shipment of TRU waste from LANL to WIPP is expected to begin in 1998 (DOE 1997b:17). This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of waste at LANL will be described in the *Los Alamos National Laboratory Site-Wide EIS* that is being prepared by DOE's Los Alamos Area Office (DOE 1995d).

4.2.2.6 RFETS

Waste generated by activities associated with storage of surplus nonpit plutonium at RFETS are a portion of the existing site waste generation rates. Because the rates of waste generation from continued storage of surplus nonpit plutonium at RFETS are not expected to appreciably change from current rates, impacts on waste management facilities would not change from those currently experienced. Because the current waste generation rates from storage of surplus nonpit plutonium at RFETS are part of the planning basis for RFETS, continued storage would not be expected to have a major impact on waste management activities at the site. RFETS has stored plutonium since 1956 and is adequately equipped to manage the wastes from the storage mission using the existing waste management infrastructure (DOE 1996a:4-359).

The nuclear weapons mission of the RFETS was terminated in 1994. The only remaining mission of the site is cleanup and remediation. The Rocky Flats Cleanup Agreement establishes a legally binding relationship between DOE, EPA, and the Colorado Department of Public Health and Environment that governs cleanup of the site (DOE 1998b:48). Waste generated by cleanup activities is expected to be much greater than wastes generated from continued storage of surplus nonpit plutonium. The impacts of the wastes generated by site cleanup activities would be addressed in individual remedial action feasibility studies (DOE 1996a:4-359).

Depending in part on decisions in the RODs for the Waste Management PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste (issued on January 20, 1998), TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria, and shipped to WIPP for disposal. Shipment of TRU waste from RFETS to WIPP is expected to begin in 1998 (DOE 1997b:17). This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

4.2.3 Socioeconomics

Under the No Action Alternative, the existing storage facilities at the candidate sites would remain operational. No new employment or in-migration of workers would be required. Thus, there would be no additional impacts on the socioeconomic conditions near the sites.

4.2.4 Human Health Risk

4.2.4.1 Hanford

Radiological Impacts. Table 4–7 presents the dose to the population within 80 km (50 mi) from storage in the year 2030 and the projected number of fatal cancers in this population from 50 years of storage as shown in the *Storage and Disposition Final PEIS*. Included in the table are the calculated annual doses to the maximally exposed member of the public and the average exposed member of the public from the continued storage of plutonium, and a projection of the fatal cancer risk to these individuals from 50 years of storage. An annual dose of 0.047 person-rem would be incurred by the population of 621,000. The corresponding number of fatal cancers in this population from 50 years of storage would be 1.2×10^{-3}. An annual dose of 4.1×10^{-4} mrem has been calculated for the maximally exposed individual (MEI). From 50 years of storage, the corresponding risk of fatal cancer to this individual would be 1.0×10^{-8}. To put these doses into perspective, comparisons with natural background radiation doses are also provided in the table. The storage doses are much lower than those from total site operations, as shown in Section 4.28.1.

Under the No Action Alternative, the annual average dose to a worker involved in storage operations and the annual dose to the total storage workforce would be 250 mrem and 46 person-rem, respectively, as shown in Table 4–8. The risk of fatal cancer to the average worker from 50 years of storage operations would be 5.0×10^{-3}, and the projected number of fatal cancers in the total storage workforce from 50 years of operation would be 0.92.

Hazardous Chemical Impacts. Hazardous chemical impacts of the No Action Alternative would be the same as those of current site operations. The Hazard Index for the MEI from normal operations at Hanford would be 6×10^{-5}, which indicates that adverse, noncancer health effects should not occur; the cancer risk is expected to be zero. The Hazard Index for the onsite worker would be 4×10^{-3}, which also suggests that noncancer effects are not expected; the cancer risk is expected to be zero (DOE 1996a:4-62).

4.2.4.2 INEEL

Radiological Impacts. Table 4–9 presents the dose to the population within 80 km (50 mi) from storage in the year 2030 and the projected number of fatal cancers in this population from 50 years of storage as shown in the *Storage and Disposition Final PEIS*. Included in the table are the calculated annual doses to the maximally exposed member of the public and the average exposed member of the public from the continued storage of plutonium, and a projection of the fatal cancer risk to these individuals from 50 years of storage.

Table 4–7. Potential Radiological Impacts on the Public of Alternative 1: No Action; Continued Storage of Plutonium at Hanford

Population dose within 80 km for year 2030	
Atmospheric release pathway (person-rem)	0.047
Liquid release pathway (person-rem)	0
Atmospheric and liquid release pathways combined (person-rem)	0.047
Percent of natural background[a]	2.5×10^{-5}
50-year fatal cancers	1.2×10^{-3}
Annual dose to the maximally exposed individual	
Atmospheric release pathway (mrem)	4.1×10^{-4}
Total liquid release pathway (mrem)	0
Atmospheric and liquid release pathways combined (mrem)	4.1×10^{-4}
Percent of natural background[a]	1.4×10^{-4}
50-year fatal cancer risk	1.0×10^{-8}
Annual dose to the average exposed individual within 80 km[b]	
Atmospheric and liquid release pathways combined (mrem)	7.6×10^{-5}
50-year fatal cancer risk	1.9×10^{-9}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2030 would receive 186,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2030 (621,000).
Source: DOE 1996a.

Table 4–8. Potential Radiological Impacts on Workers of Alternative 1: No Action; Continued Storage of Plutonium at Hanford

Total dose (person-rem/yr)	46
50-year fatal cancers	0.92
Average worker dose (mrem/yr)	250
50-year fatal cancer risk	5.0×10^{-3}

Note: Under the No Action Alternative, 225 in-plant workers (including 185 monitored for radiation exposure) would be required to operate the storage facility. The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in storage operations would be kept below 500 mrem/yr. Based on a review of worker doses associated with similar operations, an average worker dose of 250 mrem/yr has been conservatively assumed. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1996a.

An annual dose of 7.6×10^{-5} person-rem would be incurred by the population of 269,000. The corresponding number of fatal cancers in this population from 50 years of storage would be 1.9×10^{-6}. An annual dose of 1.4×10^{-5} mrem has been calculated for the MEI. From 50 years of storage, the corresponding risk of fatal cancer to this individual would be 3.5×10^{-10}. To put these doses into perspective, comparisons with natural background radiation doses are also provided in the table. The storage doses are much lower than those from total site operations, as shown in Section 4.28.2.

Under the No Action Alternative, the annual average dose to a worker involved in storage operations and the annual dose to the total storage workforce would be 26 mrem and 1.5 person-rem, respectively, as shown in Table 4–10. The associated risk of fatal cancer to the average worker from 50 years of storage operations

Table 4–9. Potential Radiological Impacts on the Public of Alternative 1: No Action; Continued Storage of Plutonium at INEEL

Population dose within 80 km for year 2030	
Atmospheric release pathway (person-rem)	7.6×10^{-5}
Liquid release pathway (person-rem)	0
Atmospheric and liquid release pathways combined (person-rem)	7.6×10^{-5}
Percent of natural background[a]	7.8×10^{-8}
50-year fatal cancers	1.9×10^{-6}
Annual dose to the maximally exposed individual	
Atmospheric release pathway (mrem)	1.4×10^{-5}
Total liquid release pathway (mrem)	0
Atmospheric and liquid release pathways combined (mrem)	1.4×10^{-5}
Percent of natural background[a]	3.9×10^{-6}
50-year fatal cancer risk	3.5×10^{-10}
Annual dose to the average exposed individual within 80 km[b]	
Atmospheric and liquid release pathways combined (mrem)	2.8×10^{-7}
50-year fatal cancer risk	7.1×10^{-12}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2030 would receive 97,100 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2030 (269,000).
Source: DOE 1996a; Mitchell et al. 1997.

Table 4–10. Potential Radiological Impacts on Workers of Alternative 1: No Action; Continued Storage of Plutonium at INEEL

Total dose (person-rem/yr)	1.5
50-year fatal cancers	0.029
Average worker dose (mrem/yr)	26
50-year fatal cancer risk	5.1×10^{-4}

Note: No Action Alternative storage worker doses are based on an average of the 1994 to 1996 measured doses for 57 workers totaling 1.5 person-rem/yr deep dose (assumed whole body). The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in storage operations would be kept below 500 mrem/yr. Based on a review of worker doses associated with similar operations, an average worker dose of 26 mrem/yr has been conservatively assumed. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1996a.

would be 5.1×10^{-4}, and the projected number of fatal cancers in the total storage workforce from 50 years of operation would be 0.029.

Hazardous Chemical Impacts. Hazardous chemical impacts of the No Action Alternative would be the same as those of current site operations. Thus, the Hazard Index for the MEI at INEEL from normal operations would be 2×10^{-2}, which indicates that adverse, noncancer health effects should not occur; the cancer risk is expected to be 3.6×10^{-6}. The Hazard Index for the onsite worker would be 0.2, which also suggests that noncancer effects are not expected; the cancer risk is expected to be 8×10^{-4} (DOE 1996a:4-163).

Next Section

4.2.4.3 Pantex

Radiological Impacts. Table 4–11 presents the dose to the population within 80 km (50 mi) from storage in the year 2030 and the projected number of fatal cancers in this population from 50 years of storage as shown in the *Storage and Disposition Final PEIS*. Included in the table are the calculated annual doses to the maximally exposed member of the public and the average exposed member of the public from the continued storage of plutonium, and a projection of the fatal cancer risks to these individuals from 50 years of storage. An annual dose of 6.3×10^{-6} person-rem would be incurred by the population of 350,000. The corresponding number of fatal cancers in this population from 50 years of storage would be 1.6×10^{-7}. An annual dose of 1.8×10^{-8} mrem has been calculated for the MEI. From 50 years of storage, the corresponding risk of fatal cancer to this individual would be 4.5×10^{-13}. To put these doses into perspective, comparisons with natural background radiation doses are also provided in the table. The storage doses are much lower than those from total site operations, as shown in Section 4.28.3.

Table 4–11. Potential Radiological Impacts on the Public of Alternative 1: No Action; Continued Storage of Plutonium at Pantex

Population dose within 80 km for year 2030	
Atmospheric release pathway (person-rem)	(a)
Liquid release pathway (person-rem)	0
Atmospheric and liquid release pathways combined (person-rem)	6.3×10^{-6}
Percent of natural background[b]	5.4×10^{-9}
50-year fatal cancers	1.6×10^{-7}
Annual dose to the maximally exposed individual	
Atmospheric release pathway (mrem)	(a)
Total liquid release pathway (mrem)	0
Atmospheric and liquid release pathways combined (mrem)	1.8×10^{-8}
Percent of natural background[b]	5.4×10^{-9}
50-year fatal cancer risk	4.5×10^{-13}
Annual dose to the average exposed individual within 80 km[c]	
Atmospheric and liquid release pathways combined (mrem)	1.8×10^{-8}
50-year fatal cancer risk	4.5×10^{-13}

a The atmospheric releases for the No Action Alternative would not be measurable above background radiation. The atmospheric and liquid release pathways combined was calculated with measured data from direct doses outside the facility.

b The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2030 would receive 116,200 person-rem.

c Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex in 2030 (350,000).

Key: RFETS, Rocky Flats Environmental Technology Site.

Note: The quantity of plutonium pits at Pantex to be stored in upgraded facilities in Zone 12 would be slightly increased by the addition of pits from RFETS. It was determined that the overall effect of moving Pantex and RFETS pits from Zone 4 to upgraded Zone 12 storage facilities would result in lower potential releases of radioactive materials (and hence, impacts) to the public. All values shown in the above table are associated with Zone 4 releases only; therefore, they serve as upper bounding estimates for potential impacts incurred from Zone 12 releases (i.e., potential impacts from Zone 12 releases would not exceed the values presented above).

Source: DOE 1996a.

Under the No Action Alternative, the annual average dose to a worker involved in storage operations and the annual dose to the total storage workforce would be 116 mrem and 3 person-rem, respectively, as shown in Table 4–12. The associated risk of fatal cancer to the average worker from 50 years of storage operations

Table 4–12. Potential Radiological Impacts on Workers of Alternative 1: No Action; Continued Storage of Plutonium at Pantex

Total dose (person-rem/yr)	3
50-year fatal cancers	0.060
Average worker dose (mrem/yr)	116
50-year fatal cancer risk	2.3×10^{-3}

Key: RFETS, Rocky Flats Environmental Technology Site.
Note: Under the No Action Alternative (with pits from RFETS), 25 in-plant workers monitored for radiation exposure would be required to operate the storage facility. The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in storage operations would be kept below 500 mrem/yr. Based on a review of worker doses associated with similar operations, an average worker dose of 116 mrem/yr has been conservatively assumed. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1996a.

would be 2.3×10^{-3}, and the projected number of fatal cancers in the total storage workforce from 50 years of operation would be 0.06.

Hazardous Chemical Impacts. Modification of Zone 12 for continued storage would slightly reduce the hazardous chemical impacts of normal operations. The Hazard Index for the MEI would be 6×10^{-3}, which indicates that adverse, noncancer effects should not occur; the cancer risk is expected to be 1×10^{-8}. The Hazard Index for the onsite worker would be 6×10^{-3}, which also suggests that noncancer effects are not expected; the cancer risk is expected to be 5×10^{-7} (DOE 1996a:4-220).

4.2.4.4 SRS

Radiological Impacts. Table 4–13 presents the dose to the population within 80 km (50 mi) from storage in the year 2030 and the projected number of fatal cancers in this population from 50 years of storage as shown in the *Storage and Disposition Final PEIS*. Included in the table are the calculated annual doses to the maximally exposed member of the public and the average exposed member of the public from the continued storage of plutonium, and a projection of the fatal cancer risks to these individuals from 50 years of storage. An annual dose of 2.9×10^{-4} person-rem would be incurred by the population of 893,000. The corresponding number of fatal cancers in this population from 50 years of storage would be 7.2×10^{-6}. An annual dose of 6.8×10^{-6} mrem has been calculated for the MEI. From 50 years of storage, the corresponding risk of fatal cancer to this individual would be 1.7×10^{-10}. To put these doses into perspective, comparisons with natural background radiation doses are also provided in the table.

Under the No Action Alternative, the annual average dose to a worker involved in storage operations and the annual dose to the total storage workforce would be 250 mrem and 7.5 person-rem, respectively, as shown in Table 4–14. The associated risk of fatal cancer to the average worker from 50 years of storage operations would be 5.0×10^{-3}, and the projected number of fatal cancers in the total storage workforce from 50 years of operation would be 0.15.

Hazardous Chemical Impacts. Hazardous chemical impacts of the No Action Alternative would be the same as those for current site operations. The Hazard Index for the MEI at SRS would be 5×10^{-3}, which indicates that adverse, noncancer health effects should not occur; the cancer risk is expected to be 1×10^{-7}. The Hazard Index for the onsite worker would be 1.2, which suggests that onsite workers may experience adverse health effects as a result of the exposures; the cancer risk is expected to be 2×10^{-4} (DOE 1996a:4-324).

Table 4–13. Potential Radiological Impacts on the Public of Alternative 1: No Action; Continued Storage of Plutonium at SRS

Population dose within 80 km for year 2030	
Atmospheric release pathway (person-rem)	2.8×10^{-4}
Total liquid release pathway (person-rem)[a]	1.0×10^{-5}
Atmospheric and liquid release pathways combined (person-rem)	2.9×10^{-4}
Percent of natural background[b]	1.1×10^{-7}
50-year fatal cancers	7.2×10^{-6}
Annual dose to the maximally exposed individual	
Atmospheric release pathway (mrem)	6.2×10^{-6}
Total liquid release pathway (mrem)[a]	6.1×10^{-7}
Atmospheric and liquid release pathways combined (mrem)	6.8×10^{-6}
Percent of natural background[b]	2.3×10^{-6}
50-year fatal cancer risk	1.7×10^{-10}
Annual dose to the average exposed individual within 80 km[c]	
Atmospheric and liquid release pathways combined (mrem)	3.2×10^{-7}
50-year fatal cancer risk	8.0×10^{-12}

[a] Includes the drinking water pathway.
[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2030 would receive 263,000 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2030 (893,000).
Source: DOE 1996a.

Table 4–14. Potential Radiological Impacts on Workers of Alternative 1: No Action; Continued Storage of Plutonium at SRS

Total dose (person-rem/yr)	7.5
50-year fatal cancers	0.15
Average worker dose (mrem/yr)	250
50-year fatal cancer risk	5.0×10^{-3}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in storage operations would be kept below 500 mrem/yr. Based on a review of worker doses associated with similar operations, an average worker dose of 250 mrem/yr has been conservatively assumed. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1996a.

4.2.4.5 LANL

Radiological Impacts. Table 4–15 presents the dose to the population within 80 km (50 mi) from storage in the year 2030 and the projected number of fatal cancers in this population from 50 years of storage as shown in the *Storage and Disposition Final PEIS.* The table also includes the calculated annual doses to the maximally exposed member of the public and the average exposed member of the public from continued storage of plutonium, and projects the fatal cancer risk to these individuals from 50 years of storage. An annual dose of 2.7 person-rem would be incurred by the population of 278,000. The corresponding number of fatal cancers in this population from 50 years of storage would be 0.068. An annual dose of 6.5 mrem is calculated for the MEI. From 50 years of storage, the corresponding risk of fatal cancer to this individual

Table 4–15. Potential Radiological Impacts on the Public of Alternative 1: No Action; Continued Storage of Plutonium at LANL

Population dose within 80 km for year 2030	
Atmospheric release pathway (person-rem)	2.7
Liquid release pathway (person-rem)	~0
Atmospheric and liquid release pathways combined (person-rem)	2.7
Percent of natural background[a]	2.8×10^{-3}
50-year fatal cancers	0.068
Annual dose to the maximally exposed individual[b]	
Atmospheric release pathway (mrem)	5.7
Total liquid release pathway (mrem)	0.80
Atmospheric and liquid release pathways combined (mrem)	6.5
Percent of natural background[a]	1.9
50-year fatal cancer risk	1.6×10^{-4}
Annual dose to the average exposed individual within 80 km[c]	
Atmospheric release pathway (mrem)	9.7×10^{-3}
50-year fatal cancer risk	2.4×10^{-7}

[a] The annual natural background radiation level at LANL is 342 mrem for the average individual; the population within 80 km (50 mi) in 2030 would receive 95,000 person-rem.
[b] Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the site in 2030 (278,000).
Key: LANL, Los Alamos National Laboratory.
Source: DOE 1996a:4-376.

would be 1.6×10^{-4}. To put these doses into perspective, comparisons with natural background radiation doses are included in the table.

Under the No Action Alternative, the annual average dose to a worker involved with storage operations and the annual dose to the total storage workforce would be 250 mrem and 12.5 person-rem, respectively, as shown in Table 4–16. The risk of fatal cancer to the average worker from 50 years of storage operations would be 5.0×10^{-3}, and the projected number of fatal cancers in the total storage workforce from 50 years of operation would be 0.25.

Table 4–16. Potential Radiological Impacts on Workers of Alternative 1: No Action; Continued Storage of Plutonium at LANL

Total dose (person-rem/yr)	12.5
50-year fatal cancers	0.25
Average worker dose (mrem/yr)	250
50-year fatal cancer risk	5.0×10^{-3}

Key: LANL, Los Alamos National Laboratory.
Note: The radiological limit for an individual worker is 5,000 mrem/yr. It is assumed that there are 50 workers, badged with dosimeters to monitor radiation exposure, with a conservatively estimated average dose of 250 mrem/yr per worker. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1996a:4-377.

Hazardous Chemical Impacts. The hazardous chemical impacts of the No Action Alternative would be the same as those of current site operations. The Hazard Index for the MEI from normal operations at LANL would be 3×10^{-2}, which indicates that adverse, noncancer health effects should not occur; the cancer risk is expected to be 5×10^{-6}. The Hazard Index for the onsite worker would be 5×10^{-2}, which also suggests that noncancer effects are not expected; the cancer risk is expected to be 2×10^{-4} (DOE 1996a:4-377).

4.2.4.6 RFETS

Radiological Impacts. Table 4–17 presents the dose to the population within 80 km (50 mi) from storage in the year 2030 and the projected number of fatal cancers in this population from 50 years of storage as shown in the *Storage and Disposition Final PEIS*. The table also includes the calculated annual doses to the maximally exposed member of the public and the average exposed member of the public from continued storage of plutonium, and projects the fatal cancer risk to these individuals from 50 years of storage. An annual dose of 0.10 person-rem would be incurred by the population of 3,116,000. The corresponding number of fatal cancers in this population from 50 years of storage would be 2.5×10^{-3}. An annual dose of 0.48 mrem is calculated for the MEI. From 50 years of storage, the corresponding risk of fatal cancer to this individual would be 1.2×10^{-5}. To put these doses into perspective, comparisons with natural background radiation doses are included in the table.

Table 4–17. Potential Radiological Impacts on the Public of Alternative 1: No Action; Continued Storage of Plutonium at RFETS

Population dose within 80 km for year 2030	
Atmospheric release pathway (person-rem)	0.10
Liquid release pathway (person-rem)	0
Atmospheric and liquid release pathways combined (person-rem)	0.10
Percent of natural background[a]	9.1×10^{-6}
50-year fatal cancers	2.5×10^{-3}
Annual dose to the maximally exposed individual	
Atmospheric release pathway (mrem)	0.13
Total liquid release pathway (mrem)	0.35
Atmospheric and liquid release pathways combined (mrem)	0.48
Percent of natural background[a]	0.14
50-year fatal cancer risk	1.2×10^{-5}
Annual dose to the average exposed individual within 80 km[b]	
Atmospheric release pathway (mrem)	3.2×10^{-5}
50-year fatal cancer risk	8.0×10^{-10}

[a] The annual natural background radiation level at RFETS is 353 mrem for the average individual; the population within 80 km (50 mi) in 2030 would receive 1,100,000 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the site in 2030 (3,116,000).
Key: RFETS, Rocky Flats Environmental Technology Site.
Source: DOE 1996a:4-356.

Under the No Action Alternative, the annual average dose to a worker involved with storage operations and the annual dose to the total storage workforce would be 250 mrem and 25 person-rem, respectively, as shown in Table 4–18 workers. The risk of fatal cancer to the average worker from 50 years of storage operations would be 5.0×10^{-3}, and the projected number of fatal cancers in the total storage workforce from 50 years of operation would be 0.50.

Table 4–18. Potential Radiological Impacts on Workers of Alternative 1: No Action; Continued Storage of Plutonium at RFETS

Total dose (person-rem/yr)	25
50-year fatal cancers	0.50
Average worker dose (mrem/yr)	250
50-year fatal cancer risk	5.0×10^{-3}

Key: RFETS, Rocky Flats Environmental Technology Site.
Note: The radiological limit for an individual worker is 5,000 mrem/yr. It is assumed that there are 100 workers, badged with dosimeters to monitor radiation exposure, with a conservatively estimated average dose of 250 mrem/yr per worker. An effective ALARA program would ensure that doses are reduced to levels that are as low as reasonably achievable.
Source: DOE 1996a:4-357.

Hazardous Chemical Impacts. The hazardous chemical impacts of the No Action Alternative would be the same as those of current site operations. The Hazard Index for the MEI from normal operations at RFETS would be 1×10^{-3}, which indicates that adverse, noncancer health effects should not occur; the cancer risk is expected to be 2×10^{-8}. The Hazard Index for the onsite worker would be 1×10^{-2}, which also suggests that noncancer effects are not expected; the cancer risk is expected to be 2×10^{-6} (DOE 1996a:4-357).

4.2.5 Facility Accidents

The facilities involved in plutonium storage under the No Action Alternative are operated in accordance with DOE orders, which ensure that the risk to the public of prompt fatalities due to accidents, or cancer fatalities due to operations are minimized. The safety of workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in a Safety Analysis Report (SAR) or a Basis for Interim Operations (BIO) document prepared and maintained specifically for a facility or a process within a facility. Under these controls, any change in approved operations or facilities could curtail operations until it can be established that worker and public safety has not been compromised.

4.2.5.1 Hanford

The *Plutonium Finishing Plant Safety Analysis Report* (WHC-SD-CP-SAR-021) analyzes a wide spectrum of accidents that are primarily associated with processing rather than vault storage. This is because a release from a vault would require more severe accident conditions than are normally analyzed in a SAR. The accidents in the SAR consist of potential process accidents such as fires, explosions, and criticality as well as an externally initiated aircraft crash and earthquake. An estimate of the effects of potential accidents in the existing storage vault at Hanford can be derived from similar storage accidents that have been postulated for an upgraded storage facility. A severe-consequence, low-frequency accident for storage under the No Action Alternative would be a beyond-design-basis earthquake. If this accident were to occur, there would be an estimated 0.12 LCF in the offsite population within 80 km (50 mi). The estimated frequency of the earthquake with sufficient damage to cause a release is 1.0×10^{-7} per year. Consistent with the treatment of beyond-design-basis earthquake in this SPD EIS, this corresponds to a frequency in the range from extremely unlikely to beyond extremely unlikely. For the MEI and noninvolved worker, there would be latent cancer fatality (LCF) probabilities of 1.7×10^{-5} and 2.2×10^{-3}, respectively. A potentially more frequent accident is penetration of the primary containment vessel caused by corrosion. If this accident were to occur, the estimated number of cancer fatalities in the offsite population would be 1.3×10^{-3}. The estimated frequency of this accident is 6.4×10^{-3} per year, which corresponds to a frequency of unlikely. For the MEI and noninvolved worker, the corresponding LCF probabilities would be 1.8×10^{-7} and 1.8×10^{-5}, respectively.

4.2.5.2 INEEL

The *Final Safety Analysis Report for the Fuel Manufacturing Facility, Building 704* (ANL-IFR-57) and the *Final Safety Analysis Report of the Zero Power Plutonium Reactor Facility* at ANL–W analyzed a wide spectrum of design basis accidents. These studies indicate that these facilities are low hazard based on the effects of design basis accidents. However, these studies do not normally analyze the effects of severe accidents. An estimate of the effects of potential severe accidents in the existing storage vault at INEEL can be derived from similar storage accidents that have been postulated for an upgraded storage facility. A severe-consequence, low-frequency accident for storage under the No Action Alternative would be a beyond-design-basis earthquake. If this accident were to occur, there would be an estimated 0.33 LCF in the offsite population within 80 km (50 mi). The estimated frequency of the earthquake with sufficient damage to cause a release is 1.0×10^{-7} per year. Consistent with the treatment of beyond-design-basis earthquake in this SPD EIS, this corresponds to a frequency in the range from extremely unlikely to beyond extremely unlikely. For the MEI and noninvolved worker, there would be LCF probabilities of 9.8×10^{-4} and 2.0×10^{-2}, respectively. A potentially more frequent accident is penetration of the primary containment vessel caused by corrosion. If this accident were to occur, the estimated number of LCFs in the offsite population would be 5.1×10^{-4}. The estimated frequency of this accident is 6.4×10^{-2} per year, which corresponds to a frequency of anticipated. For the MEI and noninvolved worker, the corresponding LCF probabilities would be 1.6×10^{-6} and 2.3×10^{-5}, respectively.

4.2.5.3 Pantex

Under the No Action Alternative, surplus plutonium pits would be stored at Pantex in upgraded facilities in Zone 12 South. The *Storage and Disposition Final PEIS* postulates a set of accidents involving upgraded storage of surplus plutonium pits that could result in releases of plutonium impacting noninvolved workers and the offsite population. For that set of accidents, the maximum consequences would be from beyond-design-basis earthquake (estimated probability of occurrence: 1.0×10^{-7} per year), which would cause an estimated 0.26 LCF in the population within 80 km (50 mi) of the Pantex site. In terms of the treatment of beyond-design-basis earthquakes in this SPD EIS, that figure corresponds to a frequency in the range of extremely unlikely to beyond extremely unlikely. For the MEI and the noninvolved worker, the LCF probabilities would be 1.7×10^{-3} and 4.7×10^{-3}, respectively. A potentially more frequent accident is penetration of the primary containment vessel caused by corrosion, which would result in an estimated 4.4×10^{-4} LCF in the offsite population. The estimated frequency of this accident is 4.0×10^{-2} per year, which corresponds to a frequency of anticipated. For the MEI and noninvolved worker, the corresponding LCF probabilities would be 2.9×10^{-6} and 7.2×10^{-6}, respectively.

4.2.5.4 SRS

Under the No Action Alternative, plutonium would be stored at SRS in a modified APSF. This modification should result in a reduced risk of accidents to workers and the public. Design modifications of the storage facility would ensure that the continued storage of plutonium is in accordance with contemporary DOE orders and applicable regulations, and that the risks to the public of prompt fatalities due to accidents and of LCFs due to operations are minimized. The safety of workers and the public during operations would be routinely controlled through Technical Safety Requirements specified in approved safety analyses for SRS facilities.

The *Storage and Disposition Final PEIS* postulates a set of accidents involving storage of plutonium pits that could result in releases of plutonium impacting noninvolved workers and the offsite population. For that set of accidents, the maximum consequences would be from a beyond-design-basis earthquake (estimated probability of occurrence: 1.0×10^{-7} per year), which would cause an estimated 0.098 LCF in the population within 80 km (50 mi) of SRS. In terms of the treatment of beyond-design-basis earthquakes in this SPD EIS, that figure corresponds to a frequency in the range from extremely unlikely to beyond extremely unlikely. For the MEI and the noninvolved worker, the LCF probabilities would be 2.0×10^{-5} and 9.8×10^{-4}, respectively. A potentially more frequent accident is penetration of the primary containment vessel caused by corrosion, which would result in an estimated 1.4×10^{-3} LCF in the offsite population. The estimated frequency of this accident is 4.8×10^{-3} per year, which corresponds to a frequency of unlikely. For the MEI and noninvolved worker, the corresponding LCF probabilities would be 2.9×10^{-7} and 1.2×10^{-5}, respectively.

4.2.5.5 LANL

Under the No Action Alternative, plutonium would continue to be stored at the site in existing facilities. These facilities currently operate in accordance with DOE orders that ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations are minimized. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in a SAR or BIO document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities could curtail operations until it can be established that worker and public safety has not been compromised.

4.2.5.6 RFETS

Under the No Action Alternative, plutonium pits would no longer be stored at the site, but other nonpit plutonium material would continue to be stored in existing facilities. These facilities currently operate in accordance with DOE orders that ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations are minimized. The safety to workers and the public from accidents at existing facilities is also controlled by technical safety requirements specified in detail in a SAR or BIO document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities could curtail operations until it can be established that worker and public safety has not been compromised.

4.2.6 Transportation

As the No Action Alternative would involve no intersite transportation of radioactive materials between any of the candidate sites, no transportation impacts would be expected if this alternative were implemented.

4.2.7 Environmental Justice

4.2.7.1 Hanford

As discussed in other parts of Section 4.2, operations conducted under the No Action Alternative would pose no significant health or other environmental risks to the public. The likelihood of an LCF for the MEI over 50 years of storage would be approximately 1 in 100 million, and the expected number of LCFs among the general population residing in the potentially affected area would be 1.2×10^{-3} (see Table 4–7). Radiological and nonradiological risks posed by implementation of the No Action Alternative would be small regardless of the racial and ethnic composition of the population, and independent of the economic status of individuals comprising the population. Operation of storage facilities at Hanford under the No Action Alternative would have no disproportionately high and adverse effects on minority or low-income populations.

4.2.7.2 INEEL

As discussed in other parts of Section 4.2, operations conducted at INEEL under the No Action Alternative would pose no significant health or other environmental risks to the public. The likelihood of an LCF for the

MEI over 50 years of storage would be essentially zero, and the expected number of LCFs among the general population residing in the potentially affected area would be 1.9×10^{-6} (see Table 4–9). Radiological and nonradiological risks posed by implementation of the No Action Alternative would be small regardless of the racial and ethnic composition of the population, and independent of the economic status of individuals comprising the population. Operation of storage facilities at INEEL under the No Action Alternative would have no disproportionately high and adverse effects on minority or low-income populations.

4.2.7.3 Pantex

As discussed in other parts of Section 4.2, operations conducted at Pantex under the No Action Alternative would pose no significant health or other environmental risks to the public. The likelihood of an LCF for the MEI over 50 years of storage would be essentially zero, and the expected number of LCFs among the general population residing in the potentially affected area would be 1.6×10^{-7} (see Table 4–11). Radiological and nonradiological risks posed by implementation of the No Action Alternative would be small regardless of the racial and ethnic composition of the population, and independent of the economic status of individuals comprising the population. Operation of storage facilities at Pantex under the No Action Alternative would have no disproportionately high and adverse effects on minority or low-income populations.

4.2.7.4 SRS

As discussed in other parts of Section 4.2, operations conducted at SRS under the No Action Alternative would pose no significant health or other environmental risks to the public. The likelihood of an LCF for the MEI over 50 years of storage would be essentially zero, and the expected number of LCFs among the general population residing in the potentially affected area would be 7.2×10^{-6} (see Table 4–13). Radiological and nonradiological risks posed by implementation of the No Action Alternative would be small regardless of the racial and ethnic composition of the population, and independent of the economic status of individuals comprising the population. Operation of storage facilities at SRS under the No Action Alternative would have no disproportionately high and adverse effects on minority or low-income populations.

4.2.7.5 LANL

As discussed in other parts of Section 4.2, operations conducted under the No Action Alternative would pose no significant health or other environmental risks to the public. The likelihood of an LCF for the MEI would be approximately 1.6×10^{-4}, and the expected number of LCFs among the general population residing in the potentially affected area would be 6.8×10^{-2} (see Table 4–15). Radiological and nonradiological risks posed by implementation of the No Action Alternative would be small independent of the racial and ethnic composition of the population, and independent of the economic status of individuals comprising the population. Operation of storage facilities at LANL under the No Action Alternative would have no disproportionately high and adverse effects on minority or low-income populations.

4.2.7.6 RFETS

As discussed in other parts of Section 4.2, operations conducted under the No Action Alternative would pose no significant health or other environmental risks to the public. The likelihood of an LCF for the MEI over 50 years of storage would be approximately 1.2×10^{-5}, and the expected number of LCFs among the general population residing in the potentially affected area would be 2.5×10^{-3} (see Table 4–17). Radiological and nonradiological risks posed by implementation of the No Action Alternative would be small independent of the racial and ethnic composition of the population, and independent of the economic status of individuals comprising the population. Operation of storage facilities at RFETS under the No Action Alternative would have no disproportionately high and adverse effects on minority or low-income populations.

4.2.8 Geology and Soils

4.2.8.1 Hanford

Continued storage of surplus plutonium, or the No Action Alternative, at Hanford would have no additional impacts on the geologic or soils resources. In the *Storage and Disposition Final PEIS*, hazards from the large-scale geologic conditions were analyzed in detail. The analysis determined that these hazards present an acceptable risk to long-term storage facilities; this decision is not revisited in this SPD EIS. More detailed descriptions of the impacts of the potential geologic hazards at Hanford are included in the *Storage and Disposition Final PEIS* (DOE 1996a:4-45–4-47). Potential effects of accidents initiated by natural phenomena such as earthquakes are discussed in Section 4.2.5.1.

Because no ground-disturbing activities would be needed for the No Action Alternative at Hanford, the soil attributes at current facility locations are inconsequential. Continued storage of surplus plutonium would not impact available geologic resources. Other than crushed rock, sand, and gravel, no economically viable geologic resources have been identified at Hanford. No soils at Hanford are currently classified as prime farmland.

4.2.8.2 INEEL

Continued storage of surplus plutonium, or the No Action Alternative, at INEEL would have no additional impacts on the geologic or soils resources. In the *Storage and Disposition Final PEIS*, hazards from the large-scale geologic conditions were analyzed in detail. The analysis determined that these hazards present an acceptable risk to long-term storage facilities; this decision is not revisited in this SPD EIS. More detailed descriptions of the impacts of the potential geologic hazards at INEEL are included in the *Storage and Disposition Final PEIS* (DOE 1996a:4-148–4-150). Potential effects of accidents initiated by natural phenomena such as earthquakes are discussed in Section 4.2.5.2.

Because no ground-disturbing activities would be needed for the No Action Alternative at INEEL, the soil attributes at current facility locations are inconsequential. Continued storage of surplus plutonium would not impact available geologic resources. Other than sand, gravel, and pumice, no economically viable geologic resources have been identified at INEEL. No soils at INEEL are currently classified as prime farmland.

4.2.8.3 Pantex

Continued storage of surplus plutonium, or the No Action Alternative, at Pantex would have no additional impacts on the geologic or soils resources. In the *Storage and Disposition Final PEIS*, hazards from the large-scale geologic conditions were analyzed in detail. The analysis determined that these hazards present an acceptable risk to long-term storage facilities; this decision is not revisited in this SPD EIS. More detailed descriptions of the impacts of the potential geologic hazards at Pantex are included in the *Storage and Disposition Final PEIS* (DOE 1996a:4-204–4-206). Potential effects of accidents initiated by natural phenomena such as earthquakes are discussed in Section 4.2.5.3.

Modifying Zone 12 to provide for continued plutonium storage was determined to have no direct or indirect effects on geologic resources (DOE 1996a:4-204). No economically viable geologic resources have been identified at Pantex. Pantex is underlain by soils of the Pullman-Randall association. The Pullman soil is classified as prime farmland. Pantex is exempt from the Farmland Protection Policy Act (FPPA) under Section 1540(c)(4) (7 U.S.C. SS4201) because the acquisition of Pantex property occurred prior to the FPPA effective date of June 22, 1982 (DOE 1996a:3-148).

4.2.8.4 SRS

Continued storage of surplus plutonium, or the No Action Alternative, at SRS would have no additional impacts on the geologic or soils resources. In the *Storage and Disposition Final PEIS*, hazards from the large-scale geologic conditions were analyzed in detail. The analysis determined that these hazards present an acceptable risk to long-term storage facilities; this decision is not revisited in this SPD EIS. More detailed descriptions of the impacts of the potential geologic hazards at SRS are included in the *Storage and Disposition Final PEIS* (DOE 1996a:4-309–4-311). Potential effects of accidents initiated by natural phenomena such as earthquakes are discussed in Section 4.2.5.4.

Because no ground-disturbing activities beyond those analyzed in the *Storage and Disposition Final PEIS* would be needed for the No Action Alternative at SRS, the soil attributes at current facility locations are inconsequential. Continued storage of surplus plutonium would not impact available geological resources. No economically viable geologic resources have been identified at SRS. No soils at SRS are currently classified as prime farmlands.

4.2.8.5 LANL

Continued storage of surplus plutonium, or the No Action Alternative, at LANL would have no additional impacts on the geologic or soils resources. In the *Storage and Disposition Final PEIS*, hazards from the large-scale geologic conditions were analyzed in detail. The analysis determined that these hazards present an acceptable risk to long-term storage facilities; this decision is not revisited in this SPD EIS. More detailed descriptions of the impacts of the potential geological hazards at LANL are included in the *Storage and Disposition Final PEIS* (DOE 1996a:4-371). Potential effects of accidents initiated by natural phenomena such as earthquakes are discussed in Section 4.2.5.5.

Because no ground-disturbing activities would be needed for the No Action Alternative at LANL, the soil attributes at current facility locations are inconsequential. Continued storage of surplus plutonium would not impact available geological resources. No economically viable geologic resources have been identified at LANL. No soils at LANL are currently classified as prime farmland.

4.2.8.6 RFETS

Continued storage of surplus plutonium, or the No Action Alternative, at RFETS would have no additional impacts on the geologic or soils resources. In the *Storage and Disposition Final PEIS*, hazards from the large-scale geologic conditions were analyzed in detail. The analysis determined that these hazards present an acceptable risk to long-term storage facilities; this decision is not revisited in this SPD EIS. More detailed descriptions of the impacts of the potential geological hazards at RFETS are included in the *Storage and Disposition Final PEIS* (DOE 1996a:4-350). Potential effects of accidents initiated by natural phenomena such as earthquakes are discussed in Section 4.2.5.6.

Because no ground-disturbing activities would be needed for the No Action Alternative at RFETS, the soil attributes at current facility locations are inconsequential. Continued storage of surplus plutonium would not impact available geological resources. No economically viable geologic resources have been identified at RFETS. No soils at RFETS are currently classified as prime farmland.

4.2.9 Water Resources

4.2.9.1 Hanford

The *Storage and Disposition Final PEIS* found that surface water withdrawals from the Columbia River are not expected to increase from the current usage of 13.5 billion l/yr (3.6 billion gal/yr). Restoration programs would continue, and water quality should improve. No additional impacts on groundwater are anticipated (DOE 1996a:4-39).

4.2.9.2 INEEL

The *Storage and Disposition Final PEIS* found that construction and operation of long-term storage facilities at INEEL would not affect water resources. No surface water would be used for construction and normal operation of these facilities. No additional impacts on groundwater are anticipated. Current groundwater use should decrease, and existing tritium plumes in groundwater, including perched groundwater, should continue to migrate southwest. Studies show that water withdrawals could change the existing plumes' direction to the east (DOE 1996a:4-143).

4.2.9.3 Pantex

The *Storage and Disposition Final PEIS* found that no demands on surface waters would occur. Because surface water is not used, there would be no impact on surface water availability or quality (DOE 1996a:4-198). The analysis also found that as baseline conditions and operations continued, groundwater usage would decrease from 836 million l/yr (221 million gal/yr) to 249 million l/yr (65.7 million gal/yr) by 2005. Groundwater would continue to be withdrawn from the Ogallala aquifer from wells on the Pantex property. Groundwater restoration activities would continue, including pump, treatment, and reinjection activities (DOE 1996a:4-198).

4.2.9.4 SRS

The *Storage and Disposition Final PEIS* found that surface water withdrawals from the Savannah River will decrease from 140.4 billion l/yr (37.1 billion gal/yr) to 127 billion l/yr (33.6 billion gal/yr) by 2005. As a result, the analysis concluded water quality would improve. The analysis also found that additional withdrawals to support long-term storage facilities at SRS would have minimal impacts on regional groundwater levels. Water requirements to support these facilities were expected to represent much less than 1 percent of projected annual withdrawals (DOE 1996a:4-306).

4.2.9.5 LANL

The *Storage and Disposition Final PEIS* found that construction and operation of long-term storage facilities at LANL would not affect water resources. No surface water would be used for construction and normal operation of these facilities. No additional impacts on groundwater are expected (DOE 1996a:4-369–370).

4.2.9.6 RFETS

The *Storage and Disposition Final PEIS* found that construction and operation of long-term storage facilities at RFETS would not affect water resources. No surface water would be used for construction and normal operation of these facilities. No additional impacts on groundwater are expected (DOE 1996a:4-348–349).

4.2.10 Ecological Resources

4.2.10.1 Hanford

Under the No Action Alternative, there would not be any construction or demolition of buildings, and any modifications required to ensure safe storage would not result in any appreciable change to current conditions. Because no new construction would occur, the No Action Alternative would have no impact on ecological resources, including terrestrial and aquatic resources, wetlands, and threatened and endangered species.

4.2.10.2 INEEL

Under the No Action Alternative, there would not be any construction or demolition of buildings, and any modifications required to ensure safe storage would not result in any appreciable change to current conditions. Because no new construction would occur, the No Action Alternative would have no impact on ecological resources, including terrestrial and aquatic resources, wetlands, and threatened and endangered species.

4.2.10.3 Pantex

Under the No Action Alternative, Zone 12 facilities would be upgraded to provide for continued storage of surplus plutonium materials. The *Storage and Disposition Final PEIS* (DOE 1996a:4-207) determined that upgrading these facilities would cause minimal disturbance of biological resources. The baseline resources described in Chapter 3 are the existing biotic conditions.

4.2.10.4 SRS

In accordance with the ROD (December 12, 1995) for the *Final EIS, Interim Management of Nuclear Materials*, DOE is planning to construct a new APSF in F-Area. This facility would enable SRS to stabilize and package plutonium metals and oxides to meet storage criteria and to provide space for storage of all plutonium and special actinide materials. Construction of APSF is expected to be completed by 2001; environmental consequences from this action are documented in the associated EIS (DOE 1995b).

4.2.10.5 LANL

Under the No Action Alternative, there would not be any construction or demolition of buildings, and any modifications required to ensure safe storage would not result in any appreciable change to current conditions. Because no new construction would occur, the No Action Alternative would have no impact on ecological resources, including terrestrial and aquatic resources, wetlands, and threatened and endangered species.

4.2.10.6 RFETS

Under the No Action Alternative, there would not be any construction or demolition of buildings, and any modifications required to ensure safe storage would not result in any appreciable change to current conditions. Because no new construction would occur, the No Action Alternative would have no impact on ecological resources, including terrestrial and aquatic resources, wetlands, and threatened and endangered species.

4.2.11 Cultural and Paleontological Resources

4.2.11.1 Hanford

Under the No Action Alternative, DOE would continue storage of plutonium material in the Plutonium Finishing Plant (PFP) in stabilized forms pursuant to Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94–1. Any impacts on cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate regulatory compliance procedures and consultations (DOE 1996a:4-51).

4.2.11.2 INEEL

Under the No Action Alternative, DOE would continue storage of plutonium material at ANL–W ZPPR and FMF vaults in stabilized forms pursuant to DNFSB Recommendation 94–1. Any impacts on cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate regulatory compliance procedures and consultations (DOE 1996a:4-154).

4.2.11.3 Pantex

Under the No Action Alternative, Zone 12 facilities would be upgraded to provide for continued storage of surplus plutonium materials. Impacts on cultural or paleontological resources should be minimal. Any impacts on cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate regulatory compliance procedures and consultations (DOE 1996a:4-209).

4.2.11.4 SRS

Under the No Action Alternative, DOE would continue storage of plutonium material in F-Area in stabilized forms pursuant to DNFSB Recommendation 94–1. Any impacts on cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate regulatory compliance procedures and consultations (DOE 1996a:4-315).

4.2.11.5 LANL

Under the No Action Alternative, DOE would continue storage of plutonium material in NMSF in stabilized form pursuant to DNFSB Recommendation 94–1. Any impacts on cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate regulatory compliance procedures and consultations (DOE 1996a:4-373).

4.2.11.6 RFETS

Under the No Action Alternative, DOE would continue storage of plutonium material in a existing facilities in stabilized form pursuant to DNFSB Recommendation 94–1. Any impacts on cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate regulatory compliance procedures and consultations (DOE 1996a:4-352).

4.2.12 Land Use and Visual Resources

With the exception of Pantex, where Zone 12 facilities would be upgraded to provide for continued storage of surplus plutonium materials, there would not be a change in existing land use at any of the sites. This construction would take place on previously disturbed land, and therefore would not cause a major change in any existing land-use plans at the site.

4.2.13 Infrastructure

4.2.13.1 Hanford

The current infrastructure at Hanford is capable of supporting all anticipated missions and functions associated with the No Action Alternative. However, certain actions under that alternative could result in changes to the site infrastructure, but they are not expected to result in any major impact. For instance, upgrades of PFP and support services and utilities could be required to complete stabilization and packaging activities for the current inventory of weapons-usable plutonium. Further detailed discussion on Hanford infrastructure can be found in the *Storage and Disposition Final PEIS* (DOE 1996a:4-29).

4.2.13.2 INEEL

The INEEL infrastructure would, without major modifications, be capable of supporting all anticipated missions and functions associated with the No Action Alternative. No major site infrastructure changes would be required. Detailed data on INEEL infrastructure are presented in the *Storage and Disposition Final PEIS* (DOE 1996a:4-134, 4-135).

4.2.13.3 Pantex

The Pantex infrastructure would be capable of supporting all anticipated missions and functions associated with the No Action Alternative. No major site infrastructure changes are required. Detailed data on Pantex infrastructure are presented in the *Storage and Disposition Final PEIS* (DOE 1996a:4-295, 4-296).

4.2.13.4 SRS

The SRS infrastructure would be capable of supporting all anticipated missions and functions associated with the No Action Alternative. No major site infrastructure changes are required. Detailed data on SRS infrastructure are presented in the *Storage and Disposition Final PEIS* (DOE 1996a:4-186, 4-187).

4.2.13.5 LANL

The LANL infrastructure would be capable of supporting all anticipated missions and functions associated with the No Action Alternative. No major infrastructure changes are required. Detailed data on LANL infrastructure are presented in the *Storage and Disposition Final PEIS* (DOE 1996a:4-365).

4.2.13.6 RFETS

The RFETS infrastructure would be capable of supporting all anticipated missions and functions associated with the No Action Alternative. No major infrastructure changes are required. Detailed data on RFETS infrastructure are presented in the *Storage and Disposition Final PEIS* (DOE 1996a:4-345).

Next Section

4.3 ALTERNATIVE 2

Alternative 2 would involve constructing and operating all three facilities for surplus plutonium disposition at Hanford. The pit conversion and immobilization facilities would be located in the existing Fuels and Materials Examination Facility (FMEF) building, and the MOX facility, in a new building near FMEF in the 400 Area.

4.3.1 Construction

4.3.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 2 at Hanford include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from Hanford construction activities, with standards and guidelines is presented as Table 4–19. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat from current emissions during the planned construction period because of an expected decrease in overall site employment.

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 1-dB increase in noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by the Occupational Safety and Health Administration (OSHA) in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

Table 4–19. Evaluation of Air Pollutant Concentrations Associated With Construction Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.39	35.5	0.36
	1 hour	40,000	9.43	57.7	0.14
Nitrogen dioxide	Annual	100	0.107	0.357	0.36
PM_{10}	Annual	50	0.0891	0.107	0.21
	24 hours	150	3.03	3.8	2.5
Sulfur dioxide	Annual	50	0.0101	1.64	3.2
	24 hours	260	0.112	9.02	3.4
	3 hours	1,300	0.765	30.4	2.3
	1 hour	700	2.30	35.2	5.4
Other regulated pollutants					
Total suspended particulates	Annual	60	0.182	0.20	0.33
	24 hours	150	5.66	6.43	4.3
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0.000008	0.000014	0.012

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

4.3.1.2 Waste Management

Table 4–20 compares the wastes generated during construction of surplus plutonium disposition facilities at Hanford with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during construction. Nonradioactive wastes generated during construction would be the responsibility of the construction contractor and would be managed in accordance with existing procedures largely at offsite facilities. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario.

Hazardous wastes generated during construction of surplus plutonium disposition facilities would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in containers approved by the U.S. Department of Transportation (DOT) and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities would be packaged in conformance with standard industrial practice, for recycling or disposal largely at offsite

Table 4–20. Potential Waste Management Impacts of Construction Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	28	NA	NA	NA
Nonhazardous				
Liquid	18,900	8[c]	NA	8[d]
Solid	998	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of 400 Area sanitary sewer.
[d] Percent of capacity of the WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); WPPSS, Washington Public Power Supply System.

facilities. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Hanford.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of surplus plutonium disposition facilities would be managed at the Washington Public Power Supply System (WPPSS) Sewage Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 8 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and 8 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, management of these wastes at Hanford should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.3.1.3 Socioeconomics

Construction-related employment requirements under Alternative 2 would be as indicated in Table 4–21.

Table 4–21. Construction Employment Requirements for Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Year	Pit Conversion	Immobilization	MOX	Total
2001	77	0	0	77
2002	116	167	290	573
2003	71	268	508	847
2004	0	236	334	570
2005	0	0	170	170
2006	0	0	160	160

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: UC 1998a, 1998b, 1998c, 1998d.

At its peak in 2003, construction of the three new plutonium disposition facilities at Hanford under this alternative would require 847 construction workers and should generate another 869 indirect jobs in the region. As this total increase of 1,716 direct and indirect jobs represents less than 0.5 percent of the projected regional economic area (REA) workforce, it should have no major impact on the REA. Moreover, it should have little effect on the community services currently offered in the region of influence (ROI). In fact, it should help offset the 15 percent reduction in Hanford's total workforce (i.e., from 12,900 to 11,000 workers) projected for the years 1997–2005.

4.3.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. According to the results of recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at Hanford under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

4.3.1.5 Facility Accidents

Plutonium disposition construction activities at Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,397 person-years of construction labor and standard industrial accident rates, approximately 240 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.3.1.6 Environmental Justice

As discussed in other parts of Section 4.3.1, construction under Alternative 2 would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities at Hanford under Alternative 2 would have no significant impacts on minority or low-income populations.

4.3.2 Operations

4.3.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 2 at Hanford were analyzed using the Industrial Source Computer Short-Term Model Version 3 (ISCST3). Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from plutonium disposition facilities, with standards and guidelines is presented as Table 4–22. Concentrations for immobilization in the ceramic form are presented because they would be greater than those for the glass form. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during operation would

Table 4–22. Evaluation of Air Pollutant Concentrations Associated With Operations Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.53	34.6	0.35
	1 hour	40,000	3.29	51.6	0.13
Nitrogen dioxide	Annual	100	0.046	0.296	0.30
PM_{10}	Annual	50	0.0025	0.0204	0.041
	24 hours	150	0.0278	0.798	0.53
Sulfur dioxide	Annual	50	0.00222	1.63	3.1
	24 hours	260	0.0247	8.94	3.4
	3 hours	1,300	0.168	29.8	2.3
	1 hour	700	0.504	33.4	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.0025	0.0204	0.034
	24 hours	150	0.0278	0.798	0.53
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	420	0.0406	0.0406	0.010

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; WDEC 1994.

be mitigated; for example, high-efficiency particulate air (HEPA) filtration has been included in the design of these facilities.

For a discussion of how the operation of these facilities would affect the site's ability to continue to meet limits of the National Emission Standards for Hazardous Air Pollutants (NESHAP) regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAP limits applicable to operation of these facilities.

The increased concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of these facilities would be a small fraction of the Prevention of Significant Deterioration (PSD) Class II area increments as summarized in Table 4–23.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

The combustion of fossil fuels associated with Alternative 2 would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 5×10^{-6} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or

Table 4–23. Evaluation of Air Pollutant Increases Associated With Operations Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.046	25	0.18
PM_{10}	Annual	0.0025	17	0.015
	24 hours	0.0278	30	0.093
Sulfur dioxide	Annual	0.00222	20	0.011
	24 hours	0.0247	91	0.027
	3 hours	0.168	512	0.033

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

4.3.2.2 Waste Management

Table 4–24 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at Hanford. Although high-level waste (HLW) would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016.

This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and

Table 4–24. Potential Waste Management Impacts of Operations Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	159	9	9	1 of WIPP
LLW	154	NA	NA	<1
Mixed LLW	4	<1	<1	<1
Hazardous	<33	NA	NA	NA
Nonhazardous				
Liquid	88,000	37[d]	NA	37[e]
Solid	<2,180	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of 400 Area sanitary sewer.
[e] Percent of capacity of WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant; WPPSS, Washington Public Power Supply System.

disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* that is being prepared by the DOE Richland Operations Office (DOE 1997c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRU Waste Package Transporter (TRUPACT) for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation at surplus plutonium disposition facilities is estimated to be 9 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,590 m^3 (2,080 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 9 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.23 ha (0.57 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at Hanford should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the new facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,540 m^3 (2,010 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) capacity of the LLW Burial Grounds and 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480 m^3/ha disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,540 m^3

(2,010 yd^3) of waste would require 0.44-ha (1.1 acres) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Mixed LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

If all TRU waste and mixed LLW generated at the surplus plutonium disposition facilities were processed in the Waste Receiving and Processing Facility, this additional waste would be 9 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of that facility.

Any hazardous wastes generated during operation would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operation period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous wastewater would be treated if necessary before being discharged to the 400 Area sanitary sewer system, which connects to the WPPSS Sewage Treatment Facility. Nonhazardous-liquid-waste generation at surplus plutonium disposition facilities is estimated to be 37 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 37 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility, and within the 138,000 m^3/yr (181,000 yd^3/yr) excess capacity of the WPPSS Sewage Treatment Facility (Mecca 1997). Therefore, management of nonhazardous liquid waste at Hanford should not have a major impact on the treatment system.

4.3.2.3 Socioeconomics

After construction, startup, and testing of the Hanford plutonium disposition facilities in 2007 under Alternative 2, 1,014 additional workers would be required to operate them (UC 1998a, 1998b, 1998c, 1998d). This level of employment should generate another 2,567 indirect jobs in the region. As the total employment increase of 3,581 direct and indirect jobs represents less than 0.9 percent of the projected REA workforce, it should have no major impact on the REA. Some of the new jobs created under this alternative could be filled from the ranks of the unemployed, currently 11 percent of the REA's population.

The total employment requirement could have minor impacts on community services in the ROI, as it should coincide with an increase in overall site employment at Hanford in connection with construction of the tank waste remediation system. Assuming that 91 percent of the new employees associated with this alternative would reside in the ROI, the 3,259 new jobs would increase the region's population by approximately 6,201 persons. This population increase, in conjunction with the normal population growth forecast by the State of Washington, would engender increased construction of local housing units. Given the current population-to-student ratio in the ROI, a population of this size would be expected to include 1,283 students, and local school districts would have to increase the number of classrooms to accommodate them.

Community services in the ROI would be expected to change to accommodate the population growth as follows: 80 teachers would be added to maintain the current student-to-teacher ratio of 16:1; 9 police officers would be added to maintain the current officer-to-population ratio of 1.6:1,000; 21 firefighters would be added to maintain the current firefighter-to-population ratio of 3.4:1,000; and 9 physicians would be added to maintain the current physician-to-population ratio of 1.4:1,000. Thus, an additional 119 positions would have to be created to maintain community services at current levels. Hospitals in the ROI would experience a drop from 2.1 to 2.0 beds per 1,000 persons unless additional beds were provided. Moreover, average school capacity would increase to 95.6 percent from the current 92.5 percent unless additional classrooms were built. None of these projected changes would have a major impact on the level of community services currently offered in the ROI.

4.3.2.4 Human Health Risk

During normal operation of the plutonium disposition facilities at Hanford, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows:

Radiological Impacts. Table 4–25 reflects the potential radiological impacts on three individual receptor groups: the population living within 80 km (50 mi) of Hanford in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate latent fatal cancer risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–25. Potential Radiological Impacts on the Public of Operations Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Impact	Pit Conversion	Immobilization: Ceramic	Immobilization: Glass	MOX	Total[a]
Population within 80 km for year 2010					
Dose (person-rem)	6.9	7.8×10^{-3}	7.1×10^{-3}	0.11	7.0
Percent of natural background[b]	5.9×10^{-3}	6.7×10^{-6}	6.1×10^{-6}	9.5×10^{-5}	6.0×10^{-3}
10-year latent fatal cancers	0.034	3.9×10^{-5}	3.6×10^{-5}	5.5×10^{-4}	0.035
Maximally exposed individual					
Annual dose (mrem)	0.017	1.1×10^{-4}	9.7×10^{-5}	1.8×10^{-3}	0.019
Percent of natural background[b]	5.7×10^{-3}	3.7×10^{-5}	3.2×10^{-5}	6.0×10^{-4}	6.3×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	5.5×10^{-10}	4.9×10^{-10}	9.0×10^{-9}	9.5×10^{-8}
Average exposed individual within 80 km[c]					
Annual dose (mrem)	0.017	2.0×10^{-5}	1.8×10^{-5}	2.8×10^{-4}	0.017
10-year latent fatal cancer risk	8.5×10^{-8}	1.0×10^{-10}	9.0×10^{-11}	1.4×10^{-9}	8.7×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from all three facilities. The total includes the higher of the values for the ceramic and glass immobilization alternatives.

[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Source: Appendix J.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 7.0 person-rem. The corresponding number of LCFs in this population from 10 years of operation would be 0.035. The dose to the maximally exposed member of the public from annual operation of all three facilities would be 0.019 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 9.5×10^{-8}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–26; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities would be an estimated 192, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–26. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and as-low-as-is-reasonably-achievable (ALARA) programs (which would include worker rotations).

Table 4–26. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	Total
Number of badged workers	383	258	350	991
Total dose (person-rem/yr)	192	194	175	561
10-year latent fatal cancers	0.77	0.77	0.70	2.2
Average worker dose (mrem/yr)	500	750	500	565[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.3×10^{-3}

[a] Represents an average of the doses for all three facilities.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998a, 1998b, 1998c, 1998d.

Hazardous Chemical Impacts. Ethylene glycol would likely be released as a result of operations at Hanford under this alternative. This chemical is considered to be toxic by EPA (1997c) because it has been found to produce kidney toxicity postingestion in studies with laboratory animals; however, it is not considered a carcinogen. The estimated dose of ambient ethylene glycol to the maximally exposed member of the public would be about 100,000 times lower than EPA-established Reference Dose (RfD) for this compound. The Hazard Index for ethylene glycol released as a result of operations at Hanford (9×10^{-6}) would be much lower than 1, indicating that adverse, noncancer health effects should not be incurred by the maximally exposed member of the public. No carcinogenic chemicals would be released as a result of operations.

4.3.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion, immobilization, and MOX facilities at Hanford are presented in Tables 4–27 through 4–30. Doses reported would not be exceeded in 95 percent of weather conditions. Accident scenarios analyzed include low-frequency/high-consequence design basis operational accidents and an extremely low-frequency/high-consequence beyond-design-basis accident involving a building collapse. For the purposes of this analysis, the accident was assumed to be a catastrophic earthquake. The accidents analyzed are representative of the spectrum of potential accidents; analyses of different accidents may be available in the past, ongoing, or future National Environmental Policy Act (NEPA) reviews or SARs.

Table 4–27. Accident Impacts of Pit Conversion Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Accident	Frequency (per year)	Dose to Noninvolved Worker[a] (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Fire	Unlikely	1.1×10^{-5}	4.3×10^{-9}	1.6×10^{-6}	8.1×10^{-10}	5.3×10^{-3}	2.6×10^{-6}
Explosion	Unlikely	2.8×10^{-3}	1.1×10^{-6}	4.2×10^{-4}	2.1×10^{-7}	1.4	6.8×10^{-4}
Leaks/spills of nuclear material	Extremely unlikely	3.9×10^{-6}	1.6×10^{-9}	5.9×10^{-7}	3.0×10^{-10}	1.9×10^{-3}	9.5×10^{-7}
Tritium release	Extremely unlikely	3.0×10^{-1}	1.2×10^{-4}	4.5×10^{-2}	2.3×10^{-5}	1.5×10^{2}	7.3×10^{-2}
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Design basis earthquake	Unlikely	3.5×10^{-4}	1.4×10^{-7}	5.2×10^{-5}	2.6×10^{-8}	1.7×10^{-1}	8.4×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-1}	4.3×10^{-5}	4.1×10^{-3}	2.0×10^{-6}	9.9	4.3×10^{-3}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	2.5×10^{2}	9.9×10^{-2}	9.4	4.7×10^{-3}	2.3×10^{4}	9.8

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: FMEF, Fuels and Materials Examination Facility.
Source: Calculated using the source terms in Table K–2 and the MACCS2 computer code.

More details on the method of analysis and specific accident scenarios are presented in Appendix F.5, and more details on the consequences are presented in Appendix K. Each accident type (e.g., fire, explosion) considered is expected to bound the consequences of a range of similar accidents with lower consequences and risk.

Table 4–28. Accident Impacts of Ceramic Immobilization Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	Unlikely	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	Unlikely	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Glovebox fire (sintering furnace)	Extremely unlikely	1.7×10^{-6}	6.8×10^{-10}	2.6×10^{-7}	1.3×10^{-10}	8.3×10^{-4}	4.1×10^{-7}
Design basis earthquake	Unlikely	4.3×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Beyond-design-basis fire	Beyond extremely unlikely	1.7×10^{-2}	6.8×10^{-6}	6.5×10^{-4}	3.2×10^{-7}	1.6	6.8×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	1.5×10^{2}	6.2×10^{-2}	5.8	2.9×10^{-3}	1.4×10^{4}	6.1

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: FMEF, Fuels and Materials Examination Facility; HYDOX, hydride oxidation.
Source: Calculated using the source terms in Table K–3 and the MACCS2 computer code.

Estimates of radiological consequences have been developed for the noninvolved worker and the MEI in the general population. Consequences are presented in terms of the radiological dose (in rem) and the probability that the dose would result in an LCF. The probability coefficients for determining the likelihood of fatal cancer, given a dose, are taken from the *1990 Recommendations of the International Commission on Radiation Protection* (ICRP 1991). For low doses or low dose rates, a probability coefficient of 4.0×10^{-4} LCF per rem is applied for workers, and 5.0×10^{-4} LCF per rem for the public. For high doses received at a high rate, probability coefficients of 8.0×10^{-4} and 1.0×10^{-3} LCF per rem are applied for workers and the public, respectively. These higher-probability coefficients apply for doses above 20 rem and dose rates above 10 rem per hour. At much higher doses, prompt fatalities rather than LCFs may be the primary concern.

The frequency listed for each accident category represents the estimated overall annual probability of occurrence for that type of accident. Because the estimated uncertainty of the accident frequencies is about a factor of 10 or more, the frequencies are characterized as anticipated, unlikely, extremely unlikely, and

Table 4–29. Accident Impacts of Glass Immobilization Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	Unlikely	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	Unlikely	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Melter eruption	Unlikely	1.6×10^{-6}	6.3×10^{-10}	2.4×10^{-7}	1.2×10^{-10}	7.7×10^{-4}	3.8×10^{-7}
Melter spill	Unlikely	3.7×10^{-7}	1.5×10^{-10}	5.6×10^{-8}	2.8×10^{-11}	1.8×10^{-4}	9.0×10^{-8}
Design basis earthquake	Unlikely	3.7×10^{-4}	1.5×10^{-7}	5.6×10^{-5}	2.8×10^{-8}	1.8×10^{-1}	9.1×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	3.1×10^{-3}	1.2×10^{-6}	1.2×10^{-4}	5.8×10^{-8}	2.8×10^{-1}	1.2×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	1.4×10^{2}	5.4×10^{-2}	5.1	2.6×10^{-3}	1.2×10^{4}	5.4

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: FMEF, Fuels and Materials Examination Facility; HYDOX, hydride oxidation.
Source: Calculated using the source terms in Table K–4 and the MACCS2 computer code.

beyond extremely unlikely, representing estimated frequency ranges of greater than 10^{-2}, 10^{-2} to 10^{-4}, 10^{-4} to 10^{-6}, and less than 10^{-6} per year, respectively.

Public. The most severe consequences of a design basis accident for the pit conversion facility would be associated with a tritium release; the most severe for the immobilization and MOX facilities, a nuclear criticality. Bounding radiological consequences for the MEI are from the tritium release, which would result in a dose of 0.045 rem, corresponding to an LCF probability of 2.3×10^{-5}. A nuclear criticality of 10^{19} fissions would result in an MEI dose of 3.4×10^{-3} rem at the immobilization facility and 5.7×10^{-3} rem at the MOX facility. Consequences of the tritium release for the general population in the environs of Hanford would include an estimated 0.073 LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

The combined radiological effects from total collapse of all three facilities in the beyond-design-basis earthquake would be approximately 39 LCFs. It should be emphasized that a seismic event of sufficient

Table 4–30. Accident Impacts of MOX Facility Under Alternative 2: Pit Conversion in FMEF, Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	9.1×10^{-2}	3.6×10^{-5}	5.7×10^{-3}	2.8×10^{-6}	7.6	3.7×10^{-3}
Explosion in sintering furnace	Extremely unlikely	2.9×10^{-3}	1.2×10^{-6}	1.1×10^{-4}	5.7×10^{-8}	3.2×10^{-1}	1.4×10^{-4}
Fire	Extremely unlikely	1.8×10^{-5}	7.1×10^{-9}	7.0×10^{-7}	3.5×10^{-10}	2.0×10^{-3}	8.6×10^{-7}
Design basis earthquake	Unlikely	4.1×10^{-4}	1.7×10^{-7}	1.6×10^{-5}	8.2×10^{-9}	4.6×10^{-2}	2.0×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	6.1×10^{-2}	2.4×10^{-5}	2.3×10^{-3}	1.1×10^{-6}	5.6	2.4×10^{-3}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.7×10^{2}	2.3×10^{-1}	2.2×10^{1}	1.1×10^{-2}	5.3×10^{4}	2.3×10^{1}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Source: Calculated using the source terms in Table K–8 and the MACCS2 computer code.

magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. A worker closer than 1,000 m (3,281 ft) from the accident would generally receive a higher dose; a worker farther away, a lower one. At some sites where the distance to the site boundary is less than 1,000 m (3,281 ft), the worker is assumed to be at the site boundary. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 1.2×10^{-4}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 10,779 person-years of labor and the standard DOE occupational accident rates, approximately 345 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.3.2.6 Transportation

Operational transportation impacts may be divided into two parts: impacts due to incident-free transportation and those due to transportation accidents. They may be further divided into: nonradiological and radiological impacts. Nonradiological impacts are specifically vehicular, such as vehicular emissions and traffic accidents. Radiological impacts are those related to the dose received by transportation workers and the public during normal operations and in the case of accidents in which the radioactive materials being shipped may be released. For more detailed information on the transportation analysis performed for this SPD EIS, see Appendix L.

Under Alternative 2, transportation to and from Hanford would include the classified shipment of plutonium pits and clean plutonium metal via safe, secure trailer (SST) from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some highly enriched uranium (HEU) and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to Oak Ridge Reservation (ORR) for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at Hanford for fabrication into MOX fuel pellets.

MOX fuel fabrication also requires uranium dioxide. Quantifying the uranium dioxide transportation requirements for this SPD EIS involved selecting representative sites for depleted uranium hexafluoride conversion. The actual sites will be determined by the MOX fuel manufacturer. A DOE enrichment facility near Portsmouth, Ohio, was chosen as a representative site for the source of the depleted uranium hexafluoride, and the nuclear fuel fabrication facility in Wilmington, North Carolina, as representative of a uranium conversion facility. These sites were also used as representative sites in the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE 1996d). It is assumed that depleted uranium hexafluoride would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide. After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at Hanford. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at Hanford under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at Hanford. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to the high-level-waste vitrification facility (HLWVF) in the 200 Area. This intrasite transportation—from 400 Area to 200 Area—could require the temporary shutdown of roads on the Hanford site. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at HLWVF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 2. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.3.1.2 and 4.3.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In all, approximately 2,300 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 6.7 million km (4.2 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 26 person-rem; the dose to the public, 38 person-rem. Accordingly, incident–free transportation of radioactive material associated with this alternative would result in 0.010 LCF among transportation workers and 0.019 LCF in the total affected population over the duration of the transportation activities. (LCFs associated with radiological releases were estimated by multiplying the occupational [worker] dose by 4.0×10^{-4} cancer per person-rem of exposure, and the public accident and accident-free doses by 5.0×10^{-4} cancer per person-rem of exposure [ICRP 1991].) The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.019.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of plutonium pits from one of DOE's storage locations to the pit conversion facility with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. The accident could result in a dose of 29 person-rem to the public for an LCF risk of 0.015 and 32 rem to the hypothetical MEI for an LCF risk of 0.016. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 2 are as follows: a radiological dose to the population of 21 person-rem, resulting in a total population risk of 0.010 LCF; and traffic accidents resulting in 0.072 traffic fatalities.

4.3.2.7 Environmental Justice

As discussed in other parts of Section 4.3.2, routine operations conducted under Alternative 2 would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Hanford would be approximately 1 in 10 million (see Table 4–25). The number of LCFs expected among the general population residing near Hanford from accident-free operations would be 0.035.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.3.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–27 through 4–30). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the site pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.3.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 2 would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

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4.4 ALTERNATIVE 3A

Alternative 3A would involve constructing and operating all three facilities for surplus plutonium disposition at SRS. All three facilities would be located in new buildings in F-Area.

4.4.1 Construction

4.4.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 3A at SRS include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from SRS construction activities, with standards and guidelines is presented as Table 4–31. Concentrations of air pollutants, especially for PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Table 4–31. Evaluation of Air Pollutant Concentrations Associated With Construction Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.91	65.9	0.66
	1 hour	40,000	8.7	287	0.72
Nitrogen dioxide	Annual	100	0.0682	9.37	9.4
PM_{10}	Annual	50	0.0656	4.20	8.4
	24 hours	150	3.63	60	40
Sulfur dioxide	Annual	80	0.00667	15.1	19
	24 hours	365	0.164	219	60
	3 hours	1,300	0.986	963	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.131	14.8	20
Hazardous and other toxic compounds					
Other toxics[b]	24 hours	150	0.000224	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from construction equipment would not be expected to annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with construction of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

4.4.1.2 Waste Management

Table 4–32 compares the wastes generated during construction of surplus plutonium disposition facilities at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–32. Potential Waste Management Impacts of Construction Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	72	NA	NA	NA
Nonhazardous				
Liquid	28,100	10[c]	NA	3[d]
Solid	2,640	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of F-Area sanitary sewer.
[d] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste will be treated and disposed of off the site by the construction contractor).

Hazardous wastes generated during construction of surplus plutonium disposition facilities would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. Because these wastes would be managed largely at non-DOE facilities, the additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of surplus plutonium disposition facilities would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 10 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 3 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.4.1.3 Socioeconomics

Construction-related employment requirements under Alternative 3A would be as indicated in Table 4–33.

Table 4–33. Construction Employment Requirements for Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	Immobilization	MOX	Total
2001	274	0	0	274
2002	417	312	290	1,019
2003	256	448	508	1,212
2004	0	282	334	616
2005	0	0	170	170
2006	0	0	160	160

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998e, 1998f, 1998g, 1998h.

At its peak in 2003, construction of the three new plutonium disposition facilities at SRS under this alternative would require 1,212 construction workers and should generate another 973 indirect jobs in the region. As the total employment increase of 2,185 direct and indirect jobs represents only 0.8 percent of the projected REA workforce, it should have no major impact on the REA. Moreover, it should have little impact on the community services currently offered in the ROI. In fact, it should help offset the 20 percent reduction in SRS's total workforce (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.4.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–34. Construction worker exposures to radiation that derives from other activities at the site, past or

Table 4–34. Potential Radiological Impacts on Construction Workers of Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	Immobilization[b]	MOX[c]	Total
Total dose (person-rem/yr)	1.3	1.4	1.2	3.9
Annual latent fatal cancers[d]	5.2×10^{-4}	5.6×10^{-4}	4.8×10^{-4}	1.6×10^{-3}
Average worker dose (mrem/yr)	4	4	4	4[e]
Annual latent fatal cancer risk	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] An estimated average of 316 workers would be associated with annual construction operations.
[b] An estimated average of 347 workers would be associated with annual construction operations at the new facility location adjacent to APSF. The number would be the same for immobilization in either ceramic or glass.
[c] An estimated average of 292 workers would be associated with annual construction operations.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for all three facilities.
Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998e, 1998f, 1998g, 1998h.

present, would be kept as low as is reasonably achievable. To this end, construction workers would be monitored (badged) as appropriate.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of plutonium disposition facility construction activities at SRS under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

4.4.1.5 Facility Accidents

Construction of new plutonium disposition facilities at SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 3,451 person-years of construction labor and standard industrial accident rates, approximately 340 cases of nonfatal occupational injury or illness and 0.48 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.4.1.6 Environmental Justice

As discussed in other parts of Section 4.4.1, construction under Alternative 3A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction of new facilities at SRS under Alternative 3A would have no significant impacts on minority or low-income populations.

4.4.2 Operations

4.4.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 3A at SRS were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles.

A comparison of maximum air pollutant concentrations, including the contribution from the plutonium disposition facilities, with standards and guidelines is presented as Table 4–35. Concentrations for immobilization in the ceramic form are presented because they would be greater than those for the glass form. Concentrations of air pollutants would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

Table 4–35. Evaluation of Air Pollutant Concentrations Associated with Operations Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.339	64.3	0.64
	1 hour	40,000	1.28	280	0.70
Nitrogen dioxide	Annual	100	0.0409	9.34	9.3
PM_{10}	Annual	50	0.00261	4.14	8.3
	24 hours	150	0.0424	56.4	38
Sulfur dioxide	Annual	80	0.0779	15.2	19
	24 hours	365	1.07	220	60
	3 hours	1,300	2.81	965	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.00261	14.7	20
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	650	0.0585	0.254	0.039

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

For a discussion of how the operation of these facilities would affect the site's ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAP limits applicable to operation of these facilities.

The increased concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of these facilities would be a small fraction of the PSD Class II area increments, as summarized in Table 4–36.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of a decrease in overall site employment during this timeframe.

The combustion of fossil fuels associated with Alternative 3A would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

The location of these facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or

Table 4–36. Evaluation of Air Pollutant Increases Associated With Operations Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0409	25	0.16
PM_{10}	Annual	0.00261	17	0.015
	24 hours	0.0424	30	0.14
Sulfur dioxide	Annual	0.0779	20	0.39
	24 hours	1.07	91	1.2
	3 hours	2.81	512	0.55

Key: DWPF, Defense Waste Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from equipment would not be expected to annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitat near the facility site (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulation (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

4.4.2.2 Waste Management

Table 4–37 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at SRS. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

Table 4–37. Potential Waste Management Impacts of Operations Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	159	9	5	1 of WIPP
LLW	154	1	NA	5
Mixed LLW	4	<1	2	NA
Hazardous	<33	<1	6	NA
Nonhazardous				
Liquid	76,000	28[d]	NA	7[e]
Solid	2,180	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation at surplus plutonium disposition facilities is estimated to be 9 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,590 m^3 (2,080 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 5 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.23 ha (0.57 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000-m^3 (187,000-yd^3) contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the new facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,540 m^3 (2,010 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,540 m^3 (2,010 yd^3) of waste would require 0.18-ha (0.42 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 2 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste would be packaged at the generating facility for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the surplus plutonium disposition facilities were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous wastewater would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities is estimated to be 28 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 7 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.4.2.3 Socioeconomics

After construction, startup, and testing of the new SRS facilities in 2007 under Alternative 3A, an estimated 996 new workers would be required to operate them (UC 1998e, 1998f, 1998g, 1998h). This level of employment should generate another 1,781 indirect jobs in the region. As the total employment requirement of 2,777 direct and indirect jobs represents less than 1 percent of the projected REA workforce, it should have no major impact on the REA. Moreover, the additional jobs would have little impact on community services currently offered in the ROI. In fact, they should decrease the reduction in SRS's total workforce projected for the years 1997–2010 from 33.3 percent (i.e., 15,000 to 10,000 workers) to 26.7 percent.

4.4.2.4 Human Health Risk

During normal operation of the plutonium disposition facilities, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers for this alternative would be as follows:

Radiological Impacts. Table 4–38 reflects the potential radiological impacts on three individual receptor groups: the population living within 80 km (50 mi) of SRS in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts projected aggregate latent fatal

Table 4–38. Potential Radiological Impacts on the Public of Operations Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	Immobilization Ceramic	Immobilization Glass	MOX	Total[a]
Population within 80 km for year 2010					
Dose (person-rem)	1.6	2.3×10^{-3}	2.2×10^{-3}	0.029	1.6
Percent of natural background[b]	6.9×10^{-4}	1.0×10^{-6}	1.0×10^{-6}	1.3×10^{-5}	7.0×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	1.2×10^{-5}	1.1×10^{-5}	1.5×10^{-4}	8.2×10^{-3}
Maximally exposed individual					
Annual dose (mrem)	3.7×10^{-3}	2.4×10^{-5}	2.2×10^{-5}	3.1×10^{-4}	4.0×10^{-3}
Percent of natural background[b]	1.3×10^{-3}	8.1×10^{-6}	7.5×10^{-6}	1.1×10^{-4}	1.4×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	1.2×10^{-10}	1.1×10^{-10}	1.6×10^{-9}	2.0×10^{-8}
Average exposed individual within 80 km[c]					
Annual dose (mrem)	2.0×10^{-3}	2.9×10^{-6}	2.8×10^{-6}	3.7×10^{-5}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	1.5×10^{-11}	1.4×10^{-11}	1.9×10^{-10}	1.0×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from all three facilities. The total includes the higher of the values for the ceramic and glass immobilization alternatives.

[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.

[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of APSF in 2010 (785,400).

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.
Source: Appendix J.

cancer risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 1.6 person-rem. The corresponding number of LCFs in this population from 10 years of operation would be 8.2×10^{-3}. The dose to the maximally exposed member of the public from annual operation of all three facilities would be 4.0×10^{-3} mrem. From 10 years of operation, the corresponding LCF risk of latent fatal cancer to this individual would be 2.0×10^{-8}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–39; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities is estimated to be 192, 175, and 174 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–39. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–39. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	Total
Number of badged workers	383	232	350	965
Total dose (person-rem/yr)	192	174	175	541
10-year latent fatal cancers	0.77	0.70	0.70	2.2
Average worker dose (mrem/yr)	500	750	500	560[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.2×10^{-3}

[a] Represents an average of the doses for all three facilities.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998e, 1998f, 1998g, 1998h.

Hazardous Chemical Impacts. Ethylene glycol would likely be released as a result of operations at SRS under this alternative. The Hazard Index (1×10^{-5}) would be much lower than 1, indicating that adverse, noncancer health effects should not be incurred by the maximally exposed member of the public. No carcinogenic chemicals would be released as a result of operations.

4.4.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion, immobilization, and MOX facilities at SRS are presented in Tables 4–40 through 4–43. More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for the pit conversion facility would be associated with a tritium release; the most severe for the immobilization and MOX facilities, a nuclear criticality. Bounding radiological consequences for the MEI are from the tritium release, which would result in a dose of 0.019 rem, corresponding to an LCF probability of 9.4×10^{-6}. A nuclear criticality of 10^{19} fissions would result in an MEI dose of 1.6×10^{-3} rem at the immobilization facility and 2.6×10^{-3} rem at the MOX facility. Consequences of the tritium release accident for the general population in the environs of SRS would include an estimated 0.033 LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

The combined radiological effects from total collapse of all three facilities in the beyond-design-basis earthquake would be approximately 17 LCFs. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this

Table 4–40. Accident Impacts of Pit Conversion Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Fire	Unlikely	6.2×10^{-6}	2.5×10^{-9}	6.7×10^{-7}	3.3×10^{-10}	2.4×10^{-3}	1.2×10^{-6}
Explosion	Unlikely	1.6×10^{-3}	6.5×10^{-7}	1.8×10^{-4}	8.8×10^{-8}	6.2×10^{-1}	3.1×10^{-4}
Leaks/spills of nuclear material	Extremely unlikely	2.3×10^{-6}	9.1×10^{-10}	2.5×10^{-7}	1.2×10^{-10}	8.7×10^{-4}	4.3×10^{-7}
Tritium release	Extremely unlikely	1.7×10^{-1}	7.0×10^{-5}	1.9×10^{-2}	9.4×10^{-6}	6.7×10^{1}	3.3×10^{-2}
Criticality	Extremely unlikely	1.7×10^{-2}	6.7×10^{-6}	1.8×10^{-3}	9.2×10^{-7}	1.8	9.0×10^{-4}
Design basis earthquake	Unlikely	2.0×10^{-4}	8.0×10^{-8}	2.2×10^{-5}	1.1×10^{-8}	7.7×10^{-2}	3.8×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	4.0×10^{-2}	1.6×10^{-5}	1.6×10^{-3}	7.8×10^{-7}	3.7	1.9×10^{-3}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	9.2×10^{1}	3.7×10^{-2}	3.6	1.8×10^{-3}	8.5×10^{3}	4.3

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: DWPF, Defense Waste Processing Facility.
Source: Calculated using the source terms in Table K–13 and the MACCS2 computer code.

worker were estimated to be the highest for the tritium release from the pit conversion facility. The consequences of such an accident would include an LCF probability of 7.0×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Table 4–41. Accident Impacts of Ceramic Immobilization Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	Unlikely	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Glovebox fire (sintering furnace)	Extremely unlikely	3.8×10^{-7}	1.5×10^{-10}	7.2×10^{-8}	3.6×10^{-11}	3.1×10^{-4}	1.5×10^{-7}
Design basis earthquake	Unlikely	9.6×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.1×10^{-9}	7.9×10^{-2}	3.9×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.7×10^{1}	2.3×10^{-2}	2.2	1.1×10^{-3}	5.3×10^{3}	2.7

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.
Source: Calculated using the source terms in Table K–18 and the MACCS2 computer code.

Nonradiological Accidents. Plutonium disposition operations at SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,581 person-years of labor and the standard DOE occupational accident rates, approximately 339 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.4.2.6 Transportation

Under Alternative 3A, transportation to and from SRS would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at SRS for fabrication into MOX fuel pellets.

Table 4–42. Accident Impacts of Glass Immobilization Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	Unlikely	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Melter eruption	Unlikely	3.5×10^{-7}	1.4×10^{-10}	6.7×10^{-8}	3.3×10^{-11}	2.9×10^{-4}	1.4×10^{-7}
Melter spill	Unlikely	8.3×10^{-8}	3.3×10^{-11}	1.6×10^{-8}	7.8×10^{-12}	6.8×10^{-5}	3.3×10^{-8}
Design basis earthquake	Unlikely	8.3×10^{-5}	3.3×10^{-8}	1.6×10^{-5}	7.9×10^{-9}	6.9×10^{-2}	3.4×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.0×10^{1}	2.0×10^{-2}	2.0	9.8×10^{-4}	4.6×10^{3}	2.3

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Source: Calculated using the source terms in Table K–19 and the MACCS2 computer code.

It is assumed that depleted uranium hexafluoride needed for MOX fuel would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide (see Section 4.3.2.6). After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at SRS. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at SRS under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or

Table 4–43. Accident Impacts of MOX Facility Under Alternative 3A: Pit Conversion and MOX in New Construction and Immobilization in New Construction and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	4.7×10^{-2}	1.9×10^{-5}	2.6×10^{-3}	1.3×10^{-6}	2.2	1.1×10^{-3}
Explosion in sintering furnace	Extremely unlikely	1.2×10^{-3}	4.7×10^{-7}	4.9×10^{-5}	2.4×10^{-8}	1.2×10^{-1}	6.1×10^{-5}
Fire	Extremely unlikely	7.1×10^{-6}	2.9×10^{-9}	3.0×10^{-7}	1.5×10^{-10}	7.4×10^{-4}	3.7×10^{-7}
Design basis earthquake	Unlikely	1.7×10^{-4}	6.6×10^{-8}	6.9×10^{-6}	3.5×10^{-9}	1.7×10^{-2}	8.7×10^{-6}
Beyond-design-basis fire	Beyond extremely unlikely	2.3×10^{-2}	9.0×10^{-6}	8.8×10^{-4}	4.4×10^{-7}	2.1	1.0×10^{-3}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	2.1×10^{2}	8.5×10^{-2}	8.3	4.1×10^{-3}	2.0×10^{4}	9.9

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility.

Source: Calculated using the source terms in Table K–22 and the MACCS2 computer code.

pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to the Defense Waste Processing Facility (DWPF) in S-Area. This intrasite transportation—from F-Area to S-Area—could require the temporary shutdown of roads on SRS. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at DWPF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 3A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.3.1.2 and 4.3.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In all, approximately 2,500 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 6.8 million km (4.3 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 53 person-rem; the dose to the public, 60 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.021 LCF among transportation workers and 0.030 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.025.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of plutonium pits from one of DOE's storage locations to the pit conversion facility with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. The accident could result in a dose of 29 person-rem to the public for an LCF risk of 0.015 and 32 rem to the hypothetical MEI for an LCF risk of 0.016. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 3A are as follows: a radiological dose to the population of 22 person-rem, resulting in a total population risk of 0.011 LCF; and traffic accidents resulting in 0.073 traffic fatalities.

4.4.2.7 Environmental Justice

As discussed in other parts of Section 4.4.2, routine operations conducted under Alternative 3A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near SRS would be approximately 1 in 50 million (see Table 4–38). The number of LCFs expected among the general population residing near SRS from accident-free operations would be approximately 8.2×10^{-3}.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.4.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–40 through 4–43). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the site pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.4.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 3A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.5 ALTERNATIVE 3B

Alternative 3B would involve constructing and operating all three facilities for surplus plutonium disposition at SRS. The immobilization facility would be located in the existing Building 221–F, and the pit conversion and MOX facilities, in new buildings in F-Area.

4.5.1 Construction

4.5.1.1 Air Quality and Noise

Potential air quality impacts of the construction of plutonium disposition facilities under Alternative 3B at SRS, are somewhat lower than those under Alternative 3A because immobilization facility construction would only require the modification of an existing building. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from SRS construction activities with standards and guidelines is presented as Table 4–44. Concentrations of air pollutants, especially for PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Table 4–44. Evaluation of Air Pollutant Concentrations Associated With Construction Under Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.44	65.4	0.65
	1 hour	40,000	6.48	285	0.71
Nitrogen dioxide	Annual	100	0.0503	9.35	9.4
PM_{10}	Annual	50	0.0542	4.19	8.4
	24 hours	150	2.48	58.9	39
Sulfur dioxide	Annual	80	0.00485	15.1	19
	24 hours	365	0.119	219	60
	3 hours	1,300	0.714	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.114	14.8	20
Hazardous and other toxic compounds					
Other toxics[b]	24 hours	150	0.000224	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

Noise impacts would be the same or lower than those for Alternative 3A (see Section 4.4.1.1).

4.5.1.2 Waste Management

Table 4–45 compares the wastes generated during the 3-year construction period for surplus plutonium disposition facilities at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that TRU waste and LLW would be generated during modification of Building 221–F. No mixed LLW would be generated. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario.

Table 4–45. Potential Waste Management Impacts of Construction Under Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	50	3	<1	<1
LLW	500	NA	NA	5
Hazardous	65	NA	NA	NA
Nonhazardous				
Liquid	27,500	10[d]	NA	3[e]
Solid	1,510	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Modification is not expected to generate remotely handled TRU waste or mixed TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of LLW is not routinely treated and stored on the site; it is assumed that the majority of hazardous waste and nonhazardous solid waste will be treated and disposed of off the site by the construction contractor); TRU, transuranic.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be packaged, and certified to WIPP waste acceptance criteria at the modification site. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU wastes generated during modification of Building 221–F are estimated to be 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 150 m^3 (196 yd^3) of TRU waste would be generated during the modification period. If all the TRU waste were stored on the site, this would be less than 1 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. If additional storage space were needed, and assuming that the waste would be stored in 208-l (55-gal) drums that would be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of less than 0.1 ha (0.25 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 150 m^3 (196 yd^3) of TRU wastes generated by modification of Building 221–F would be less than 1 percent of the 143,000-m^3 (187,000-yd^3) contact-handled TRU waste that DOE plans to dispose of at WIPP and within the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the modification site before transfer for disposal in existing onsite facilities. A total of 1,500-m^3 (1,960-yd^3) LLW would be generated during modification of Building 221–F. LLW generated during the modification period is estimated to be 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,500 m^3 (1,960 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Hazardous wastes generated during construction of surplus plutonium disposition facilities would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of surplus plutonium disposition facilities would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous-liquid-waste generation during construction of these facilities is estimated to be 10 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 3 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.5.1.3 Socioeconomics

Construction-related employment requirements under Alternative 3B would be as indicated in Table 4–46.

At its peak in 2003, construction of the three plutonium disposition facilities at SRS under this alternative would require 1,164 construction workers and should generate another 934 indirect jobs in the region. As this total of 2,098 direct and indirect jobs represents only about 0.8 percent of the projected REA workforce, there should be no major impact on the REA. Moreover, there should be little impact on the community services

Table 4–46. Construction Employment Requirements for Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Year	Pit Conversion	Immobilization	MOX	Total
2001	274	0	0	274
2002	417	248	290	955
2003	256	400	508	1,164
2004	0	330	334	664
2005	0	0	170	170
2006	0	0	160	160

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998e, 1998h, 1998i, 1998j.

currently offered in the ROI. In fact, it should help offset the approximately 20 percent reduction in SRS's total workforce (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.5.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities is presented as Table 4–47 for workers at risk. Construction worker exposures to radiation that derives from other activities at the site, past or present, would be kept as low as is reasonably achievable. Toward this end, construction workers would be monitored (badged) as appropriate.

Table 4–47. Potential Radiological Impacts on Construction Workers of Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion[a]	Immobilization[b]	MOX[c]	Total
Total dose (person-rem/yr)	1.3	4.7	1.2	7.2
Annual latent fatal cancers[d]	5.2×10^{-4}	1.9×10^{-3}	4.8×10^{-4}	2.9×10^{-3}
Average worker dose (mrem/yr)	4	15	4	7.8[e]
Annual latent fatal cancer risk	1.6×10^{-6}	6.0×10^{-6}	1.6×10^{-6}	3.1×10^{-6}

[a] An estimated average of 316 workers would be associated with annual construction operations.
[b] There would be 315 badged workers associated with construction and modification of the existing Building 221–F. The number would be the same for immobilization in either ceramic or glass.
[c] An estimated average of 292 workers would be associated with annual construction operations.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for all three facilities.
Key: DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998e, 1998h, 1998i, 1998j.

Hazardous Chemical Impacts. Because the estimated airborne concentration of benzene delivered to the maximally exposed member of the public at SRS under this alternative is the same as that estimated for Alternative 3A, the estimated cancer risk associated with this exposure is also the same as that discussed for Alternative 3A.

4.5.1.5 Facility Accidents

Construction of new pit conversion and MOX facilities, and modification of Building 221–F for plutonium conversion and immobilization at SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 3,387 person-years of construction labor and standard industrial accident rates, approximately 340 cases of nonfatal occupational injury or illness and 0.47 fatality could be expected (DOL 1997a, 1997b). As all construction would take place prior to introduction of the radiological process inventory, no noteworthy radiological accidents should occur.

4.5.1.6 Environmental Justice

As discussed in other parts of Section 4.5.1, construction under Alternative 3B would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities at SRS would have no significant impacts on minority or low-income populations.

4.5.2 Operations

4.5.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 3B at SRS were analyzed using ISCST3 and found to be about the same as those under Alternative 3A (see Section 4.4.2.1). Noise impacts would be the same as those for Alternative 3A (see Section 4.4.2.1).

4.5.2.2 Waste Management

Table 4–48 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at SRS. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation at surplus plutonium disposition facilities is estimated to be 9 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,590 m^3 (2,080 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 5 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available

Table 4–48. Potential Waste Management Impacts of Operations Under Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	159	9	5	1 of WIPP
LLW	154	1	NA	5
Mixed LLW	4	<1	2	NA
Hazardous	<33	<1	6	NA
Nonhazardous				
Liquid	78,000	28[d]	NA	8[e]
Solid	2,180	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.23 ha (0.57 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the new facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,540-m^3 (2,010-yd^3) LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,540 m^3 (2,010 yd^3) of waste would require 0.18-ha (0.42 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 2 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste would be packaged at the generating facility for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the surplus plutonium disposition facilities were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous wastewater would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities is estimated to be 28 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 8 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.5.2.3 Socioeconomics

After construction, startup, and testing of the three plutonium disposition facilities at SRS in 2007 under Alternative 3B, an estimated 1,022 new workers would be required to operate them (UC 1998e, 1998h, 1998i, 1998j). This level of employment should generate another 1,827 indirect jobs in the region. As the total increase of 2,849 direct and indirect jobs represents less than 1 percent of the projected REA workforce, it should have no major impact on the REA. The new employees also should have little impact on community services within the ROI. In fact, the additional workers should decrease the reduction in SRS's total workforce projected for the years 1997–2010 from 33.3 percent (i.e., 15,000 to 10,000 workers) to 26.5 percent.

4.5.2.4 Human Health Risk

During normal operation of the plutonium disposition facilities, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–49 reflects the potential radiological impacts on three individual receptor groups: the population living within 80 km (50 mi) of SRS in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate latent fatal cancer risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three facilities, the projected total population dose in the year 2010 would be 1.6 person-rem. The corresponding number of LCFs in this population from 10 years of operation would be 8.2×10^{-3}. The dose to the maximally exposed member of the public from annual operation of all three facilities would be 4.0×10^{-3} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 2.1×10^{-8}. The impacts on the average individual would be lower.

Table 4–49. Potential Radiological Impacts on the Public of Operations Under Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	Immobilization Ceramic	Immobilization Glass	MOX	Total[a]
Population within 80 km for year 2010					
Dose (person-rem)	1.6	2.3×10^{-3}	2.2×10^{-3}	0.029	1.6
Percent of natural background[b]	6.9×10^{-4}	1.0×10^{-6}	1.0×10^{-6}	1.3×10^{-5}	7.0×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	1.2×10^{-5}	1.1×10^{-5}	1.5×10^{-4}	8.2×10^{-3}
Maximally exposed individual					
Annual dose (mrem)	3.7×10^{-3}	2.4×10^{-5}	2.2×10^{-5}	3.1×10^{-4}	4.0×10^{-3}
Percent of natural background[b]	1.3×10^{-3}	8.1×10^{-6}	7.5×10^{-6}	1.1×10^{-4}	1.4×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	1.2×10^{-10}	1.1×10^{-10}	1.6×10^{-9}	2.1×10^{-8}
Average exposed individual within 80 km[c]					
Annual dose (mrem)	2.0×10^{-3}	2.9×10^{-6}	2.8×10^{-6}	3.7×10^{-5}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	1.5×10^{-11}	1.4×10^{-11}	1.9×10^{-10}	1.0×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from all three facilities. The total includes the higher of the values for the ceramic and glass immobilization alternatives.
[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 231,000 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the facilities in 2010 (about 783,000).
Key: DWPF, Defense Waste Processing Facility.
Source: Appendix J.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–50; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities would be an estimated 192, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–50. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at SRS under this alternative would be the same as that for Alternative 3A, the estimated noncancer risks associated with exposure to this compound would also be the same as those discussed for Alternative 3A. No carcinogenic chemicals would be released as a result of operations.

4.5.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion and MOX facilities at SRS for this alternative are equivalent to those in Alternative 3A (see Tables 4–40

Table 4–50. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	Total
Number of badged workers	383	258	350	991
Total dose (person-rem/yr)	192	194	175	561
10-year latent fatal cancers	0.77	0.77	0.70	2.2
Average worker dose (mrem/yr)	500	750	500	565[a]
10-year risk of latent fatal cancer	2.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.3×10^{-3}

[a] Represents an average of the doses for all three facilities.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998e, 1998h, 1998i, 1998j.

and 4–43). The potential consequences of such accidents from operation of the immobilization facility in Building 221–F are presented in Tables 4–51 and 4–52. More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for this alternative would be associated with the design basis earthquake at SRS. Bounding radiological consequences for the MEI are from the design basis earthquake's effect on the immobilization facility in Building 221–F, which would include a dose of 0.44 rem, corresponding to an LCF probability of 2.2×10^{-4}. Among the general population off the site, an estimated 0.53 LCF could occur as a result of the bounding design basis earthquake at SRS. Since a design basis earthquake could affect all facilities simultaneously, these consequences would be at least partially additive with the doses from pit disassembly and conversion and MOX fuel fabrication. However, due to the ability of these new facilities to withstand the design basis earthquake, the relative contributions would be negligible. The frequency of such an earthquake is prescribed to be 1 in 5,000 per year.

The combined radiological effects of a total collapse of all three facilities from the beyond-design-basis earthquake would be equivalent to the consequences presented in Alternative 3A, Section 4.4.2.6.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the design basis earthquake at SRS. The consequences of such an accident would include an LCF probability of 4.6×10^{-3}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and

Table 4–51. Accident Impacts of Ceramic Immobilization Under Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	4.2×10^{-1}	1.7×10^{-4}	8.0×10^{-2}	4.0×10^{-5}	3.4×10^{2}	1.7×10^{-1}
Glovebox fire (calcining furnace)	Extremely unlikely	3.3×10^{-5}	1.3×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	2.7×10^{-2}	1.3×10^{-5}
Hydrogen explosion	Unlikely	4.7×10^{-2}	1.9×10^{-5}	8.8×10^{-3}	4.4×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Glovebox fire (sintering furnace)	Extremely unlikely	1.9×10^{-4}	7.4×10^{-8}	3.5×10^{-5}	1.8×10^{-8}	1.5×10^{-1}	7.5×10^{-5}
Design basis earthquake	Unlikely	1.1×10^{1}	4.6×10^{-3}	4.4×10^{-1}	2.2×10^{-4}	1.0×10^{3}	5.3×10^{-1}
Beyond-design-basis fire	Beyond extremely unlikely	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.7×10^{1}	2.3×10^{-2}	2.2	1.1×10^{-3}	5.3×10^{3}	2.7

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Source: Calculated using the source terms in Table K–14 and the MACCS2 computer code.

structures to high radiation exposures and uptakes of radionuclides. For most accidents, the immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,867 person-years of labor and the standard DOE occupational accident rates, approximately 348 cases of nonfatal occupational injury or illness and 0.35 fatality could be expected for the duration of operations.

4.5.2.6 Transportation

Because the only difference between Alternative 3A and 3B is the location of the immobilization facility within F-Area at SRS, the transportation required for Alternative 3B would be the same as that for Alternative 3A.

Table 4–52. Accident Impacts of Glass Immobilization Under Alternative 3B: Pit Conversion and MOX in New Construction and Immobilization in Building 221–F and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	4.2×10^{-1}	1.7×10^{-4}	8.0×10^{-2}	4.0×10^{-5}	3.4×10^{2}	1.7×10^{-1}
Glovebox fire (calcining furnace)	Extremely unlikely	3.3×10^{-5}	1.3×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	2.7×10^{-2}	1.3×10^{-5}
Hydrogen explosion	Unlikely	4.7×10^{-2}	1.9×10^{-5}	8.8×10^{-3}	4.4×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Melter eruption	Unlikely	1.7×10^{-4}	6.9×10^{-8}	3.3×10^{-5}	1.6×10^{-8}	1.4×10^{-1}	6.9×10^{-5}
Melter spill	Unlikely	4.0×10^{-5}	1.6×10^{-8}	7.7×10^{-6}	3.8×10^{-9}	3.3×10^{-2}	1.6×10^{-5}
Design basis earthquake	Unlikely	1.0×10^{1}	4.0×10^{-3}	3.9×10^{-1}	1.9×10^{-4}	9.2×10^{2}	4.6×10^{-1}
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.0×10^{1}	2.0×10^{-2}	2.0	9.8×10^{-4}	4.6×10^{3}	2.3

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Source: Calculated using the source terms in Table K–15 and the MACCS2 computer code.

Therefore, the transportation risks associated with Alternative 3B are equivalent to those discussed in Section 4.4.2.6.

4.5.2.7 Environmental Justice

As discussed in other parts of Section 4.5.2, routine operations conducted under Alternative 3B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near SRS would be approximately 1 in 48 million (see Table 4–49). The number of LCFs expected among the general population residing near SRS from accident-free operations would be 8.2×10^{-3}.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.5.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–51 and 4–52). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the site pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.5.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 3B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.6 ALTERNATIVE 4A

Alternative 4A would involve constructing and operating the pit conversion facility in Zone 4 at Pantex and the immobilization and MOX facilities at Hanford. The immobilization facility would be located in the existing FMEF building, and the MOX facility would be located in new buildings near FMEF in the 400 Area.

4.6.1 Construction

4.6.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 4A at Pantex include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from Pantex construction activities, with standards and guidelines is presented as Table 4–53. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at Pantex would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of this facility at Pantex relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of this facility would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 1.6 km [1.0 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of this facility would likely produce less than a 1-dB increase in noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

Sources of potential air quality impacts of construction under Alternative 4A at Hanford, including modification of FMEF for plutonium conversion and immobilization and construction of a new MOX facility, were analyzed. Construction impacts result from emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

Table 4–53. Evaluation of Pantex Air Pollutant Concentrations Associated With Construction Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	3.77	623	6.2
	1 hour	40,000	23.5	3,020	7.5
Nitrogen dioxide	Annual	100	0.501	2.44	2.4
PM_{10}	Annual	50	0.349	9.14	18
	24 hours	150	4.18	93.6	62
Sulfur dioxide	Annual	80	0.0326	0.033	0.041
	24 hours	365	0.392	0.392	0.11
	3 hours	1,300	1.71	1.71	0.13
	30 minutes	1,048	6.98	6.98	0.67
Other regulated pollutants					
Total suspended particulates	3 hours	200	42.7	42.7[b]	21
	1 hour	400	174	174[b]	44
Hazardous and other toxic compounds					
Other toxics[e]	24 hours	3[c]	0	7.8[d]	260
	1 hour	75[c]	0	19.4	26

a The more stringent of the Federal and State standards is presented if both exist for the averaging period.
b Three- and 1-hr concentrations for total suspended particulates are not listed for existing sources in the source document. Only the contribution from sources associated with the alternative are represented.
c Effects-screening level of the Texas Natural Resource Conservation Commission. Such levels are not ambient air standards, but merely "tools" used by the Toxicology and Risk Assessment staff to evaluate impacts of air pollutant emissions. Thus, exceedance of the screening levels by ambient air contaminants does not necessarily indicate a problem. That circumstance, however, would prompt a more thorough evaluation.
d Twenty-four-hour concentration for existing sources was estimated from the 1-hr concentration.
e Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed for benzene.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; TNRCC 1997a, 1997b.

A comparison of maximum air pollutant concentrations, including the contribution from Hanford construction activities, with standards and guidelines is presented as Table 4–54. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards as a result of activities at Hanford. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. The concentrations of toxic air pollutants such as hydrogen chloride and benzene would be unchanged from the No Action Alternative (see discussion of these concentrations in Section 4.2.1.3). Air pollution impacts during operation would be mitigated by including HEPA filtration in the design of these facilities.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

Table 4–54. Evaluation at Hanford of Air Pollutant Concentrations Associated With Construction Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.11	35.2	0.35
	1 hour	40,000	7.54	55.8	0.14
Nitrogen dioxide	Annual	100	0.087	0.337	0.34
PM_{10}	Annual	50	0.0601	0.078	0.16
	24 hours	150	2.71	3.48	2.3
Sulfur dioxide	Annual	50	0.00879	1.64	3.2
	24 hours	260	0.0977	9.01	3.4
	3 hours	1,300	0.665	30.3	2.3
	1 hour	700	1.99	34.9	5.3
Other regulated pollutants					
Total suspended particulates	Annual	60	0.105	0.122	0.2
	24 hours	150	4.8	5.57	3.7
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0.0007008	0.000014	0.012

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 1-dB increase in noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

4.6.1.2 Waste Management

Tables 4–55 and 4–56 compare the wastes generated during construction of surplus plutonium disposition facilities at Pantex and Hanford with the existing treatment, storage, and disposal capacity for the various waste types at each site. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–55. Potential Waste Management Impacts of Construction at Pantex Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	50	NA	NA	NA
Nonhazardous				
Liquid	5,300	NA	NA	1[c]
Solid	120	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of the Wastewater Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Table 4–56. Potential Waste Management Impacts of Construction at Hanford Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	15	NA	NA	NA
Nonhazardous				
Liquid	16,700	7[c]	NA	7[d]
Solid	970	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of 400 Area sanitary sewer.
[d] Percent of capacity of the WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); WPPSS, Washington Public Power Supply System.

Hazardous wastes generated during construction of surplus plutonium disposition facilities would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the Pantex or Hanford hazardous waste management systems.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management systems at Pantex or Hanford.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of the pit conversion facility at Pantex would be managed on the site by the Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be less than 1 percent of the 946,250-m^3/yr (1,237,700-yd^3/yr) capacity of the Wastewater Treatment Facility. Therefore, management of these wastes at Pantex should not have a major impact on the nonhazardous liquid waste treatment system during construction.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of the immobilization and MOX facilities would be managed on the site at the WPPSS Sewage Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 7 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and 7 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, management of these wastes at Hanford should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.6.1.3 Socioeconomics

Construction-related employment requirements under Alternative 4A would be as indicated in Table 4–57.

Table 4–57. Construction Employment Requirements for Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Year	Pit Conversion	Immobilization	MOX	Total
2001	298	0	0	298
2002	452	167	290	909
2003	275	268	508	1,051
2004	0	236	334	570
2005	0	0	170	170
2006	0	0	160	160

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: UC 1998b, 1998c, 1998d, 1998k.

At its peak in 2002, construction of the new pit conversion facility at Pantex under this alternative would require 452 construction workers and generate another 381 indirect jobs in the region. As this total employment requirement of 833 direct and indirect jobs represents only 0.3 percent of the projected REA workforce, it should have no major impact on the REA. Moreover, it should have little impact on community services within the ROI. In fact, it should help offset the nearly 40 percent reduction in the Pantex total workforce (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2005.

At its peak in 2003, construction of the immobilization and MOX facilities at Hanford would require 776 construction workers and should generate another 796 indirect jobs in the region. This total employment requirement of 1,572 direct and indirect jobs represents only 0.4 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have little effect on the community services currently offered in the ROI. In fact, it should help offset the nearly 15 percent reduction in Hanford's workforce (i.e., from 12,900 to approximately 11,000 workers) projected for the years 1997–2005.

4.6.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. According to results of recent radiation surveys (DOE 1997e; Antonio 1998) conducted in the Zone 4 area at Pantex and the 400 Area at Hanford, construction workers would not be expected to receive any additional radiation exposure above natural background levels in those areas. Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at Hanford under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

No hazardous chemicals would be released as a result of construction activities at Pantex under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.6.1.5 Facility Accidents

Construction of plutonium disposition facilities at Pantex and Hanford could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 3,158 person-years of construction labor and standard industrial accident rates, approximately 310 cases of nonfatal occupational injury or illness and 0.44 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.6.1.6 Environmental Justice

As discussed in the other parts of Section 4.6.1, construction under Alternative 4A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities at Pantex and Hanford under Alternative 4A would have no significant impacts on minority or low-income populations.

4.6.2 Operations

4.6.2.1 Air Quality and Noise

Potential air quality impacts of the operation of the new pit conversion facility under Alternative 4A at Pantex were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the pit conversion facility, with standards and guidelines is presented as Table 4–58. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of this facility.

Table 4–58. Evaluation of Pantex Air Pollutant Concentrations Associated With Operations Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.381	620	6.2
	1 hour	40,000	2.14	2,990	7.5
Nitrogen dioxide	Annual	100	0.0374	1.98	2
PM_{10}	Annual	50	0.00215	8.79	18
	24 hours	150	0.0225	89.5	60
Sulfur dioxide	Annual	80	0.00064	0.00064	0.0008
	24 hours	365	0.00753	0.00755	0.0021
	3 hours	1,300	0.0327	0.0328	0.0025
	30 minutes	1,048	0.129	0.129	0.012
Other regulated pollutants					
Total suspended particulates	3 hours	200	0.0937	0.0937[b]	0.047
	1 hour	400	0.274	0.274[b]	0.068
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	26[c]	0	0[d]	0
	1 hour	260[c]	0	0[d]	0

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates are not reported for existing sources. Only the contribution from sources associated with the alternative are represented.
[c] Effects-screening level of the Texas Natural Resource Conservation Commission. Such levels are not ambient air standards, but merely "tools" used by the Toxicology and Risk Assessment staff to evaluate impacts of air pollutant emissions. Thus, exceedance of the screening levels by ambient air contaminants does not necessarily indicate a problem. That circumstance, however, would prompt a more thorough evaluation.
[d] No existing or alternative related sources of this pollutant have been identified at the site.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; TNRCC 1997a, 1997b.

For a discussion of how the operation of the pit conversion facility at Pantex would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.3.4. There are no other NESHAP limits applicable to operation of this facility.

The increases in air pollutant concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of this facility would be a small fraction of the PSD Class II area increments as summarized in Table 4–59.

Total vehicle emissions associated with activities at Pantex would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

Table 4–59. Evaluation of Pantex Air Pollutant Increases Associated With Operations Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0374	25	0.15
PM_{10}	Annual	0.00215	17	0.013
	24 hours	0.0225	30	0.075
Sulfur dioxide	Annual	0.00064	20	0.0032
	24 hours	0.00753	91	0.0083
	3 hours	0.0327	512	0.0064

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

The location of this facility at Pantex relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operation would include new or existing sources (e.g., cooling systems, vents, motors, and material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of this facility would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 1.6 km [1.0 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with operation of this facility would likely produce less than a 1-dB increase in noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Potential air quality impacts of the operation of facilities under Alternative 4A at Hanford were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from plutonium disposition facilities, with standards and guidelines is presented as Table 4–60. Concentrations for immobilization in the ceramic form are presented because they would be greater than those for the glass form. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of activities at Hanford. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue.

For a discussion of how the operation of the immobilization and MOX facilities at Hanford would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAP limits applicable to operation of these facilities.

Table 4–60. Evaluation of Hanford Air Pollutant Concentrations Associated With Operations Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF, and MOX in New Construction at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.386	34.5	0.35
	1 hour	40,000	2.31	50.6	0.13
Nitrogen dioxide	Annual	100	0.0294	0.279	0.28
PM_{10}	Annual	50	0.00209	0.020	0.04
	24 hours	150	0.0232	0.793	0.53
Sulfur dioxide	Annual	50	0.00194	1.63	3.1
	24 hours	260	0.0216	8.93	3.4
	3 hours	1,300	0.147	29.8	2.3
	1 hour	700	0.44	33.3	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.00209	0.02	0.033
	24 hours	150	0.0232	0.793	0.53
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	420	0.0406	0.0406	0.0097

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; WDEC 1994.

The increases in air pollutant concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of these facilities would be a small fraction of the PSD Class II area increments as summarized in Table 4–61.

Table 4–61. Evaluation of Hanford Air Pollutant Increases Associated With Operations Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0294	25	0.12
PM_{10}	Annual	0.00209	17	0.012
	24 hours	0.0232	30	0.077
Sulfur dioxide	Annual	0.00194	20	0.0097
	24 hours	0.0216	91	0.024
	3 hours	0.147	512	0.029

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.

Source: EPA 1997b.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

The combustion of fossil fuels associated with Alternative 4A would result in the emission of carbon dioxide, which is one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative represent less than 6×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.6.2.2 Waste Management

Tables 4–62 and 4–63 compare the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at Pantex and Hanford. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation at Hanford should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated (Pantex and Hanford) and disposed of (Hanford) on the sites or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment and storage of radioactive, hazardous, mixed, and nonhazardous wastes at Pantex are described in the *Final EIS for the Continued Operation of Pantex and Associated Storage of Nuclear Weapon Components* (DOE 1996b). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* that is being prepared by the DOE Richland Operations Office (DOE 1997c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford and a new facility at Pantex.

Table 4–62. Potential Waste Management Impacts of Operations at Pantex Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford[a]

Waste Type[b]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[c]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[d]	18	NA	NA	<1 of WIPP
LLW	60	8	25	<1 of NTS
Mixed LLW	1	NA	NA	NA
Hazardous	2	<1	NA	NA
Nonhazardous				
Liquid	25,000	3[e]	NA	3[e]
Solid	1,800	NA	NA	NA

[a] Information summarized from Appendix H.
[b] See definitions in Appendix F.8.
[c] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[d] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[e] Percent of capacity of the Wastewater Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); NTS, Nevada Test Site; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Table 4–63. Potential Waste Management Impacts of Operations at Hanford Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford[a]

Waste Type[b]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[c]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[d]	141	8	8	1 of WIPP
LLW	94	NA	NA	<1
Mixed LLW	3	<1	<1	<1
Hazardous	<31	NA	NA	NA
Nonhazardous				
Liquid	48,000	20[e]	NA	20[f]
Solid	<380	NA	NA	NA

[a] Information summarized from Appendix H.
[b] See definitions in Appendix F.8.
[c] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[d] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[e] Percent of capacity of 400 Area sanitary sewer.
[f] Percent of capacity of WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant; WPPSS, Washington Public Power Supply System.

TRU waste generation at the pit conversion facility at Pantex is estimated to be a total of 180 m^3 (235 yd^3) over the 10-year operation period. Because TRU waste is not currently stored at Pantex, storage space would be provided within the pit conversion facility. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of approximately 260 m^2 (2,800 ft^2) would be required. This would be 1.5 percent of the 17,345 m^2 (186,700 ft^2) of floor space available in the pit conversion facility. Therefore, impacts of the management of TRU waste at Pantex should not be major.

TRU waste generation at the immobilization and MOX facilities at Hanford is estimated to be 8 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,410 m^3 (1,840 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 8 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.20 ha (0.49 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at Hanford should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000-m^3 (187,000-yd^3) contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW generated at Pantex would be treated, packaged, certified, and accumulated at the pit conversion facility before transfer for additional treatment and disposal in onsite and offsite facilities. LLW generation at the pit conversion facility is estimated to be 8 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility. Waste would be stored on the site on an interim basis before being shipped for offsite disposal. If the shipment of LLW to offsite disposal were delayed, about 600 m^3 (780 yd^3) of LLW may need to be stored at Pantex. This is about 25 percent of the approximately 2,400-m^3 (3,140-yd^3) existing storage capacity at Pantex. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.1 ha (0.25 acre) is required. Therefore, impacts of the storage of additional quantities of LLW at Pantex should not be major. If a new LLW storage facility were needed, appropriate NEPA documentation would be prepared.

LLW from Pantex is currently shipped to NTS for disposal. The additional LLW from operation of the pit conversion facility at Pantex would be 3 percent of the 20,000-m^3 (26,000-yd^3) LLW disposed of at NTS in 1995 and less than 1 percent of the 500,000-m^3 (650,000-yd^3) disposal capacity at NTS. Using the 6,085 m^3/ha disposal land usage factor for NTS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), the additional LLW from Pantex would require 0.1-ha (0.25-acre) of disposal space at NTS or a similar facility. Therefore, impacts of the management of this additional LLW should not be major. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996c).

At Hanford, LLW would be packaged, certified, and accumulated at the immobilization and MOX facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 940 m^3 (1,230 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) capacity of the LLW Burial Grounds and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480 m^3/ha disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.27-ha (0.67-acre) disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Pantex. Pantex currently ships mixed LLW to Envirocare of Utah and Diversified Scientific Services, Inc. of Tennessee. These facilities or other treatment or disposal facilities that meet DOE criteria would be used to manage the 10 m^3 (13 yd^3) of waste that would be generated. Therefore, the management of this additional waste at Pantex should not have a major impact on the mixed LLW management system.

At Hanford, mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan. Mixed LLW generation at the immobilization and MOX facilities is estimated to be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (22,000-yd^3) capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system. If all TRU waste and mixed LLW generated at the surplus plutonium disposition facilities at Hanford were processed in the Waste Receiving and Processing Facility, this additional waste would be 8 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of that facility.

Any hazardous wastes generated during operation of the pit conversion facility at Pantex would be packaged in DOT-approved containers and shipped off the site to licensed commercial recycling, treatment, and disposal facilities. Because these wastes would be less than 1 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility and would be disposed of at offsite commercial facilities, the additional waste load generated during the operation period should not have a major impact on Pantex hazardous waste management system. If all LLW and hazardous wastes generated at the pit conversion facility at Pantex were processed in the planned Hazardous Waste Treatment and Processing Facility, this additional waste would be 8 percent of the 750-m^3/yr (980-yd^3/yr) capacity of that facility.

At Hanford, any hazardous wastes generated during operation of the immobilization and MOX facilities would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operation period should not have a major impact on Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management systems at Pantex and Hanford.

Nonhazardous wastewater generated by the pit conversion facility would be treated if necessary before being discharged to the Pantex Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at Pantex is estimated to be 3 percent of the 946,250-m^3/yr (1,237,700-yd^3/yr) capacity of the Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at Pantex should not have a major impact on the treatment system.

At Hanford, nonhazardous wastewater generated by the immobilization and MOX facilities would be treated if necessary before being discharged to the 400 area sanitary sewer system, which connects to the WPPSS Sewage Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at Hanford is estimated to be 20 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 20 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility, and within the 138,000 m^3/yr (181,000 yd^3/yr) excess capacity of the WPPSS Sewage Treatment Facility (Mecca 1997). Therefore, management of nonhazardous liquid waste at Hanford should not have a major impact on the treatment system.

4.6.2.3 Socioeconomics

Under Alternative 4A, operation of the pit conversion facility at Pantex would begin in 2004 and should require 400 new workers (UC 1998k). This level of employment should generate another 1,355 indirect jobs within the region. As the total employment requirement of 1,755 direct and indirect jobs represents only 0.7 percent of the projected REA workforce, there should be no major impact on the REA. Moreover, the additional required workers should not markedly impact community services within the Pantex ROI. In fact, they should help offset the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2005.

After construction, startup, and testing of the immobilization and MOX facilities at Hanford in 2007 under Alternative 4A, an estimated 614 new workers would be required to operate them (UC 1998b, 1998c, 1998d, 1998k). This level of employment would be expected to generate another 1,555 related jobs in the region. The total employment requirement of 2,169 direct and indirect jobs represents less than 0.6 percent of the projected REA workforce, and thus should have no major impact on the REA. Some of the new jobs created under this alternative could be filled from the ranks of unemployed, currently 11 percent of the REA's population.

This employment requirement could have minor impacts on community services in the ROI, as it should coincide with an expected increase in overall site employment for construction of the tank waste remediation system. Assuming that 91 percent of the new employees associated with this alternative resided in the ROI, an increase of 1,974 new jobs within the workforce would result in an overall population increase of approximately 3,756 persons. This population increase, in conjunction with the normal population growth forecast by the State of Washington, would engender increased construction of local housing units. Given the current population-to-student ratio in the ROI, a population of this size would be expected to include 777 students, and local school districts would increase the number of classrooms to accommodate them.

Community services in the ROI would be expected to change to accommodate the population growth as follows: 48 teachers would be added to maintain the current student-to-teacher ratio of 16:1; 6 police officers would be added to maintain the current officer-to-population ratio of 1.6:1,000; 13 firefighters would be added to maintain the current firefighter-to-population ratio of 3.4:1,000; and 5 physicians would be added to maintain the current physician-to-population ratio of 1.4:1,000. Thus, an additional 72 positions would have to be created to maintain community services at current levels. Hospitals in the ROI would not experience any change from the 2.1 beds per 1,000 persons currently available. Moreover, average school enrollment would increase to 94.3 percent from the current 92.5 percent unless additional classrooms were built. None of these projected changes should have a major impact on the level of community services currently offered in the ROI.

4.6.2.4 Human Health Risk

During normal operation of the plutonium disposition facilities, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–64 reflects the potential radiological impacts on three individual receptor groups at Pantex and Hanford: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–64. Potential Radiological Impacts on the Public of Operations Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Impact	Pit Conversion	Immobilization		MOX	Hanford Total
		Ceramic	Glass		
Population within 80 km for year 2010					
Dose (person-rem)	0.58	7.8×10^{-3}	7.1×10^{-3}	0.11	0.12
Percent of natural background[a]	5.8×10^{-4}	6.7×10^{-6}	6.1×10^{-6}	9.5×10^{-5}	1.0×10^{-4}
10-year latent fatal cancers	2.9×10^{-3}	3.9×10^{-5}	3.6×10^{-5}	5.5×10^{-4}	5.9×10^{-4}
Maximally exposed individual					
Annual dose (mrem)	0.062	1.1×10^{-4}	9.7×10^{-5}	1.8×10^{-3}	1.9×10^{-3}
Percent of natural background[a]	0.019	3.7×10^{-5}	3.2×10^{-5}	6.0×10^{-4}	6.4×10^{-4}
10-year latent fatal cancer risk	3.1×10^{-7}	5.5×10^{-10}	4.9×10^{-10}	9.0×10^{-9}	9.5×10^{-9}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	1.9×10^{-3}	2.0×10^{-5}	1.8×10^{-5}	2.8×10^{-4}	3.0×10^{-4}
10-year latent fatal cancer risk	9.5×10^{-9}	1.0×10^{-10}	9.0×10^{-11}	1.4×10^{-9}	1.5×10^{-9}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and Hanford (387,800) in 2010.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Source: Appendix J.

Given incident-free operation of all three facilities, the projected total population dose in the year 2010 would be 0.58 person-rem at Pantex and 0.12 person-rem at Hanford. The corresponding number of LCFs in the population from 10 years of operation would be 2.9×10^{-3} around Pantex and 5.9×10^{-4} around Hanford. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization and MOX facilities at Hanford would be 1.9×10^{-3} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 9.5×10^{-9}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–65; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities would be an estimated 192, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–65. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–65. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Impact	Pit Conversion	MOX	Immobilization (Ceramic or Glass)	Hanford Total
Number of badged workers	383	350	258	608
Total dose (person-rem/yr)	192	175	194	369
10-year latent fatal cancers	0.77	0.70	0.77	1.5
Average worker dose (mrem/yr)	500	500	750	607[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: *UC 1998b, 1998c, 1998d, 1998k.*

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at Hanford under this alternative would be the same as that for Alternative 2, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released as a result of operations.

No hazardous chemicals would be released as a result of operations at Pantex under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.6.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are presented in Table 4–66. The potential consequences of such accidents from operation of the immobilization and MOX facilities at Hanford are equivalent to those included in Alternative 2 (see Tables 4–28 through 4–30). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for this alternative would be associated with a tritium release from the pit conversion facility. Bounding radiological consequences for the MEI are from the tritium release at Pantex, which would result in a dose of 0.058 rem, corresponding to an LCF probability of 2.9×10^{-5}. Among the general population in the environs of Pantex, the bounding tritium release accident would result in an estimated 0.012 LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year. At Hanford, the design basis accidents for the immobilization and MOX facilities would be equivalent to those presented in Alternative 2, see Section 4.3.2.5.

A beyond-design-basis earthquake at Pantex could result in collapse of the pit conversion facility and an estimated 1.5 LCFs among the general population. A similar earthquake at Hanford could result in total collapse of FMEF and the new MOX facility, with an estimated 29 LCFs. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Table 4–66. Accident Impacts of Pit Conversion Under Alternative 4A: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in New Construction at Hanford

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Fire	Unlikely	5.2×10^{-6}	2.1×10^{-9}	2.1×10^{-6}	1.0×10^{-9}	8.6×10^{-4}	4.3×10^{-7}
Explosion	Unlikely	1.4×10^{-3}	5.4×10^{-7}	5.4×10^{-4}	2.7×10^{-7}	2.2×10^{-1}	1.1×10^{-4}
Leaks/spills of nuclear material	Extremely unlikely	1.9×10^{-6}	7.6×10^{-10}	7.6×10^{-7}	3.8×10^{-10}	3.1×10^{-4}	1.6×10^{-7}
Tritium release	Extremely unlikely	1.4×10^{-1}	5.8×10^{-5}	5.8×10^{-2}	2.9×10^{-5}	2.4×10^{1}	1.2×10^{-2}
Criticality	Extremely unlikely	1.5×10^{-2}	6.0×10^{-6}	6.0×10^{-3}	3.0×10^{-6}	1.6	8.5×10^{-4}
Design basis earthquake	Unlikely	1.7×10^{-4}	6.7×10^{-8}	6.7×10^{-5}	3.3×10^{-8}	2.8×10^{-2}	1.4×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	2.8×10^{-2}	1.1×10^{-5}	4.4×10^{-3}	2.2×10^{-6}	1.3	6.3×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	6.4×10^{1}	2.6×10^{-2}	1.0×10^{1}	5.1×10^{-3}	3.0×10^{3}	1.5
Aircraft crash[d]	Beyond extremely unlikely	3.6×10^{1}	1.5×10^{-2}	5.7	2.9×10^{-3}	1.7×10^{3}	8.3×10^{-1}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
[d] For the aircraft crash accident, the dose at 1,000 m (3,281 ft) is beyond the range of applicability of the standard probability coefficient for determining the likelihood of fatal cancer (i.e., 4×10^{-4} LCF per rem). The standard coefficient would tend to overstate the cancer fatality risk at the stated dose. Also, the dose may be in the range where subacute injury is an additional concern.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: Calculated using the source terms in Table K–11 and the MACCS2 computer code.

A beyond-design-basis aircraft crash at Pantex, involving a large commercial or military jet aircraft, was also evaluated based on public interest. This crash could result in penetration of the pit conversion facility by a crash-induced missile such as a jet turbine shaft, causing a release of plutonium and an estimated 0.83 LCF among the general population. Other possible consequences of such a crash include immediate fatality to the aircraft occupants, as well as serious injuries and fatalities to persons in the pit conversion facility and the surrounding area who are impacted by the aircraft or building debris. The frequency of such an airplane crash is estimated to be less than 1 in 1,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the tritium release. The consequences of such an accident would include an LCF probability of 5.8×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers either would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Pantex and Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,779 person-years of labor and the standard DOE occupational accident rates, approximately 345 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.6.2.6 Transportation

Under Alternative 4A, transportation to and from Pantex would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transported to the MOX facility at Hanford for fabrication into MOX fuel pellets.

It is assumed that depleted uranium hexafluoride needed for MOX fuel would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide (see Section 4.3.2.6). After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at Hanford. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at Hanford under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at Hanford. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to HLWVF in 200 Area. This intrasite transportation—from 400 Area to 200 Area—could require the temporary shutdown of roads on the Hanford site. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at HLWVF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 4A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Under all of the alternatives being considered in this SPD EIS, some transportation would be required to support routine shipments of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.6.1.2 and 4.6.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

TRU waste generated at Pantex, however, was not covered by the WM PEIS ROD, as there was no such waste at Pantex at the time the ROD was issued, and none was likely to be generated in ongoing site operations. Location of the pit conversion facility at Pantex would result in the generation of TRU waste, as described in Section 4.6.2.2. Moreover, a fairly large increase in the amount of LLW at Pantex (i.e., 25 percent of the site's current storage capacity) could be expected under this alternative. Currently, this type of waste is shipped to the NTS for disposal. In order to account for the transportation of TRU waste from Pantex to WIPP, and LLW from Pantex to NTS, additional shipments are analyzed in this SPD EIS.

In all, approximately 2,200 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 6.2 million km (3.9 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed at this alternative has been estimated at 26 person-rem; the dose to the public, 38 person-rem. Accordingly, the incident-free transportation of radioactive material associated with this alternative would to result in 0.010 LCF among transportation workers and 0.019 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.018.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of plutonium oxide from the pit conversion facility at Pantex to Hanford with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. The accident could result in a dose of 145 person-rem to the public for an LCF risk of 0.07 and 159 rem to the hypothetical MEI for an LCF risk of 0.08. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 4A are as follows: a radiological dose to the population of 23 person-rem, resulting in a total population risk of 0.011 LCF; and traffic accidents resulting in 0.068 traffic fatalities.

4.6.2.7 Environmental Justice

As discussed in other parts of Section 4.6.2, routine operations conducted under Alternative 4A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million, and would be approximately 1 in 100 million for the MEI residing near Hanford (see Table 4–64). The number of LCFs expected among the general populations residing near Pantex and Hanford from accident-free operations would be approximately 2.9×10^{-3} and 5.9×10^{-4}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.5.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Table 4–66). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.6.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 4A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.7 ALTERNATIVE 4B

Alternative 4B would involve constructing and operating the pit conversion facility in Zone 4 at Pantex, and the immobilization and MOX facilities in the existing FMEF building in the 400 Area at Hanford. Activities at Pantex would be the same as under Alternative 4A.

4.7.1 Construction

4.7.1.1 Air Quality and Noise

Potential air quality and noise impacts of construction under Alternative 4B at Pantex are the same as those for Alternative 4A (see Section 4.6.1.1).

Sources of potential air quality impacts of construction under Alternative 4B at Hanford include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at Hanford, with standards and guidelines is presented as Table 4–67. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards as a result of activities at Hanford. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe. Noise impacts would be similar to those for Alternative 4A at Hanford (see Section 4.6.1.1).

4.7.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as for Alternative 4A. See Section 4.6.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

Table 4–68 compares the wastes generated during modification of the FMEF building at Hanford with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year modification period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during modification. However, if any were generated, the waste should be managed in accordance with site practice and applicable Federal and State regulations. Waste generated during modification would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during modification of the FMEF building would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during modification would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment,

Table 4–67. Evaluation of Hanford Air Pollutant Concentrations Associated With Construction Under Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.511	34.6	0.35
	1 hour	40,000	3.48	51.7	0.13
Nitrogen dioxide	Annual	100	0.0398	0.29	0.29
PM_{10}	Annual	50	0.0463	0.0642	0.13
	24 hours	150	2.16	2.93	2.0
Sulfur dioxide	Annual	50	0.00406	1.63	3.1
	24 hours	260	0.0452	8.96	3.4
	3 hours	1,300	0.307	29.9	2.3
	1 hour	700	0.922	33.9	5.2
Other regulated pollutants					
Total suspended particulates	Annual	60	0.0855	0.103	0.17
	24 hours	150	3.90	4.67	3.1
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0.000008	0.000014	0.012

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

Table 4–68. Potential Waste Management Impacts of Construction at Hanford Under Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford

		Estimated Additional Waste Generation as a Percent of[b]		
Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	13	NA	NA	NA
Nonhazardous				
Liquid	18,300	8[c]	NA	8[d]
Solid	510	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year modification period.
[c] Percent of capacity of 400 Area sanitary sewer.
[d] Percent of capacity of the WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); WPPSS, Washington Public Power Supply System.

and disposal facilities. The additional waste load generated during the modification period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid wastes generated during modification of the FMEF building would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at Hanford.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during modification of the FMEF building at Hanford would be managed on the site at the WPPSS Sewage Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generated during modification is estimated to be 8 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and 8 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, management of these wastes at Hanford should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

4.7.1.3 Socioeconomics

Construction-related employment requirements for Alternative 4B would be as indicated in Table 4–69.

Table 4–69. Construction Employment Requirements for Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford

Year	Pit Conversion	Immobilization	MOX	Total
2001	298	0	0	298
2002	452	167	290	909
2003	275	268	362	905
2004	0	236	290	526
2005	0	0	170	170
2006	0	0	160	160

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: UC 1998b, 1998c, 1998d, 1998k.

Employment requirements for construction of a new pit conversion facility at Pantex under this alternative would be the same as those for Alternative 4A (see Section 4.6.1.3).

At its peak in 2003, construction of the immobilization and MOX facilities at Hanford would require 630 construction workers and generate another 647 indirect jobs in the region. As this total employment requirement of 1,277 direct and indirect jobs in 2003 represents less than 0.4 percent of the projected REA workforce, it should have no major impact on the REA. This requirement should also have little impact on community services currently offered in the ROI. In fact, it should help offset the approximately 15 percent reduction in Hanford employment (i.e., from 12,900 to approximately 11,000 workers) projected for the years 1997–2005.

4.7.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. According to recent radiation surveys (DOE 1997e; Antonio 1998) conducted in the Zone 4 area at Pantex and the 400 Area at Hanford, construction workers would not be expected to receive any additional radiation exposure above natural background levels in those areas. Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at Hanford under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

No hazardous chemicals would be released as a result of construction activities at Pantex under this alternative; therefore, no cancer or adverse, noncancer health effects would occur.

4.7.1.5 Facility Accidents

Construction of new plutonium conversion facilities at Pantex and Hanford could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,968 person-years of construction labor and standard industrial accident rates, approximately 290 cases of nonfatal occupational injury or illness and 0.42 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.7.1.6 Environmental Justice

As discussed in the other parts of Section 4.7.1, construction under Alternative 4B would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 4B at Pantex and Hanford would have no significant impacts on minority or low-income populations.

4.7.2 Operations

4.7.2.1 Air Quality and Noise

Potential air quality and noise impacts of the operation of the new pit conversion facility under Alternative 4B at Pantex are the same as those for Alternative 4A (see Section 4.6.2.1).

Potential air quality impacts of the operation of facilities under 4B at Hanford were analyzed using ISCST3 as described in Appendix F.1. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the plutonium disposition facilities, with standards and guidelines is presented as Table 4–70. Concentrations for immobilization in the ceramic form are presented because they are greater than those for the glass form. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

For a discussion of how the operation of the immobilization and MOX facilities at Hanford would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAP limits applicable to operation of these facilities.

The increases in air pollutant concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of these facilities would be a small fraction of the PSD Class II area increments as summarized in Table 4–71.

Table 4–70. Evaluation of Hanford Air Pollutant Concentrations Associated With Operations Under Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.386	34.5	0.35
	1 hour	40,000	2.31	50.6	0.13
Nitrogen dioxide	Annual	100	0.0294	0.279	0.28
PM_{10}	Annual	50	0.00209	0.02	0.04
	24 hours	150	0.0232	0.793	0.53
Sulfur dioxide	Annual	50	0.00194	1.63	3.1
	24 hours	260	0.0216	8.93	3.4
	3 hours	1,300	0.147	29.8	2.3
	1 hour	700	0.44	33.3	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.00209	0.02	0.033
	24 hours	150	0.0232	0.793	0.53
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	420	0.0406	0.0406	0.0097

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

Table 4–71. Evaluation of Hanford Air Pollutant Increases Associated With Operations Under Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0294	25	0.12
PM_{10}	Annual	0.00209	17	0.012
	24 hours	0.0232	30	0.077
Sulfur dioxide	Annual	0.00194	20	0.0097
	24 hours	0.0216	91	0.024
	3 hours	0.147	512	0.029

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

Noise impacts would be similar to those for Alternative 4A at Hanford (see Section 4.6.2.1).

The combustion of fossil fuels associated with Alternative 4B would result in the emission of carbon dioxide, which is one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative represent less than 6×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.7.2.2 Waste Management

Impacts of operations for this alternative would be the same as for Alternative 4A. See Section 4.6.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex and Hanford.

4.7.2.3 Socioeconomics

Employment requirements for operation of the new pit conversion facility at Pantex under Alternative 4B would be the same as those for Alternative 4A (see Section 4.6.2.3).

Employment requirements for operation of the immobilization and MOX facilities at Hanford under Alternative 4B would be the same as those for Alternative 4A (see Section 4.6.2.3).

4.7.2.4 Human Health Risk

During normal operation of plutonium disposition facilities under Alternative 4B, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows:

Radiological Impacts. Table 4–72 reflects the potential radiological impacts on three individual receptor groups at Pantex and Hanford: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three facilities, the projected total population dose in the year 2010 would be 0.58 person-rem at Pantex and 0.059 person-rem at Hanford. The corresponding number of LCFs in the population from 10 years of operation would be 2.9×10^{-3} around Pantex and 3.0×10^{-4} around Hanford. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding LCF risk of to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization and MOX facilities at Hanford would be 8.0×10^{-4} mrem. From 10 years of operation, the corresponding LCF risk of to this individual would be 4.0×10^{-9}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–73; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities would be an estimated 192, 175, and

Table 4–72. Potential Radiological Impacts on the Public of Operations Under Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford

Impact	Pit Conversion	Immobilization Ceramic	Immobilization Glass	MOX	Hanford Total
Population within 80 km for year 2010					
Dose (person-rem)	0.58	7.8×10^{-3}	7.1×10^{-3}	0.051	0.059
Percent of natural background[a]	5.8×10^{-4}	6.7×10^{-6}	6.1×10^{-6}	4.4×10^{-5}	5.1×10^{-5}
10-year latent fatal cancers	2.9×10^{-3}	3.9×10^{-5}	3.6×10^{-5}	2.6×10^{-4}	3.0×10^{-4}
Maximally exposed individual					
Annual dose (mrem)	0.062	1.1×10^{-4}	9.7×10^{-5}	6.9×10^{-4}	8.0×10^{-4}
Percent of natural background[a]	0.019	3.7×10^{-5}	3.2×10^{-5}	2.3×10^{-4}	2.7×10^{-4}
10-year latent fatal cancer risk	3.1×10^{-7}	5.5×10^{-10}	4.9×10^{-10}	3.5×10^{-9}	4.0×10^{-9}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	1.9×10^{-3}	2.0×10^{-5}	1.8×10^{-5}	1.3×10^{-4}	1.5×10^{-4}
10-year latent fatal cancer risk	9.5×10^{-9}	1.0×10^{-10}	9.0×10^{-11}	6.5×10^{-10}	7.5×10^{-10}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and Hanford (387,800) in 2010.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: Appendix J.

194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–73. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–73. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	Hanford Total
Number of badged workers	383	258	350	608
Total dose (person-rem/yr)	192	194	175	369
10-year latent fatal cancers	0.77	0.77	0.70	1.5
Average worker dose (mrem/yr)	500	750	500	607[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998b, 1998c, 1998d, 1998k.

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at Hanford under this alternative would be the same as that for Alternative 2, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released.

4.7.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are equivalent to those of Alternative 4A (see Table 4–66), and the potential consequences from operation of the immobilization facility at Hanford, equivalent to those included in Alternative 2 (see Tables 4–28 and 4–29). The potential impacts of such accidents from operation of the MOX facility in FMEF at Hanford are presented in Table 4–74. More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Table 4–74. Accident Impacts of MOX Facility Under Alternative 4B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF and MOX in FMEF at Hanford

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in sintering furnace	Extremely unlikely	4.9×10^{-4}	2.0×10^{-7}	7.4×10^{-5}	3.7×10^{-8}	2.4×10^{-1}	1.2×10^{-4}
Fire	Extremely unlikely	3.0×10^{-6}	1.2×10^{-9}	4.5×10^{-7}	2.3×10^{-10}	1.5×10^{-3}	7.3×10^{-7}
Design basis earthquake	Unlikely	7.0×10^{-5}	2.8×10^{-8}	1.1×10^{-5}	5.3×10^{-9}	3.4×10^{-2}	1.7×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	6.1×10^{-2}	2.4×10^{-5}	2.3×10^{-3}	1.1×10^{-6}	5.6	2.4×10^{-3}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.7×10^{2}	2.3×10^{-1}	2.2×10^{1}	1.1×10^{-2}	5.3×10^{4}	2.3×10^{1}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: Calculated using the source terms in Table K–7 and the MACCS2 computer code.

Public. The most severe consequences of a design basis accident for the pit conversion and immobilization facilities under this alternative would be equivalent to the accidents discussed in Section 4.6.2.5 and Section 4.3.2.5, respectively. The most severe consequences of a design basis accident for the MOX facility in FMEF would be a nuclear criticality. A nuclear criticality of 10^{19} fissions would result in an MEI dose of 3.4×10^{-3} rem for the MOX facility corresponding to an LCF probability of 1.7×10^{-6}. Among the general population around Hanford, an estimated 2.7×10^{-3} LCF could occur as a result of the MOX criticality accident. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

A beyond-design-basis earthquake at Hanford could result in collapse of FMEF, including both immobilization and MOX facilities, with an estimated 29 LCFs. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

The beyond-design-basis accidents at Pantex would be equivalent to those discussed in Section 4.6.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 5.8×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Pantex and Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,779 person-years of labor and the standard DOE occupational accident rates, approximately 345 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.7.2.6 Transportation

Because the only difference between Alternative 4A and 4B is the location of the MOX facility within 400 Area at Hanford, the transportation required for Alternative 4B would be the same as that for Alternative 4A. Therefore, the transportation risks associated with Alternative 4B are equivalent to those discussed in Section 4.6.2.6.

4.7.2.7 Environmental Justice

As discussed in other parts of Section 4.7.2, routine operations conducted under Alternative 4B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million (see Table 4–72); the likelihood for the MEI residing near Hanford would be essentially zero. The number of LCFs expected among the general population residing near Pantex and Hanford from accident-free operations would increase by approximately 2.9×10^{-3} and 3.0×10^{-4}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.7.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–28, 4–29, 4–66, and 4–74). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.7.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 4B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.8 ALTERNATIVE 5A

Alternative 5A would involve constructing and operating the pit conversion facility in Zone 4 at Pantex and the immobilization and MOX facilities at SRS. The immobilization and MOX facilities would be located in new buildings in F-Area. Activities at Pantex would be the same as under Alternative 4A.

4.8.1 Construction

4.8.1.1 Air Quality and Noise

Potential air quality impacts of the construction of plutonium disposition facilities under Alternative 5A at Pantex are the same as those for Alternative 4A (see Section 4.6.1.1).

Noise impacts are the same as those for Alternative 4A at Pantex (see Section 4.6.1.1).

Sources of potential air quality impacts of construction under Alternative 5A at SRS include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at SRS, with standards and guidelines is presented as Table 4–75. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

Table 4–75. Evaluation of SRS Air Pollutant Concentrations Associated With Construction Under Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.1	65.1	0.65
	1 hour	40,000	5.01	284	0.71
Nitrogen dioxide	Annual	100	0.0415	9.34	9.3
PM_{10}	Annual	50	0.0259	4.16	8.3
	24 hours	150	2.65	59	39
Sulfur dioxide	Annual	80	0.0042	15.1	19
	24 hours	365	0.103	219	60
	3 hours	1,300	0.621	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.0415	14.7	20
Hazardous and other toxic compounds					
Other toxics[b]	24 hours	150	0.000224	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

4.8.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as for Alternative 4A. See Section 4.6.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

Table 4–76 compares the wastes generated during construction of surplus plutonium disposition facilities at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during construction of surplus plutonium disposition facilities would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for

Table 4–76. Potential Waste Management Impacts of Construction at SRS Under Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	22	NA	NA	NA
Nonhazardous				
Liquid	22,800	8[c]	NA	2[d]
Solid	2,520	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of F-Area sanitary sewer.
[d] Percent of capacity of the Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of the immobilization and MOX facilities would be managed on the site at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 8 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 2 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.8.1.3 Socioeconomics

Construction-related employment requirements for Alternative 5A would be as indicated in Table 4–77.

Table 4–77. Construction Employment Requirements for Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Year	Pit Conversion	Immobilization	MOX	Total
2001	298	0	0	298
2002	452	312	290	1,054
2003	275	448	508	1,231
2004	0	282	334	616
2005	0	0	170	170
2006	0	0	160	160

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998f, 1998g, 1998h, 1998k.

At its peak in 2002, construction of the new pit conversion facility at Pantex under this alternative would require 452 construction workers and generate another 381 indirect jobs in the region. As the total employment requirement of 833 direct and indirect jobs represents only 0.3 percent of the projected REA workforce, it should have no major impact on the REA. It should also have little impact on community services within the ROI. In fact, it should help offset the nearly 40 percent reduction in the total Pantex workforce from—i.e., from 2,900 to 1,750 workers—projected for the years 1997–2005.

At its peak in 2003, construction of the immobilization and MOX facilities at SRS would require 956 construction workers and generate another 767 indirect jobs in the region. The total employment requirement of 1,723 direct and indirect jobs represents less than 0.7 percent of the projected REA workforce, and thus should have no major impact on the REA. This requirement should also have little impact on community services within the ROI. In fact, it should help offset the nearly 20 percent reduction in SRS' overall labor force—i.e., from 15,000 to 12,000 workers—projected for the years 1997–2005.

4.8.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–78. According to a recent radiation survey (DOE 1997e) conducted in the Zone 4 area at Pantex, construction workers would not be expected to receive any additional radiation exposure above natural background levels in the area. Data indicate, at SRS however, that a construction worker could be exposed to radiation deriving from other activities, past or present, at the site. Regardless of location, construction worker exposures would be limited to ensure that doses are kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Table 4–78. Potential Radiological Impacts on Construction Workers of Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Impact	Pit Conversion[a]	Immobilization[b]	MOX[c]	SRS Total
Total dose (person-rem/yr)	0	1.4	1.2	2.6
Annual latent fatal cancers[d]	0	5.6×10^{-4}	4.8×10^{-4}	1.0×10^{-3}
Average worker dose (mrem/yr)	0	4	4	4[e]
Annual latent fatal cancer risk	0	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] An estimated average of 342 workers would be associated with annual construction operations.
[b] An estimated average of 347 workers would be associated with annual construction operations at the new facility location adjacent to APSF. The number would be the same for immobilization in either ceramic or glass.
[c] An estimated average of 292 workers would be associated with annual construction operations.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for both facilities.
Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1997e; ICRP 1991; NAS 1990; UC 1998f, 1998g, 1998h, 1998k.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at SRS under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

No hazardous chemicals would be released as a result of construction activities at Pantex under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.8.1.5 Facility Accidents

Construction of plutonium disposition facilities at Pantex and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 3,529 person-years of construction labor and standard industrial accident rates, approximately 350 cases of nonfatal occupational injury or illness and 0.49 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.8.1.6 Environmental Justice

As discussed in the other parts of Section 4.8.1, construction under Alternative 5A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities conducted under Alternative 5A at SRS would have no significant impacts on minority or low-income populations.

4.8.2 Operations

4.8.2.1 Air Quality and Noise

Potential air quality impacts of the operation of the new pit conversion facility under Alternative 5A at Pantex are the same as those for Alternative 4A (see Section 4.6.2.1). Noise impacts are the same as those for Alternative 4A at Pantex (see Section 4.6.2.1).

Source of potential air quality impacts of the operation of facilities under Alternative 5A at SRS were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the plutonium disposition facilities, with standards and guidelines is presented as Table 4–79. Concentrations of air pollutant concentrations would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

For a discussion of how the operation of the immobilization and MOX facilities at SRS would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAP limits applicable to operation of these facilities.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide are a small fraction of the PSD Class II area increments, as summarized in Table 4–80.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the

Table 4–79. Evaluation of SRS Air Pollutant Concentrations Associated With Operations Under Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.25	64.3	0.64
	1 hour	40,000	0.92	280	0.70
Nitrogen dioxide	Annual	100	0.0183	9.32	9.3
PM_{10}	Annual	50	0.00121	4.14	8.3
	24 hours	150	0.0223	56.4	38
Sulfur dioxide	Annual	80	0.0471	15.1	19
	24 hours	365	0.649	220	60
	3 hours	1,300	1.72	963	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.00121	14.7	20
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	650	0.0585	0.254	0.039

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

Table 4–80. Evaluation of SRS Air Pollutant Increases Associated With Operations Under Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0183	25	0.073
PM_{10}	Annual	0.00121	17	0.0071
	24 hours	0.0223	30	0.074
Sulfur dioxide	Annual	0.0471	20	0.24
	24 hours	0.649	91	0.71
	3 hours	1.72	512	0.34

Key: DWPF, Defense Waste Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

The combustion of fossil fuels associated with Alternative 5A would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.8.2.2 Waste Management

At Pantex, operation impacts of this alternative would be the same as for Alternative 4A. Therefore, see Section 4.6.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

Table 4–81 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at SRS. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation at SRS should be the same for the ceramic and glass immobilization technologies.

Table 4–81. Potential Waste Management Impacts of Operations at SRS Under Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	141	8	4	1 of WIPP
LLW	94	1	NA	3
Mixed LLW	3	<1	2	NA
Hazardous	<31	<1	6	NA
Nonhazardous				
Liquid	51,000	18[d]	NA	5[e]
Solid	<380	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU wastes generated at the immobilization and MOX facilities at SRS is estimated to be 8 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,410 m^3 (1,840 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 4 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.20 ha (0.49 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,590 m^3 (2,080 yd^3) of additional TRU wastes generated at Pantex and SRS would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

At SRS, LLW would be packaged, certified, and accumulated at the immobilization and MOX facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 940 m^3 (1,230 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility and 3 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.11 ha (0.27 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

At SRS, mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan. Mixed LLW generated at the immobilization and MOX facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility, and 2 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

At SRS, any hazardous wastes generated during operation of the immobilization and MOX facilities would be packaged for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the immobilization and MOX facilities at SRS were treated in the Consolidated Incinerator Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

At SRS, nonhazardous wastewater generated by the immobilization and MOX facilities would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at SRS is estimated to be 18 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 5 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.8.2.3 Socioeconomics

Under Alternative 5A, operation of the pit conversion facility at Pantex would begin in 2004 and should require 400 new workers (UC 1998k). This level of employment should generate another 1,355 indirect jobs within the region. The total employment requirement of 1,755 direct and indirect jobs represents less than 0.7 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have little impact on community services within the Pantex ROI. In fact, it should help offset the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2010.

After construction, startup, and testing of the immobilization and MOX facilities at SRS in 2007 under Alternative 5A, an estimated 596 new workers would be required to operate them (UC 1998f, 1998g, 1998h). This level of employment would be expected to generate another 1,066 indirect jobs within the region. The total employment requirement of 1,662 direct and indirect jobs represents less than 0.6 percent of the projected REA workforce, and thus should have no major impact on the REA. The additional required workers should also have little impact on community services within the ROI. In fact, they should help offset the 33 percent reduction in the total SRS workforce (i.e., 15,000 to 10,000 workers) projected for the years 1997–2010.

4.8.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows:

Radiological Impacts. Table 4–82 reflects the potential radiological impacts on three individual receptor groups at Pantex and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 0.58 person-rem at Pantex and 0.031 person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 2.9×10^{-3} around Pantex and 1.6×10^{-4} around SRS. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization and MOX facilities at SRS would be 3.3×10^{-4} mrem. From 10 years of operation, the corresponding LCF risk of to this individual would be 1.7×10^{-9}. The impacts on the average individual would be lower.

Table 4–82. Potential Radiological Impacts on the Public of Operations Under Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Impact	Pit Conversion	Immobilization		MOX	SRS Total
		Ceramic	Glass		(Ceramic or Glass)
Population within 80 km for year 2010					
Dose (person-rem)	0.58	2.3×10^{-3}	2.2×10^{-3}	0.029	0.031
Percent of natural background[a]	5.8×10^{-4}	1.0×10^{-6}	1.0×10^{-6}	1.3×10^{-5}	1.4×10^{-5}
10-year latent fatal cancers	2.9×10^{-3}	1.2×10^{-5}	1.1×10^{-5}	1.5×10^{-4}	1.6×10^{-4}
Maximally exposed individual					
Annual dose (mrem)	0.062	2.4×10^{-5}	2.2×10^{-5}	3.1×10^{-4}	3.3×10^{-4}
Percent of natural background[a]	0.019	8.1×10^{-6}	7.5×10^{-6}	1.1×10^{-4}	1.2×10^{-4}
10-year latent fatal cancer risk	3.1×10^{-7}	1.2×10^{-10}	1.1×10^{-10}	1.6×10^{-9}	1.7×10^{-9}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	1.9×10^{-3}	2.9×10^{-6}	2.8×10^{-6}	3.7×10^{-5}	4.0×10^{-5}
10-year latent fatal cancer risk	9.5×10^{-9}	1.5×10^{-11}	1.4×10^{-11}	1.9×10^{-10}	2.0×10^{-10}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and the SRS APSF (785,400) in 2010.
Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.
Source: Appendix J.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–83; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; for immobilization facility workers, 750 mrem.

The annual dose received by the total site workforce for each of these facilities has been estimated at 192, 175, and 174 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–83. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at SRS under this alternative would be the same as that for Alternative 3A, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released.

No hazardous chemicals would be released as a result of operations at Pantex under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

Table 4–83. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 5A: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF and MOX in New Construction at SRS

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	SRS Total
Number of badged workers	383	232	350	582
Total dose (person-rem/yr)	192	174	175	349
10-year latent fatal cancers	0.77	0.70	0.70	1.4
Average worker dose (mrem/yr)	500	750	500	600[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998f, 1998g, 1998h, 1998k.

4.8.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex would be equivalent to those of Alternative 4A (see Table 4–66), and the potential consequences from operation of the immobilization and MOX facilities at SRS, equivalent to those included in Alternative 3A (see Tables 4–41 through 4–43). More details on the method of analysis, assumptions, and specific accident scenarios are presented for Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for the pit conversion facility are shown in Section 4.6.2.5; the most severe consequences for the immobilization and MOX facilities, in Section 4.4.2.5.

A beyond-design-basis earthquake at SRS could result in total collapse of the immobilization and MOX facilities, with an estimated 13 LCFs. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

The beyond-design-basis accidents at Pantex would be equivalent to those discussed in Section 4.6.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 5.8×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Pantex and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,581 person-years of labor and the standard DOE occupational accident rates, approximately 339 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.8.2.6 Transportation

Under Alternative 5A, transportation to and from Pantex would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transported to the to the MOX facility at SRS for fabrication into MOX fuel pellets.

It is assumed that depleted uranium hexafluoride needed for MOX fuel would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide (see Section 4.3.2.6). After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at SRS. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at SRS under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to DWPF in S-Area. This intrasite transportation—from F-Area to S-Area—could require the temporary shutdown of roads on SRS. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at DWPF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 5A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.8.1.2 and 4.8.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites, as analyzed in the WM PEIS.

However, TRU waste generated at Pantex was not covered by the WM PEIS ROD, as there was no such waste at Pantex at the time the ROD was issued, and none was likely to be generated in ongoing site operations. Location of the pit conversion facility at Pantex would result in the generation of TRU waste, as described in Section 4.8.2.2. Moreover, a fairly large increase in the amount of LLW at Pantex (i.e., 25 percent of the site's current storage capacity) could be expected under this alternative. Currently, this type of waste is shipped to the NTS for disposal. In order to account for the transportation of TRU waste from Pantex to WIPP and LLW from Pantex to NTS, additional shipments are analyzed in this SPD EIS.

In all, approximately 2,400 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 6.8 million km (4.2 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 53 person-rem; the dose to the public, 60 person-rem. Accordingly, the incident-free transportation of radioactive material associated with this alternative would result in 0.021 LCF among transportation workers and 0.030 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.025.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of plutonium oxide from the pit conversion facility at Pantex to Savannah River with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. The accident could result in a dose of 145 person-rem to the public for an LCF risk of 0.07 and 159 rem to the hypothetical MEI for an LCF risk of 0.08. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 5A are as follows: a radiological dose to the population of 24 person-rem, resulting in a total population risk of 0.012 LCF; and traffic accidents resulting in 0.073 traffic fatalities.

4.8.2.7 Environmental Justice

As discussed in other parts of Section 4.8.2, routine operations conducted under Alternative 5A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million (see Table 4–82); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near Pantex and SRS from accident-free operations would increase by approximately 2.9×10^{-3} and 1.6×10^{-4}, respectively.

Design basis accidents at the site would not be expected to cause cancer fatalities among the public (see Section 4.8.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–66 and 4–41 through 4–43). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.8.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 5A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.9 ALTERNATIVE 5B

Alternative 5B would involve constructing and operating the pit conversion facility in Zone 4 at Pantex and the immobilization and MOX facilities at SRS. The immobilization facility would be located in the existing 221–F building, and the MOX facility would be located in a new building in F-Area. Activities at Pantex would be the same as under Alternative 4A.

4.9.1 Construction

4.9.1.1 Air Quality and Noise

Potential air quality impacts of construction of plutonium disposition facilities under Alternative 5B at Pantex are the same as those for Alternative 4A (see Section 4.6.1.1). Noise impacts are the same as those for Alternative 4A at Pantex (see Section 4.6.1.1).

Sources of potential air quality impacts of construction under Alternative 5B at SRS include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at SRS, with standards and guidelines is presented as Table 4–84. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

Noise impacts would be the same or less than those for Alternative 5A at SRS (see Section 4.8.1.1).

4.9.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as for Alternative 4A. See Section 4.6.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

Table 4–85 compares the wastes generated during construction of surplus plutonium disposition facilities at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that TRU waste and LLW would be generated during modification of Building 221–F. No mixed LLW would be generated during construction. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on

Table 4–84. Evaluation of SRS Air Pollutant Concentrations Associated With Construction Under Alternative 5B: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF and MOX in New Construction at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.623	64.6	0.65
	1 hour	40,000	2.79	281	0.70
Nitrogen dioxide	Annual	100	0.0235	9.32	9.3
PM_{10}	Annual	50	0.0145	4.15	8.3
	24 hours	150	1.5	57.9	39
Sulfur dioxide	Annual	80	0.00238	15.1	19
	24 hours	365	0.0585	219	60
	3 hours	1,300	0.349	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.0242	14.7	20
Hazardous and other toxic compounds					
Other toxics[b]	24 hours	150	0.000224	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

Table 4–85. Potential Waste Management Impacts of Construction at SRS Under Alternative 5B: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF and MOX in New Construction at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	50	3	<1	<1
LLW	500	NA	NA	5
Hazardous	15	NA	NA	NA
Nonhazardous				
Liquid	22,200	8[d]	NA	2[e]
Solid	1,390	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Construction is not expected to generate remotely handled TRU waste or mixed TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of the Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of the LLW is not routinely treated and stored on the site; it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); TRU, transuranic.

January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive and hazardous wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be packaged, and certified to WIPP waste acceptance criteria at the construction site. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU wastes generated by modification of Building 221-F at SRS is estimated to be 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 150 m^3 (196 yd^3) of TRU waste would be generated during construction. If all the TRU waste were stored on the site, this would be less than 1 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. If additional storage space were needed, and assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of less than 0.1 ha (0.25 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 150 m^3 (196 yd^3) of TRU wastes generated by construction of these facilities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the construction site before transfer for disposal in existing SRS facilities. A total of 1,500 m^3 (1,960 yd^3) of LLW would be generated during construction of surplus plutonium disposition facilities. LLW generated during construction is estimated to be 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,500 m^3 (1,960 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Hazardous wastes generated during construction of surplus plutonium disposition facilities at SRS would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities at SRS would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of the immobilization and MOX facilities at SRS would be managed on the site at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 8 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 2 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.9.1.3 Socioeconomics

Construction-related employment requirements for Alternative 5B would be as indicated in Table 4–86.

Table 4–86. Construction Employment Requirements for Alternative 5B: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF and MOX in New Construction at SRS

Year	Pit Conversion	Immobilization	MOX	Total
2001	298	0	0	298
2002	452	248	290	990
2003	275	400	508	1,183
2004	0	330	334	664
2005	0	0	170	170
2006	0	0	160	160

Key: DWPF, Defense Waste Processing Facility.
Source: NAS 1990; UC 1998h, 1998i, 1998j, 1998k.

Employment requirements for construction of the new pit conversion facility at Pantex under this alternative would be the same as those for Alternative 4A (see Section 4.6.1.3).

At its peak in 2003, construction of the immobilization and MOX facilities at SRS would require 908 construction workers and generate another 729 indirect jobs in the region. The total employment requirement of 1,637 direct and indirect jobs represents less than 0.6 percent of the projected REA workforce, and thus should have no major impacts on the REA. It should also have little impact on community services within the ROI. In fact, it should help offset the nearly 20 percent reduction in SRS employment (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.9.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–87. According to a recent radiation survey (DOE 1997e) conducted in the Zone 4 area at Pantex, construction workers would not be expected to receive any additional radiation exposure above natural background levels in the area. Data indicate, however, that a construction worker in F-Area at SRS could be exposed to radiation deriving from other activities, past or present, at the site. Regardless of location, construction worker exposures would be limited to ensure that doses are kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Hazardous Chemical Impacts. Because the estimated airborne concentration of benzene delivered to the maximally exposed member of the public at SRS under this alternative would be the same as that for Alternative 5A, the estimated cancer risk associated with this exposure would also be the same.

No hazardous chemicals would be released as a result of construction activities at Pantex under this alternative, thus, no cancer or adverse, noncancer health effects would occur.

Table 4–87. Potential Radiological Impacts on Construction Workers of Alternative 5B: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF and MOX in New Construction at SRS

Impact	Pit Conversion[a]	Immobilization[b]	MOX[c]	SRS Total
Total dose (person-rem/yr)	0	4.7	1.2	5.9
Annual latent fatal cancers[d]	0	1.9×10^{-3}	4.8×10^{-4}	2.4×10^{-3}
Average worker dose (mrem/yr)	0	15	4	9.7[e]
Annual latent fatal cancer risk	0	6.0×10^{-6}	1.6×10^{-6}	3.9×10^{-6}

[a] An estimated average of 230 workers would be associated with annual construction operations.
[b] There would be 315 workers associated with construction and modification of the existing Building 221–F. The number would be the same for immobilization in either ceramic or glass.
[c] An estimated average of 292 workers would be associated with annual construction operations.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for both facilities.
Key: DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1997e; ICRP 1991; NAS 1990; UC 1998h, 1998i, 1998j, 1998k.

4.9.1.5 Facility Accidents

Construction of plutonium disposition facilities at Pantex and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given on the estimated 3,465 person-years of construction labor and standard industrial accident rates, approximately 340 cases of nonfatal occupational injury or illness and 0.49 fatality could be expected (DOL 1997a, 1997b). As all construction would take place prior to introduction of the radiological process inventory, no noteworthy radiological accidents should occur.

4.9.1.6 Environmental Justice

As discussed in the other parts of Section 4.9.1, construction under Alternative 5B would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 5B at SRS would have no significant impacts on minority or low-income populations.

4.9.2 Operations

4.9.2.1 Air Quality and Noise

Potential air quality impacts of the operation of the new pit conversion facility under Alternative 5B at Pantex are the same as those for Alternative 4A at Pantex (see Section 4.6.2.1). Noise impacts are the same as those for Alternative 4A at Pantex (see Section 4.6.2.1).

Potential air quality impacts of the operation of facilities under Alternative 5B at SRS were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving material and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G. Maximum air pollutant concentrations are about the same as those for Alternative 5A at SRS (see Section 4.8.2.1). Noise impacts would be similar to those for Alternative 5A at SRS (see Section 4.8.2.1).

For a discussion of how the operation of the immobilization and MOX facilities at SRS would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAP limits applicable to operation of these facilities.

The combustion of fossil fuels associated with Alternative 5B would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.9.2.2 Waste Management

At Pantex, operation impacts of this alternative would be the same as for Alternative 4A. See Section 4.6.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

Table 4–88 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at SRS. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies.

Table 4–88. Potential Waste Management Impacts of Operations at SRS Under Alternative 5B: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF and MOX in New Construction at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	141	8	4	1 of WIPP
LLW	94	1	NA	3
Mixed LLW	3	<1	2	NA
Hazardous	<31	<1	6	NA
Nonhazardous				
Liquid	53,000	19[d]	NA	5[e]
Solid	<380	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU wastes generated by the immobilization and MOX facilities at SRS is estimated to be 8 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,410 m^3 (1,840 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 4 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.20 ha (0.49 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated at Pantex and SRS would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

At SRS, LLW would be packaged, certified, and accumulated at the immobilization and MOX facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 940 m^3 (1,230 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility and 3 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.11 ha (0.27 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

At SRS, mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan. Mixed LLW generated by the immobilization and MOX facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility, and 2 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

At SRS, any hazardous wastes generated during operation of the immobilization and MOX facilities would be packaged for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the immobilization and MOX facilities at SRS were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

At SRS, nonhazardous wastewater generated by the immobilization and MOX facilities would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at SRS is estimated to be 19 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 5 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.9.2.3 Socioeconomics

Employment requirements for operation of the new pit conversion facility at Pantex under Alternative 5B would be the same as those for Alternative 4A (see Section 4.6.2.3).

After construction, startup, and testing of the immobilization and MOX facilities at SRS in 2007 under Alternative 5B, an estimated 622 new workers would be required to operate them (UC 1998h, 1998i, 1998j). This level of employment would generate another 1,112 indirect jobs within the region. As the total employment requirement of 1,734 direct and indirect jobs represents only about 0.6 percent of the projected REA workforce, it should have no major impacts on the REA. The additional workers should also have little effect on community services within the ROI. In fact, they should help decrease the reduction in total site employment projected for the years 1997–2010 from 33.3 percent (i.e., 15,000 to 10,000 workers) to less than 30 percent.

4.9.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows:

Radiological Impacts. Table 4–89 reflects the potential radiological impacts on three individual receptor groups at Pantex and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three plutonium disposition facilities, the total population dose in the year 2010 would be 0.58 person-rem at Pantex and 0.031 person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 2.9×10^{-3} around Pantex and 1.6×10^{-4} around SRS. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization and MOX facilities at SRS would be 3.3×10^{-4} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.7×10^{-9}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and

Table 4–89. Potential Radiological Impacts on the Public of Operations Under Alternative 5B: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF and MOX in New Construction at SRS

Impact	Pit Conversion	Immobilization		MOX	SRS Total
		Ceramic	Glass		(Ceramic or Glass)
Population within 80 km for year 2010					
Dose (person-rem)	0.58	2.3×10^{-3}	2.2×10^{-3}	0.029	0.031
Percent of natural background[a]	5.8×10^{-4}	1.0×10^{-6}	1.0×10^{-6}	1.3×10^{-5}	1.4×10^{-5}
10-year latent fatal cancers	2.9×10^{-3}	1.2×10^{-5}	1.1×10^{-5}	1.5×10^{-4}	1.6×10^{-4}
Maximally exposed individual					
Annual dose (mrem)	0.062	2.4×10^{-5}	2.2×10^{-5}	3.1×10^{-4}	3.3×10^{-4}
Percent of natural background[a]	0.019	8.1×10^{-6}	7.5×10^{-6}	1.1×10^{-4}	1.2×10^{-4}
10-year latent fatal cancer risk	3.1×10^{-7}	1.2×10^{-10}	1.1×10^{-10}	1.6×10^{-9}	1.7×10^{-9}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	1.9×10^{-3}	2.9×10^{-6}	2.8×10^{-6}	3.7×10^{-5}	4.0×10^{-5}
10-year latent fatal cancer risk	9.5×10^{-9}	1.5×10^{-11}	1.4×10^{-11}	1.9×10^{-10}	2.0×10^{-10}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 231,000 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and the SRS facilities (about 783,000) in 2010.

Key: DWPF, Defense Waste Processing Facility.

Source: Appendix J.

reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operation are presented in Table 4–90; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–90. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at SRS under this alternative would be the same as that for Alternative 3A, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released as a result of operations.

No hazardous chemicals would be released as a result of operations at Pantex under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.9.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are equivalent to those of Alternative 4A (see Table 4–66); potential consequences from

Table 4–90. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 5B: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF and MOX in New Construction at SRS

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	SRS Total
Number of badged workers	383	258	350	608
Total dose (person-rem/yr)	192	194	175	369
10-year latent fatal cancers	0.77	0.77	0.70	1.5
Average worker dose (mrem/yr)	500	750	500	607[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/year (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998h, 1998i, 1998j, 1998k.

operation of the immobilization facility at SRS would be equivalent to those included in Alternative 3B (see Tables 4–51 and 4–52); and potential consequences from operation of the MOX facility at SRS, equivalent to those included in Alternative 3A (see Table 4–43). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of the design basis accident for the pit conversion facility are shown in Section 4.6.2.5; the most severe consequences for the immobilization and MOX facilities, in Section 4.4.2.5.

A beyond-design-basis earthquake at SRS could result in total collapse of the immobilization facility in Building 221–F and the new MOX facility, with an estimated 13 LCFs. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

The beyond-design-basis accidents at Pantex would be equivalent to those discussed in Section 4.6.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposal action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the design basis earthquake. The consequences of such an accident would include an LCF probability of 4.6×10^{-3}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Pantex and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,867 person-years of labor and the standard DOE occupational accident rates, approximately 348 cases of nonfatal occupational injury or illness and 0.35 fatality could be expected for the duration of operations.

4.9.2.6 Transportation

Because the only difference between Alternative 5A and 5B is the location of the immobilization facility within F-Area at SRS, the transportation required for Alternative 5B would be the same as that for Alternative 5A. Therefore, the transportation risks associated with Alternative 5B are equivalent to those discussed in Section 4.8.2.6.

4.9.2.7 Environmental Justice

As discussed in other parts of Section 4.9.2, routine operations conducted under Alternative 5B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million (see Table 4–89); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near Pantex and SRS from accident-free operations would increase by approximately 2.9×10^{-3} and 1.6×10^{-4}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.9.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–43, 4–51, 4–52, and 4–66). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.9.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 5B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.10 ALTERNATIVE 6A

Alternative 6A would involve constructing and operating the pit conversion and MOX facilities at Hanford and the immobilization facility at SRS. The pit conversion facility would be located in the existing FMEF building with the MOX facility located in a new building near FMEF. The immobilization facility would be located in a new facility in F-Area.

4.10.1 Construction

4.10.1.1 Air Quality and Noise

Sources of potential air quality impacts of Hanford construction under Alternative 6A include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from Hanford construction activities, with standards and guidelines is presented as Table 4–91. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat from current emissions during the planned construction period because of an expected decrease in overall site employment.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Sources of potential air quality impacts of construction under Alternative 6A at SRS include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at SRS, with standards and guidelines is presented as Table 4–92. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated

Table 4–91. Evaluation of Hanford Air Pollutant Concentrations Associated With Construction Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.16	35.2	0.35
	1 hour	40,000	7.9	56.2	0.14
Nitrogen dioxide	Annual	100	0.0896	0.34	0.34
PM_{10}	Annual	50	0.0866	0.105	0.21
	24 hours	150	2.94	3.71	2.5
Sulfur dioxide	Annual	50	0.00838	1.64	3.2
	24 hours	260	0.0931	9	3.4
	3 hours	1,300	0.633	30.2	2.3
	1 hour	700	1.9	34.8	5.3
Other regulated pollutants					
Total suspended particulates	Annual	60	0.179	0.197	0.33
	24 hours	150	5.57	6.34	4.2
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0.000008	0.000014	0.012

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise should not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with construction of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on

Table 4–92. Evaluation of SRS Air Pollutant Concentrations Associated With Construction Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.648	64.6	0.65
	1 hour	40,000	2.94	282	0.70
Nitrogen dioxide	Annual	100	0.0242	9.32	9.3
PM_{10}	Annual	50	0.0129	4.15	8.3
	24 hours	150	1.33	57.7	38
Sulfur dioxide	Annual	80	0.00245	15.1	19
	24 hours	365	0.0604	219	60
	3 hours	1,300	0.362	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.0187	14.7	20
Hazardous and other toxic compounds					
Hydrogen chloride	24 hours	175	0	1.06	0.61
Other toxics[b]	24 hours	150	0	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Processing Facility, SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

4.10.1.2 Waste Management

Tables 4–93 and 4–94 compare the wastes generated during construction of surplus plutonium disposition facilities at Hanford and SRS with the existing treatment, storage, and disposal capacity for the various waste types at each site. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during construction of surplus plutonium disposition facilities at Hanford and SRS would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on Hanford or SRS hazardous waste management systems.

Table 4–93. Potential Waste Management Impacts of Construction at Hanford Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	24	NA	NA	NA
Nonhazardous				
Liquid	14,300	6[c]	NA	6[d]
Solid	848	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of the 400 Area sanitary sewer.
[d] Percent of capacity of the WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); WPPSS, Washington Public Power Supply System.

Table 4–94. Potential Waste Management Impacts of Construction at SRS Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	11	NA	NA	NA
Nonhazardous				
Liquid	9,800	4[c]	NA	1[d]
Solid	1,700	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of F-Area sanitary sewer.
[d] Percent of capacity of the Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); WPPSS, Washington Public Power Supply System.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities at Hanford and SRS would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management systems at Hanford or SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of the pit conversion and MOX facilities at Hanford would be managed on the site at the WPPSS Sewage Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 6 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and 6 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility.

Therefore, management of these wastes at Hanford should not have a major impact on the nonhazardous liquid waste treatment system during construction.

To be conservative, it was also assumed that all nonhazardous liquid wastes generated during construction of the immobilization facility at SRS would be managed on the site at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 4 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.10.1.3 Socioeconomics

Construction-related employment requirements for Alternative 6A would be as indicated in Table 4–95.

Table 4–95. Construction Employment Requirements for Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	MOX	Immobilization	Total
2001	77	0	0	77
2002	116	290	312	718
2003	71	508	448	1,027
2004	0	334	282	616
2005	0	170	0	170
2006	0	160	0	160

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a, 1998d, 1998f, 1998g.

At its peak in 2003, construction of the pit conversion and MOX facilities at Hanford under this alternative would require 579 construction workers and generate another 594 indirect jobs in the region. The total employment requirement of 1,173 direct and indirect jobs represents about 0.3 percent of the projected REA workforce, and thus should have no major impacts on the REA. That requirement should also have little impact on the community services currently offered in the ROI. In fact, it should help offset the nearly 15 percent reduction in Hanford employment (i.e., from 12,900 to approximately 11,000 workers) projected for the years 1997–2005.

At its peak in 2003, construction of the new immobilization facility at SRS would require 448 construction workers and generate another 360 indirect jobs in the region. As this total employment requirement of 808 direct and indirect jobs represents less than 0.3 percent of the total projected REA workforce, it should have no major impact on the REA. It should also have little impact on the community services currently offered in the SRS ROI. In fact, it should help offset the nearly 20 percent reduction in SRS's total workforce from its 1997 level (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.10.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–96. According to recent radiation surveys (Antonio 1998; UC 1998a, 1998d, 1998f, 1998g)

Table 4–96. Potential Radiological Impacts on Construction Workers of Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	MOX[b]	Hanford Total	Immobilization[c]
Total dose (person-rem/yr)	0	0	0	1.4
Annual latent fatal cancers[d]	0	0	0	5.6×10^{-4}
Average worker dose (mrem/yr)	0	0	0[e]	4
Annual latent fatal cancer risk	0	0	0	1.6×10^{-6}

a An estimated average of 88 workers would be associated with annual construction and modification operations.
b An estimated average of 292 workers would be associated with annual construction operations.
c An estimated average of 347 workers would be associated with annual construction operations at the new facility location adjacent to APSF. The number would be the same for immobilization in either ceramic or glass.
d Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
e Represents an average of the doses for both facilities.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: Antonio 1998; ICRP 1991; NAS 1990; UC 1998a, 1998d, 1998f, 1998g.

conducted at the Hanford 400 Area and SRS F-Area, construction workers at Hanford would not be expected to receive doses above natural background levels. At SRS, however, construction workers could receive small doses above natural background levels. Regardless of location, construction workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at Hanford under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

4.10.1.5 Facility Accidents

Plutonium disposition construction activities at Hanford and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,768 person-years of construction labor and standard industrial accident rates, approximately 270 cases of nonfatal occupational injury or illness and 0.39 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.10.1.6 Environmental Justice

As discussed in the other parts of Section 4.10.1, construction under Alternative 6A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of individuals the population. Therefore, construction activities under Alternative 6A at Hanford and SRS would have no significant impacts on minority or low-income populations.

4.10.2 Operations

4.10.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 6A at Hanford were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G, including those resulting from the plutonium disposition facilities.

A comparison of maximum air pollutant concentrations, including the contribution from plutonium disposition facilities, with standards and guidelines is presented as Table 4–97. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

Table 4–97. Evaluation of Hanford Air Pollutant Concentrations Associated With Operations Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.247	34.3	0.34
	1 hour	40,000	1.68	50	0.13
Nitrogen dioxide	Annual	100	0.031	0.281	0.28
PM_{10}	Annual	50	0.00143	0.0193	0.039
	24 hours	150	0.0159	0.786	0.52
Sulfur dioxide	Annual	50	0.00123	1.63	3.1
	24 hours	260	0.0136	8.92	3.4
	3 hours	1,300	0.0928	29.7	2.3
	1 hour	700	0.278	33.2	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.00143	0.0193	0.032
	24 hours	150	0.0159	0.786	0.52
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	420	0.0406	0.0406	0.010

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; WDEC 1994.

For a discussion of how the operation of the pit conversion and MOX facilities at Hanford would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAP limits applicable to operation of these facilities.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from operation of these facilities would be a small fraction of the PSD Class II area increments as summarized in Table 4–98.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee

Table 4–98. Evaluation of Hanford Air Pollutant Increases Associated With Operations Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.031	25	0.12
PM_{10}	Annual	0.00143	17	0.0084
	24 hours	0.0159	30	0.053
Sulfur dioxide	Annual	0.00123	20	0.0062
	24 hours	0.0136	91	0.015
	3 hours	0.0928	512	0.018

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Potential air quality impacts of operation of the new immobilization facility under Alternative 6A at SRS were analyzed using ISCST3. Operation impacts result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including those resulting from the immobilization facility, with standards and guidelines is presented as Table 4–99. Concentrations for immobilization in the ceramic form are presented because they would be greater than those for the glass form. Concentration of air pollutants would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of the facility.

For a discussion of how the operation of the immobilization facility at SRS would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.3.4.4. There are no other NESHAP limits applicable to operation of this facility.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of the facility would be a small fraction of the PSD Class II area increments as summarized in Table 4–100.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of the facility at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operation would include new

Table 4–99. Evaluation of SRS Air Pollutant Concentrations Associated With Operations Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.141	64.1	0.64
	1 hour	40,000	0.575	279	0.70
Nitrogen dioxide	Annual	100	0.0093	9.31	9.3
PM_{10}	Annual	50	0.000697	4.14	8.3
	24 hours	150	0.0125	56.4	38
Sulfur dioxide	Annual	80	0.0165	15.1	19
	24 hours	365	0.229	219	60
	3 hours	1,300	0.613	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.000697	14.7	20
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	650	0	0.195	0.03

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging time.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; SCDHEC 1996.

Table 4–100. Evaluation of SRS Air Pollutant Increases Associated With Operations Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0093	25	0.037
PM_{10}	Annual	0.000697	17	0.0041
	24 hours	0.0125	30	0.042
Sulfur dioxide	Annual	0.0165	20	0.083
	24 hours	0.229	91	0.25
	3 hours	0.613	512	0.12

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; PSD, prevention of significant deterioration.

Source: EPA 1997b.

or existing sources (e.g., cooling systems, vents, motors, and material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of the facility would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility (see Section 4.26). Traffic associated with operation of the facility would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increase in annoyance to the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

The combustion of fossil fuels associated with Alternative 6A would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 3×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.10.2.2 Waste Management

Tables 4–101 and 4–102 compare the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at Hanford and SRS. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation at SRS should be the same for the ceramic and glass immobilization technologies.

Table 4–101. Potential Waste Management Impacts of Operations at Hanford Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	64	4	4	<1 of WIPP
LLW	94	NA	NA	<1
Mixed LLW	3	<1	<1	<1
Hazardous	<3	NA	NA	NA
Nonhazardous				
Liquid	65,000	28[d]	NA	28[e]
Solid	<1,950	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of the 400 Area sanitary sewer.
[e] Percent of capacity of the WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning

Table 4–102. Potential Waste Management Impacts of Operations at SRS Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	95	6	3	1 of WIPP
LLW	60	<1	NA	2
Mixed LLW	1	<1	1	NA
Hazardous	30	<1	6	NA
Nonhazardous				
Liquid	26,000	9[d]	NA	3[e]
Solid	230	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed waste at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* that will be prepared by the DOE Richland Operations Office (DOE 1997c). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford and the planned TRU Waste Characterization and Certification Facility at SRS.

TRU wastes generated by the pit conversion and MOX facilities at Hanford is estimated to be 4 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 640 m^3 (837 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 4 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of less than 0.1 ha (0.25 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at Hanford should not be major.

TRU waste generation at the immobilization facility at SRS is estimated to be 6 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 950 m^3 (1,240 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 3 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.14 ha (0.35 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

At Hanford, LLW would be packaged, certified, and accumulated at the pit conversion and MOX facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 940 m^3 (1,230 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) capacity of the LLW Burial Grounds and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480 m^3/ha disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.27-ha (0.67-acre) disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

At SRS, LLW would be packaged, certified, and accumulated at the new immobilization facility before transfer for additional treatment and disposal in existing onsite facilities. A total of 600 m^3 (780 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility and 2 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 m^3 (780 yd^3) of waste would require 0.1-ha (0.25-acre) disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

At Hanford, mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan. Mixed LLW generation at the pit conversion and MOX facilities is estimated to be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (22,000-yd^3) capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system. If all TRU waste and mixed LLW generated at the surplus plutonium disposition facilities at Hanford were processed in the Waste Receiving and Processing Facility, this additional waste would be 4 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of that facility.

At SRS, mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan. Mixed LLW generation at the immobilization facility is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility, 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

At Hanford, any hazardous wastes generated during operation of the pit conversion and MOX facilities would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operation period should not have a major impact on Hanford hazardous waste management system.

At SRS, any hazardous wastes generated during operation of the immobilization facility would be packaged for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the immobilization facility at SRS were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management systems at Hanford and SRS.

At Hanford, nonhazardous wastewater generated by the pit conversion and MOX facilities would be treated if necessary before being discharged to the 400 Area sanitary sewer system, which connects to the WPPSS Sewage Treatment Facility. Nonhazardous liquid wastes generated by the pit conversion and MOX facilities at Hanford is estimated to be 28 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 28 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the WPPSS Sewage Treatment Facility (Mecca 1997). Therefore, management of nonhazardous liquid waste at Hanford should not have a major impact on the treatment system.

At SRS, nonhazardous wastewater would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by the immobilization facility at SRS is estimated to be 9 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 3 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.10.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and MOX facilities at Hanford in 2007 under Alternative 6A, an estimated 750 new workers would be required to operate them (UC 1998a, 1998d). This level of employment would be expected to generate another 1,899 related jobs in the region. The total employment requirement of 2,649 direct and indirect jobs represents less than 0.7 percent of the projected REA workforce, and thus should have no major impact on the REA. Some of the new jobs created under this alternative could be filled from the ranks of the unemployed, currently 11 percent of the REA's population.

This employment requirement could have minor impacts on community services in the ROI, as it should coincide with an increase in overall site employment in connection with construction of the tank waste remediation system. Assuming that 91 percent of the new employees associated with this alternative resided in the ROI, an increase of 2,411 jobs in the workforce would result in an overall population increase of approximately 4,587 persons. This population increase, in conjunction with the normal population growth forecast by the State of Washington State, would engender increased construction of local housing units. Given the current population-to-student ratio in the ROI, a population of this size should include 949 students, and local school districts would be expected to increase the number of classrooms to accommodate them.

Community services in the ROI would change to reflect the growth in population as follows: 59 teachers would be added to maintain the current student-to-teacher ratio of 16:1; 7 police officers would be added to maintain the current officer-to-population ratio of 1.6:1,000; 15 firefighters would be added to maintain the current firefighter-to-population ratio of 3.4:1,000; and 6 physicians would be added to maintain the current physician-to-population ratio of 1.4:1,000. In total, it is estimated that an additional 88 positions would have to be created to maintain community services at current levels. In addition, hospitals in the ROI would experience a drop from 2.1 to 2.0 beds per 1,000 persons unless additional beds were provided. Similarly, the average school enrollment would increase to 94.8 percent from the current rate of 92.5 percent unless additional classrooms were built. None of these projected changes should have a major impact on the level of community services currently offered in the ROI.

After construction, startup, and testing of the immobilization facility at SRS in 2005 under Alternative 6A, an estimated 246 new workers would be required to operate it. This level of employment would generate another 440 indirect jobs within the region. As the total employment requirement of 686 direct and indirect jobs represents less than 0.3 percent of the total projected REA workforce, it should have no major impact on the REA. In fact, it should help to decrease slightly the one-third reduction in SRS employment (i.e., from 15,000 to 10,000 workers) projected for the years 1997–2010.

4.10.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows:

Radiological Impacts. Table 4–103 reflects the potential radiological impacts on three individual receptor groups at Hanford and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 7.0 person-rem at Hanford and 2.3×10^{-3} person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 0.035 around Hanford and 1.2×10^{-5} around SRS. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at Hanford would be 0.019 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 9.4×10^{-8}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 2.4×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.2×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–104; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The

Table 4–103. Potential Radiological Impacts on the Public of Operations Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	MOX	Hanford Total	Immobilization	
				Ceramic	Glass
Population within 80 km for year 2010					
Dose (person-rem)	6.9	0.11	7.0	2.3×10^{-3}	2.2×10^{-3}
Percent of natural background[a]	5.9×10^{-3}	9.5×10^{-5}	6.0×10^{-3}	1.0×10^{-6}	1.0×10^{-6}
10-year latent fatal cancers	0.034	5.5×10^{-4}	0.035	1.2×10^{-5}	1.1×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.017	1.8×10^{-3}	0.019	2.4×10^{-5}	2.2×10^{-5}
Percent of natural background[a]	5.7×10^{-3}	6.0×10^{-4}	6.3×10^{-3}	8.1×10^{-6}	7.5×10^{-6}
10-year latent fatal cancer risk	8.5×10^{-8}	9.0×10^{-9}	9.4×10^{-8}	1.2×10^{-10}	1.1×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	0.017	2.8×10^{-4}	0.017	2.9×10^{-6}	2.8×10^{-6}
10-year latent fatal cancer risk	8.5×10^{-8}	1.4×10^{-9}	8.6×10^{-8}	1.5×10^{-11}	1.4×10^{-11}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford (387,800) and the SRS APSF (785,400) in 2010.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Source: Appendix J.

Table 4–104. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 6A: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	MOX	Hanford Total	Immobilization (Ceramic or Glass)
Number of badged workers	383	350	733	232
Total dose (person-rem/yr)	192	175	367	174
10-year latent fatal cancers	0.77	0.70	1.5	0.70
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998a, 1998d, 1998f, 1998g.

annual dose received by the total site workforce for each of these facilities has been estimated at 192, 175, and 174 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–104. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at Hanford under this alternative would be the same as that for Alternative 2, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released as a result of operations.

4.10.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion and MOX facilities at Hanford are equivalent to those included in Alternative 2 (see Tables 4–27 and 4–30) and the potential consequences from operation of the immobilization facility at SRS, equivalent to those included in Alternative 3A (see Tables 4–41 and 4–42). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of the design basis accident for the pit conversion and MOX facilities are shown in Section 4.3.2.5; and the most severe consequences for the immobilization facility, in Section 4.4.2.5.

A beyond-design-basis earthquake at Hanford could result in the collapse of the pit conversion facility in FMEF and the MOX facility, and an estimated 33 LCFs among the general population. A similar earthquake at SRS could result in the collapse of the immobilization facility and an estimated 2.7 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 1.2×10^{-4}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Hanford and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,581 person-years of labor and the standard DOE occupational accident rates, approximately 339 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.10.2.6 Transportation

Under Alternative 6A, transportation to and from Hanford would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at Hanford for fabrication into MOX fuel pellets.

It is assumed that depleted uranium hexafluoride needed for MOX fuel would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide (see Section 4.3.2.6). After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at Hanford. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at SRS under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to DWPF in S-Area. This intrasite transportation—from F-Area to S-Area—could require the temporary shutdown of roads on the Hanford site. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at DWPF, it would eventually be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 6A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.3.1.2 and 4.3.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In total, approximately 2,500 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 7.9 million km (4.9 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 54 person-rem; the dose to the public, 64 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.021 LCF among transportation workers and 0.032 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.026.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of plutonium pits from one of DOE's storage locations to the pit conversion facility with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. The accident could result in a dose of 29 person-rem to the public for an LCF risk of 0.015 and 32 rem to the hypothetical MEI for an LCF risk of 0.016. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 6A are as follows: a radiological dose to the population of 22 person-rem, resulting in a total population risk of 0.011 LCF; and traffic accidents resulting in 0.089 traffic fatalities.

4.10.2.7 Environmental Justice

As discussed in other parts of Section 4.10.2, routine operations conducted under Alternative 6A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Hanford would be approximately 1 in 12 million (see Table 4–103); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near Hanford and SRS from accident-free operations would increase by approximately 0.035 and 1.2×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.10.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–27, 4–30, 4–41, and 4–42). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.10.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 6A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.11 ALTERNATIVE 6B

Alternative 6B would involve constructing and operating the pit conversion and MOX facilities at Hanford and the immobilization facility at SRS. The pit conversion and MOX facilities would be located in the existing FMEF building. The immobilization facility would be located in a new facility in F-Area. Activities at SRS would be the same as under Alternative 6A.

4.11.1 Construction

4.11.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 6B at Hanford include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at Hanford, with standards and guidelines is presented as Table 4–105. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford Activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat from current emissions during the planned construction period because of an expected decrease in overall site employment.

Noise impacts would be the same or less than those for Alternative 6A at Hanford (see Section 4.10.1.1).

Potential air quality impacts of construction under Alternative 6B at SRS are the same as those for Alternative 6A (see Section 4.10.1.1). Noise impacts are the same as those for Alternative 6A at SRS (see Section 4.10.1.1).

4.11.1.2 Waste Management

Tables 4–106 and 4–107 compare the wastes generated during construction of surplus plutonium disposition facilities at Hanford and SRS with the existing treatment, storage, and disposal capacity for the various waste types at each site. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during construction of surplus plutonium disposition facilities at Hanford and SRS would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to

Table 4–105. Evaluation of Hanford Air Pollutant Concentrations Associated With Construction Under Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.456	34.5	0.35
	1 hour	40,000	3.10	51.4	0.13
Nitrogen dioxide	Annual	100	0.0338	0.284	0.28
PM_{10}	Annual	50	0.0719	0.0898	0.18
	24 hours	150	2.37	3.14	2.1
Sulfur dioxide	Annual	50	0.00274	1.63	3.1
	24 hours	260	0.0304	8.94	3.4
	3 hours	1,300	0.207	29.8	2.3
	1 hour	700	0.621	33.5	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.159	0.177	0.30
	24 hours	150	4.65	5.42	3.6
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0.000008785	0.000014	0.012

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

Table 4–106. Potential Waste Management Impacts of Construction at Hanford Under Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	19	NA	NA	NA
Nonhazardous				
Liquid	13,300	6[c]	NA	6[d]
Solid	308	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of the 400 Area sanitary sewer.
[d] Percent of capacity of the WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); WPPSS, Washington Public Power Supply System.

Table 4–107. Potential Waste Management Impacts of Construction at SRS Under Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	11	NA	NA	NA
Nonhazardous				
Liquid	9,800	4[c]	NA	1[d]
Solid	1,700	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Percent of capacity of F-Area sanitary sewer.
[d] Percent of the capacity of the Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on Hanford or SRS hazardous waste management systems.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities at Hanford and SRS would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management systems at Hanford or SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during modification of the FMEF building at Hanford would be managed on the site at the WPPSS Sewage Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during modification is estimated to be 6 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and 6 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, management of these wastes at Hanford should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

To be conservative, it was also assumed that all nonhazardous liquid wastes generated during construction of the immobilization facility at SRS would be managed on the site at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 4 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.11.1.3 Socioeconomics

Construction-related employment requirements for Alternative 6B would be as indicated in Table 4–108.

Table 4–108. Construction Employment Requirements for Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	MOX	Immobilization	Total
2001	77	0	0	77
2002	116	290	312	718
2003	71	362	448	881
2004	0	290	282	572
2005	0	170	0	170
2006	0	160	0	160

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a, 1998d, 1998f, 1998g.

At its peak in 2003, construction of the pit conversion and MOX facilities at Hanford under this alternative would require 433 construction workers and generate another 444 indirect jobs in the region. The total employment requirement of 877 direct and indirect jobs represents less than 0.3 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have little effect on the community services currently offered in the ROI. In fact, it should help offset the nearly 15 percent reduction in Hanford employment (i.e., from 12,900 to approximately 11,000 workers) projected for the years 1997–2005.

Employment requirements for construction of the immobilization facility at SRS would be the same as those for Alternative 6A (see Section 4.10.1.3).

4.11.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented as Table 4–109. According to recent radiation surveys (Antonio 1998; UC 1998a, 1998d, 1998f, 1998g) conducted at the Hanford 400 Area and SRS F-Area, construction workers at Hanford would not be expected to receive doses above natural background levels as a result of other ongoing or past activities. At SRS, however, construction workers may receive small doses above natural background levels. Regardless of location, construction workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at Hanford under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

4.11.1.5 Facility Accidents

Plutonium disposition construction activities at Hanford and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,578 person-years of construction labor and standard industrial accident rates, approximately 260 cases of nonfatal occupational injury or illness and 0.36 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

Table 4–109. Potential Radiological Impacts on Construction Workers of Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	MOX[b]	Hanford Total	Immobilization[c]
Total dose (person-rem/yr)	0	0	0	1.4
Annual latent fatal cancers[d]	0	0	0	5.6×10^{-4}
Average worker dose (mrem/yr)	0	0	0[e]	4
Annual latent fatal cancer risk	0	0	0	1.6×10^{-6}

[a] An estimated average of 88 workers would be associated with annual construction and modification operations.
[b] An estimated average of 254 workers would be associated with annual construction and modification operations.
[c] An estimated average of 347 workers would be associated with annual construction operations at the new facility location adjacent to APSF. The number would be the same for immobilization in either ceramic or glass.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for both facilities.
Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are be reduced to levels that are as low as is reasonably achievable.
Source: Antonio 1998; ICRP 1991; NAS 1990; UC 1998a, 1998d, 1998f, 1998g.

4.11.1.6 Environmental Justice

As discussed in the other parts of Section 4.11.1, construction under Alternative 6B would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 6B at Hanford and SRS would have no significant impacts on minority or low-income populations.

4.11.2 Operations

4.11.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 6B at Hanford were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including those resulting from the plutonium disposition facilities, with standards and guidelines is presented as Table 4–110. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

For a discussion of how the operation of the pit conversion and MOX facilities at Hanford would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAP limits applicable to operation of these facilities.

Table 4–110. Evaluation of Hanford Air Pollutant Concentrations Associated With Operations Under Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.247	34.3	0.34
	1 hour	40,000	1.68	50	0.13
Nitrogen dioxide	Annual	100	0.031	0.281	0.28
PM_{10}	Annual	50	0.00143	0.0193	0.039
	24 hours	150	0.0159	0.786	0.52
Sulfur dioxide	Annual	50	0.00123	1.63	3.1
	24 hours	260	0.0136	8.92	3.4
	3 hours	1,300	0.0928	29.7	2.3
	1 hour	700	0.278	33.2	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.00143	0.0193	0.032
	24 hours	150	0.0159	0.786	0.52
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	420	0.0406	0.0406	0.0097

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; WDEC 1994.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of these facilities would be a small fraction of the PSD Class II area increments as summarized in Table 4–111. Noise impacts would be similar to those for Alternative 6A at Hanford (see Section 4.10.2.1).

Table 4–111. Evaluation of Hanford Air Pollutant Increases Associated With Operations Under Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.031	25	0.12
PM_{10}	Annual	0.00143	17	0.0084
	24 hours	0.0159	30	0.053
Sulfur dioxide	Annual	0.00123	20	0.0062
	24 hours	0.0136	91	0.015
	3 hours	0.0928	512	0.018

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; PSD, prevention of significant deterioration.

Source: EPA 1997b.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

Potential air quality impacts of operation of the immobilization facility under Alternative 6B at SRS are the same as those for Alternative 6A (see Section 4.10.2.1). Noise impacts are the same as those for Alternative 6A at SRS (see Section 4.10.2.1).

The combustion of fossil fuels associated with Alternative 6B would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 3×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.11.2.2 Waste Management

Impacts of operations for this alternative would be the same as for Alternative 6A. Therefore, see Section 4.10.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford and SRS.

4.11.2.3 Socioeconomics

Employment requirements for operation of the pit conversion and MOX facilities at Hanford under Alternative 6B would be the same as those for Alternative 6A (see Section 4.10.2.3).

Employment requirements for operation of the immobilization facility at SRS under Alternative 6B would be the same as those for Alternative 6A (see Section 4.10.2.3).

4.11.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows:

Radiological Impacts. Table 4–112 reflects the potential radiological impacts on three individual receptor groups at Hanford and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 7.0 person-rem at Hanford and 2.3×10^{-3} person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 0.034 around Hanford and 1.2×10^{-5} around SRS. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at Hanford would be 0.018 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 9.0×10^{-8}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 2.4×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.2×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against

Table 4–112. Potential Radiological Impacts on the Public of Operations Under Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	MOX	Hanford Total	Immobilization	
				Ceramic	Glass
Population within 80 km for year 2010					
Dose (person-rem)	6.9	0.051	7.0	2.3×10^{-3}	2.2×10^{-3}
Percent of natural background[a]	5.9×10^{-3}	4.4×10^{-5}	6.0×10^{-3}	1.0×10^{-6}	1.0×10^{-6}
10-year latent fatal cancers	0.034	2.6×10^{-4}	0.034	1.2×10^{-5}	1.1×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.017	6.9×10^{-4}	0.018	2.4×10^{-5}	2.2×10^{-5}
Percent of natural background[a]	5.7×10^{-3}	2.3×10^{-4}	5.9×10^{-3}	8.1×10^{-6}	7.5×10^{-6}
10-year latent fatal cancer risk	8.5×10^{-8}	3.5×10^{-9}	9.0×10^{-8}	1.2×10^{-10}	1.1×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	0.017	1.3×10^{-4}	0.017	2.9×10^{-6}	2.8×10^{-6}
10-year latent fatal cancer risk	8.5×10^{-8}	6.5×10^{-10}	8.6×10^{-8}	1.5×10^{-11}	1.4×10^{-11}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford (387,800) and the SRS APSF (785,400) in 2010.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Source: Appendix J.

applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–113; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192, 175, and 174 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–113. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at Hanford under this alternative would be the same as that under Alternative 2, the estimated noncancer risks associated with exposure to this compound would also the same. No carcinogenic chemicals would be released as a result of operations.

4.11.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Hanford are equivalent to those included in Alternative 2 (see Table 4–27); potential consequences from operation of the MOX facility in FMEF at Hanford would be equivalent to those included in Alternative 4B (see Table 4–74); and potential consequences from operation of the immobilization facility at SRS, equivalent to those included in Alternative 3A (see Table 4–41 and 4–42). More details on the method

Table 4–113. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 6B: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	MOX	Hanford Total	Immobilization (Ceramic or Glass)
Number of badged workers	383	350	733	232
Total dose (person-rem/yr)	192	175	367	174
10-year latent fatal cancers	0.77	0.70	1.5	0.70
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998a, 1998d, 1998f, 1998g.

of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. For the most severe consequences of the design basis accident for the pit conversion, MOX, and immobilization facilities, see Sections 4.3.2.5, 4.7.2.5, and 4.4.2.5, respectively.

A beyond-design-basis earthquake at Hanford could result in the collapse of the pit conversion and MOX facilities in FMEF and an estimated 33 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

The beyond-design-basis accident at SRS would be equivalent to that discussed in Section 4.10.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 1.2×10^{-4}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Hanford and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,581 person-years of labor and the standard DOE occupational accident rates, approximately 339 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.11.2.6 Transportation

Because the only difference between Alternative 6A and 6B is the location of the MOX facility within 400 Area at Hanford, the transportation required for Alternative 6B would be the same as that for Alternative 6A. Therefore, the transportation risks associated with Alternative 6B are equivalent to those discussed in Section 4.10.2.6.

4.11.2.7 Environmental Justice

As discussed in other parts of Section 4.11.2, routine operations conducted under Alternative 6B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Hanford would be approximately 1 in 12 million (see Table 4–112); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near Hanford and SRS from accident-free operations would increase by approximately 0.034 and 1.2×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.11.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–27, 4–41, 4–42, and 4–74). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.11.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 6B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.12 ALTERNATIVE 6C

Alternative 6C would involve constructing and operating the pit conversion and MOX facilities at Hanford and the immobilization facility at SRS. The pit conversion facility would be located in the existing FMEF building with the MOX facility located in a new building near FMEF. The immobilization facility would be located in the existing Building 221–F in F-Area. Activities at Hanford would be the same as under Alternative 6A.

4.12.1 Construction

4.12.1.1 Air Quality and Noise

Potential air quality impacts of construction under Alternative 6C at Hanford are the same as those for Alternative 6A as discussed in Section 4.10.1.1.

Noise impacts are the same as those for Alternative 6A at Hanford (see Section 4.10.1.1).

Sources of potential air quality impacts of construction under Alternative 6C at SRS, including modification of Building 221–F for plutonium conversion and immobilization include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at SRS, with standards and guidelines is presented as Table 4–114. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

Noise impacts would be the same or less than those for Alternative 6A at SRS (see Section 4.10.1.1).

4.12.1.2 Waste Management

At Hanford, construction impacts for this alternative would be the same as for Alternative 6A. See Section 4.10.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford.

Table 4–115 compares the wastes generated during modification of Building 221–F at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that TRU waste and LLW would be generated during modification of Building 221–F. No mixed LLW would be generated. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during modification. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario.

Table 4–114. Evaluation of SRS Air Pollutant Concentrations Associated With Construction Under Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.168	64.2	0.64
	1 hour	40,000	0.723	279	0.70
Nitrogen dioxide	Annual	100	0.00623	9.31	9.3
PM_{10}	Annual	50	0.00148	4.14	8.3
	24 hours	150	0.172	56.6	38
Sulfur dioxide	Annual	80	0.000634	15.1	19
	24 hours	365	0.0153	219	60
	3 hours	1,300	0.0906	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.00148	14.7	20
Hazardous and other toxic compounds					
Other toxics[b]	24 hours	150	0	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

Table 4–115. Potential Waste Management Impacts of Construction at SRS Under Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]: Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	50	3	<1	<1 of WIPP
LLW	500	NA	NA	5
Hazardous	4	NA	NA	NA
Nonhazardous				
Liquid	9,200	3[d]	NA	1[e]
Solid	570	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Modification is not expected to generate remotely handled TRU waste or mixed TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of the Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of the LLW is not routinely treated and stored on the site; it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive and hazardous wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be packaged, and certified to WIPP waste acceptance criteria at the modification site. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU wastes generated during modification of Building 221–F at SRS is estimated to be 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 150 m^3 (196 yd^3) of TRU waste would be generated during the modification period. If all the TRU waste were stored on the site, this would be less than 1 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. If additional storage space were needed, and assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of less than 0.1 ha (0.25 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 150 m^3 (196 yd^3) of TRU wastes generated by modification of Building 221–F would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the modification site before transfer for disposal in existing SRS facilities. A total of 1,500 m^3 (1,960 yd^3) of LLW would be generated during modification of Building 221–F. LLW generated during the modification period is estimated to be 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,500 m^3 (1,960 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Hazardous wastes generated during modification of Building 221–F at SRS would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during modification would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the modification period should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid wastes generated during modification of Building 221–F at SRS would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was also assumed that all nonhazardous liquid wastes generated during modification of Building 221–F at SRS would be managed on the site at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during modification of these facilities is estimated to be 3 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

4.12.1.3 Socioeconomics

Construction-related employment requirements for Alternative 6C would be as indicated in Table 4–116.

Table 4–116. Construction Employment Requirements for Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Year	Pit Conversion	MOX	Immobilization	Total
2001	77	0	0	77
2002	116	290	248	654
2003	71	508	400	979
2004	0	334	330	664
2005	0	170	0	170
2006	0	160	0	160

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a, 1998d, 1998i, 1998j.

Employment requirements for construction of the pit conversion and MOX facilities at Hanford under this alternative would be the same as those for Alternative 6A (see Section 4.10.1.3).

At its peak in 2003, construction of the immobilization facility at SRS would require 400 construction workers and generate another 321 indirect jobs in the region. The total employment requirement of 721 direct and indirect jobs represents less than 0.3 percent of the total projected REA workforce, and thus should have no major impact on the REA. It should also have limited effect on the community services currently offered in the SRS ROI. In fact, it should help offset the approximately 20 percent reduction in SRS employment (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.12.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–117. According to recent radiation surveys (Antonio 1998) conducted at the Hanford 400 Area and SRS F-Area, construction workers at Hanford would not be expected to receive doses above natural background levels. At SRS, however, construction workers may receive small doses above natural background levels. Regardless of location, construction workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. Because the estimated airborne concentration of benzene delivered to the maximally exposed member of the public at Hanford under this alternative would be the same as that for Alternative 6A, the estimated cancer risk associated with this exposure would also be the same.

Table 4–117. Potential Radiological Impacts on Construction Workers of Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion[a]	MOX[b]	Hanford Total	Immobilization[c]
Total dose (person-rem/yr)	0	0	0	4.7
Annual latent fatal cancers[d]	0	0	0	1.9×10^{-3}
Average worker dose (mrem/yr)	0	0	0[e]	15
Annual latent fatal cancer risk	0	0	0	6.0×10^{-6}

[a] An estimated average of 88 workers would be associated with annual construction and modification operations.
[b] An estimated average of 292 workers would be associated with annual construction operations.
[c] There would be 315 badged workers associated with construction and modification of the existing Building 221–F. The number would be the same for immobilization in either ceramic or glass.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: Antonio 1998; ICRP 1991; NAS 1990; UC 1998a, 1998d, 1998i, 1998j.

4.12.1.5 Facility Accidents

Construction of plutonium disposition facilities at Hanford and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,704 person-years of construction labor and standard industrial accident rates, approximately 270 cases of nonfatal occupational injury or illness and 0.38 fatality could be expected (DOL 1997a, 1997b). As all construction would take place prior to introduction of the radiological process inventory, no noteworthy radiological accidents should occur.

4.12.1.6 Environmental Justice

As discussed in the other parts of Section 4.12.1, construction under Alternative 6C would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 6C at Hanford and SRS would have no significant impacts on minority or low-income populations.

4.12.2 Operations

4.12.2.1 Air Quality and Noise

Potential air quality impacts of operation of facilities under Alternative 6C at Hanford are the same as those for Alternative 6A at Hanford (see Section 4.10.2.1).

Noise impacts are the same as those for Alternative 6A at Hanford (see Section 4.10.2.1).

Potential air quality impacts of the operation of the immobilization facility under Alternative 6C at SRS were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, the use trucks in moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the immobilization facility, with standards and guidelines is presented as Table 4–118. Concentrations for immobilization in the ceramic form are presented because they would be greater than those for the glass form. Operation of the immobilization facility would likely increase air pollutant concentrations at the site boundary, but concentrations would not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of the facility.

Table 4–118. Evaluation of SRS Air Pollutant Concentrations Associated With Operations Under Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.148	64.1	0.64
	1 hour	40,000	0.589	279	0.70
Nitrogen dioxide	Annual	100	0.00968	9.31	9.3
PM_{10}	Annual	50	0.000724	4.14	8.3
	24 hours	150	0.013	56.4	38
Sulfur dioxide	Annual	80	0.0166	15.1	19
	24 hours	365	0.229	219	60
	3 hours	1,300	0.615	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.000724	14.7	20
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	650	0	0.195	0.03

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; SCDHEC 1996.

For a discussion of how the operation of the immobilization facility at SRS would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAP limits applicable to operation of this facility.

The increases in air pollutant concentrations for nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of this facility would be a small fraction of the PDS Class II area increments as summarized in Table 4–119.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

Noise impacts would be similar to those for Alternative 6A at SRS (see Section 4.10.2.1).

Table 4–119. Evaluation of SRS Air Pollutant Increases Associated With Operations Under Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.00968	25	0.039
PM_{10}	Annual	0.000724	17	0.0043
	24 hours	0.013	30	0.043
Sulfur dioxide	Annual	0.0166	20	0.083
	24 hours	0.229	91	0.25
	3 hours	0.615	512	0.12

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

The combustion of fossil fuels associated with Alternative 6C would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 3×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.12.2.2 Waste Management

At Hanford, impacts of operations for this alternative would be the same as for Alternative 6A. See Section 4.10.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford.

Table 4–120 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at SRS. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Wastes generated by the immobilization facility at SRS should be the same for the ceramic and glass technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at other facilities at SRS.

Table 4–120. Potential Waste Management Impacts of Operations at SRS Under Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	95	6	3	1 of WIPP
LLW	60	<1	NA	2
Mixed LLW	1	<1	1	NA
Hazardous	30	<1	6	NA
Nonhazardous				
Liquid	28,000	10[d]	NA	3[e]
Solid	230	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

TRU waste generation at the immobilization facility at SRS is estimated to be 6 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 950 m^3 (1,240 yd^3) of TRU waste would be generated over the 10-year operation period. Because this waste is assumed to be packaged, certified, and shipped to WIPP on a regular basis, storage should not be a problem. However, if all the TRU waste were stored on the site, this would be 3 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.14 ha (0.35 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated at Hanford and SRS would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

At SRS, LLW would be packaged, certified, and accumulated at the new immobilization facility before transfer for additional treatment and disposal in existing onsite facilities. A total of 600 m^3 (780 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility and 2 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 m^3 (780 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

At SRS, mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan. Mixed LLW generation at the immobilization facility is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator

Facility, and 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

At SRS, any hazardous wastes generated during operation of the immobilization facility would be packaged for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the immobilization facility at SRS were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

At SRS, nonhazardous wastewater would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by the immobilization facility at SRS is estimated to be 10 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 3 percent of the 1.03-million-m^3/yr (1.35-million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.12.2.3 Socioeconomics

Employment requirements for operation of the pit conversion and MOX facilities at Hanford under Alternative 6C would be the same as those for Alternative 6A (see Section 4.10.2.3).

After construction, startup, and testing of the immobilization facility at SRS in 2005 under Alternative 6C, an estimated 272 new workers would be required to operate it. This increased employment would be expected to generate another 486 indirect jobs in the region. As this total of 758 new direct and indirect jobs represents less than 0.3 percent of the total projected REA workforce, it should have no major impacts on the REA. The additional workers should also have little effect on community services within the ROI. In fact, they should help to decrease slightly the almost one-third reduction in SRS employment (i.e., from 15,000 to 10,000 workers) projected for the years 1997–2010.

4.12.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to and potential health effects on the public and workers for this alternative are described below.

Radiological Impacts. Table 4–121 reflects the potential radiological impacts on three individual receptor groups at Hanford and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected

Table 4–121. Potential Radiological Impacts on the Public of Operations Under Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Members of the Public	Pit Conversion	MOX	Hanford Total	Immobilization Ceramic	Immobilization Glass
Population within 80 km for year 2010					
Dose (person-rem)	6.9	0.11	7.0	2.3×10^{-3}	2.2×10^{-3}
Percent of natural background[a]	5.9×10^{-3}	9.5×10^{-5}	6.0×10^{-3}	1.0×10^{-6}	1.0×10^{-6}
10-year latent fatal cancers	0.034	5.5×10^{-4}	0.035	1.2×10^{-5}	1.1×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.017	1.8×10^{-3}	0.019	2.4×10^{-5}	2.2×10^{-5}
Percent of natural background[a]	5.7×10^{-3}	6.0×10^{-4}	6.3×10^{-3}	8.1×10^{-6}	7.5×10^{-6}
10-year latent fatal cancer risk	8.5×10^{-8}	9.0×10^{-9}	9.4×10^{-8}	1.2×10^{-10}	1.1×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	0.017	2.8×10^{-4}	0.017	2.9×10^{-6}	2.8×10^{-6}
10-year latent fatal cancer risk	8.5×10^{-8}	1.4×10^{-9}	8.6×10^{-8}	1.5×10^{-11}	1.4×10^{-11}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 230,500 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford (387,800) and SRS Building 221–F (781,500) in 2010.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Source: Appendix J.

aggregate LCF risk to these groups from 10 years of operations. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 7.0 person-rem at Hanford and 2.3×10^{-3} person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 0.035 around Hanford and 1.2×10^{-5} around SRS. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at Hanford would be 0.019 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 9.4×10^{-8}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 2.4×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.2×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–122; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of

Table 4–122. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 6C: Pit Conversion in FMEF and MOX in New Construction at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	MOX	Hanford Total	Immobilization (Ceramic or Glass)
Number of badged workers	383	350	733	258
Total dose (person-rem/yr)	192	175	367	194
10-year latent fatal cancers	0.77	0.70	1.5	0.77
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998a, 1998d, 1998i, 1998j.

operation are included in Table 4–122. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at Hanford under this alternative would be the same as that for Alternative 2, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released as a result of operations.

4.12.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion and MOX facilities at Hanford are equivalent to those included in Alternative 2 (see Tables 4–27 and 4–30), and the potential consequences from operation of the immobilization facility at SRS, equivalent to those included in Alternative 3B (see Tables 4–51 and 4–52). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. For information on design basis accidents related to the immobilization facility at SRS, see Section 4.5.2.5. For design basis accidents related to the pit conversion and MOX facilities at Hanford, see Section 4.3.2.5.

A beyond-design-basis earthquake at SRS could result in total collapse of the immobilization facility in Building 221–F, with an estimated 2.7 LCFs. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

The beyond-design-basis accidents at Hanford would be equivalent to those discussed in Section 4.10.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the design basis earthquake at SRS. The consequences of such an accident would include an LCF probability of 4.6×10^{-3}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Hanford and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,867 person-years of labor and the standard DOE occupational accident rates, approximately 348 cases of nonfatal occupational injury or illness and 0.35 fatality could be expected for the duration of operations.

4.12.2.6 Transportation

Because the only difference between Alternative 6A and 6C is the location of the immobilization facility within F-Area at SRS, the transportation required for Alternative 6C would be the same as that for Alternative 6A. Therefore, the transportation risks associated with Alternative 6C are equivalent to those discussed in Section 4.10.2.6.

4.12.2.7 Environmental Justice

As discussed in other parts of Section 4.12.2, routine operations conducted under Alternative 6C would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Hanford would be approximately 1 in 11 million (see Table 4–121); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near Hanford and SRS from accident-free operations would increase by approximately 0.035 and 1.2×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.12.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–27, 4–30, 4–51, and 4–52). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.12.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 6C would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

Citation Previous Section

4.13 ALTERNATIVE 6D

Alternative 6D would involve constructing and operating the pit conversion and MOX facilities at Hanford and the immobilization facility at SRS. The pit conversion and MOX facilities would be located in the existing FMEF building. The immobilization facility would be located in the existing Building 221-F in F-Area. Activities at Hanford would be the same as under Alternative 6B, and activities at SRS would be the same as under Alternative 6C.

4.13.1 Construction

4.13.1.1 Air Quality and Noise

Potential air quality impacts of construction under Alternative 6D at Hanford are the same as those for Alternative 6B (see Section 4.11.1.1). Noise impacts are the same as those for Alternative 6B at Hanford (see Section 4.11.1.1).

Potential air quality impacts of construction under Alternative 6D at SRS are the same as those for Alternative 6C (see Section 4.12.1.1). Noise impacts are the same as those for Alternative 6C at SRS (see Section 4.12.1.1).

4.13.1.2 Waste Management

At Hanford, construction impacts of this alternative would be the same as for Alternative 6B. See Section 4.11.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford.

At SRS, construction impacts of this alternative would be the same as for Alternative 6C. See Section 4.12.1.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.13.1.3 Socioeconomics

Construction-related employment requirements for Alternative 6D would be as indicated in Table 4–123.

Table 4–123. Construction Employment Requirements for Alternative 6D: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Year	Pit Conversion	MOX	Immobilization	Total
2001	77	0	0	77
2002	116	290	248	654
2003	71	362	400	833
2004	0	290	330	620
2005	0	170	0	170
2006	0	160	0	160

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a, 1998d, 1998i, 1998j.

Employment requirements for construction of the pit conversion and MOX facilities at Hanford under this alternative would be the same as those for Alternative 6B (see Section 4.11.1.3).

Employment requirements for construction of the immobilization facility at SRS would be the same as those for Alternative 6C (see Section 4.12.1.3).

4.13.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–124. According to recent radiation surveys (Antonio 1998; UC 1998a, 1998d, 1998i, 1998j) conducted at 400 Area at Hanford and F-Area at SRS, construction workers at Hanford would not be expected to receive doses above natural background levels. At SRS, however, construction workers may receive small doses above natural background levels. Regardless of location, construction workers may be monitored (badged) as a precautionary measure.

Table 4–124. Potential Radiological Impacts on Construction Workers of Alternative 6D: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion[a]	MOX[b]	Hanford Total	Immobilization[c]
Total dose (person-rem/yr)	0	0	0	4.7
Annual latent fatal cancers[d]	0	0	0	1.9×10^{-3}
Average worker dose (mrem/yr)	0	0	0[e]	15
Annual latent fatal cancer risk	0	0	0	6.0×10^{-6}

[a] An estimated average of 88 workers would be associated with annual construction and modification operations.
[b] An estimated average of 254 badged workers would be associated with annual construction and modification operations.
[c] There would be 315 badged workers associated with construction and modification of the existing Building 221–F. The number would be the same for immobilization in either ceramic or glass.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: Antonio 1998; ICRP 1991; NAS 1990; UC 1998a, 1998d, 1998i, 1998j.

Hazardous Chemical Impacts. Because the estimated airborne concentration of benzene delivered to the maximally exposed member of the public at Hanford under this alternative would be the same as that for Alternative 6A, the estimated cancer and risk associated with this exposure would also be the same.

4.13.1.5 Facility Accidents

Construction of plutonium disposition facilities at Hanford and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,514 person-years of construction labor and standard industrial accident rates, approximately 250 cases of nonfatal occupational injury or illness and 0.35 fatality could be expected (DOL 1997a, 1997b). As all construction would take place prior to introduction of the radiological process inventory, no noteworthy radiological accidents should occur.

4.13.1.6 Environmental Justice

As discussed in the other parts of Section 4.13.1, construction under Alternative 6D would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 6D at Hanford and SRS would have no significant impacts on minority or low-income populations.

4.13.2 Operations

4.13.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 6D at Hanford are the same as those for Alternative 6B (see Section 4.11.2.1). Noise impacts are the same as those for Alternative 6B at Hanford (see Section 4.11.2.1).

Potential air quality impacts of the operation of the immobilization facility under Alternative 6D at SRS are the same as those for Alternative 6C (see Section 4.12.2.1). Noise impacts are the same as those for Alternative 6C at SRS (see Section 4.12.2.1).

The combustion of fossil fuels associated with Alternative 6D would result in the emission of carbon dioxide, which is one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative represent less than 3×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.13.2.2 Waste Management

At Hanford, impacts of operations for this alternative would be the same for as Alternative 6A. See Section 4.10.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford.

At SRS, impacts of operations for this alternative would be the same as for Alternative 6C. See Section 4.12.2.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.13.2.3 Socioeconomics

Employment requirements for operation of the pit conversion and MOX facilities at Hanford under Alternative 6D would be the same as those for Alternative 6B (see Section 4.11.2.3).

Employment requirements for operation of the immobilization facility at SRS under Alternative 6D would be the same as those for Alternative 6C (see Section 4.12.2.3).

4.13.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–125 reflects the potential radiological impacts on three individual receptor groups at Hanford and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk from 10 years of operations. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–125. Potential Radiological Impacts on the Public of Operations Under Alternative 6D: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	MOX	Hanford Total	Immobilization Ceramic	Immobilization Glass
Population within 80 km for year 2010					
Dose (person-rem)	6.9	0.051	7.0	2.3×10^{-3}	2.2×10^{-3}
Percent of natural background[a]	5.9×10^{-3}	4.4×10^{-5}	6.0×10^{-3}	1.0×10^{-6}	1.0×10^{-6}
10-year latent fatal cancers	0.034	2.6×10^{-4}	0.034	1.2×10^{-5}	1.1×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.017	6.9×10^{-4}	0.018	2.4×10^{-5}	2.2×10^{-5}
Percent of natural background[a]	5.7×10^{-3}	2.3×10^{-4}	5.9×10^{-3}	8.1×10^{-6}	7.5×10^{-6}
10-year latent fatal cancer risk	8.5×10^{-8}	3.5×10^{-9}	9.0×10^{-8}	1.2×10^{-10}	1.1×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	0.017	1.3×10^{-4}	0.017	2.9×10^{-6}	2.8×10^{-6}
10-year latent fatal cancer risk	8.5×10^{-8}	6.5×10^{-10}	8.6×10^{-8}	1.5×10^{-11}	1.4×10^{-11}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 230,500 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford (387,800) and SRS Building 221–F (781,500) in 2010.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Source: Appendix J.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 7.0 person-rem at Hanford and 2.3×10^{-3} person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 0.034 around Hanford and 1.2×10^{-5} around SRS. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at Hanford would be 0.018 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 9.0×10^{-8}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 2.4×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.2×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–126; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–126. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–126. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 6D: Pit Conversion and MOX Collocated in FMEF at Hanford, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	MOX	Hanford Total	Immobilization (Ceramic or Glass)
Number of badged workers	383	350	733	258
Total dose (person-rem/yr)	192	175	367	194
10-year latent fatal cancers	0.77	0.70	1.5	0.77
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998a, 1998d, 1998i, 1998j.

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at Hanford under this alternative would be the same as that for Alternative 2, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released as a result of operations.

4.13.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Hanford are equivalent to those included in Alternative 2 (see Table 4–27); potential consequences from operation of the MOX facility in FMEF at Hanford would be equivalent to those included in Alternative 4B (see Table 4–74); and potential consequences from operation of the immobilization facility at SRS, equivalent to those included in Alternative 3B (see Tables 4–51 and 4–52). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. For information on design basis accidents related to the immobilization facility at SRS, see Section 4.5.2.5. The design basis accidents for the pit conversion and MOX facilities at Hanford are discussed in Sections 4.3.2.5 and 4.7.2.5, respectively.

The beyond-design-basis accident at Hanford would be equivalent to that discussed in Section 4.11.2.5. The beyond-design-basis accident at SRS would be equivalent to that discussed in Section 4.12.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the design basis earthquake at SRS. The consequences of such an accident would include an LCF probability of 4.6×10^{-3}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Hanford and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,867 person-years of labor and the standard DOE occupational accident rates, approximately 348 cases of nonfatal occupational injury or illness and 0.35 fatality could be expected for the duration of operations.

4.13.2.6 Transportation

Because the only difference between Alternative 6A and 6D is the location of the MOX facility within 400 Area at Hanford and the immobilization facility within F-Area at SRS, the transportation for Alternative 6D would be the same as that for Alternative 6A. Therefore, the transportation risks associated with Alternative 6D are equivalent to those discussed in Section 4.10.2.6.

4.13.2.7 Environmental Justice

As discussed in other parts of Section 4.13.2, routine operations conducted under Alternative 6D would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Hanford would be approximately 1 in 11 million (see Table 4–125); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near Hanford and SRS from accident-free operations would increase by approximately 0.034 and 1.2×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.13.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–27, 4–51, 4–52, and 4–74). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.13.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 6D would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.14 ALTERNATIVE 7A

Alternative 7A would involve constructing and operating the pit conversion and MOX facilities at INEEL and the immobilization facility at SRS. The pit conversion facility would be located in the existing Fuel Processing Facility (FPF) building, and the MOX facility would be located in a new building. The immobilization facility would be located in a new building in F-Area. Activities at SRS would be the same as under Alternative 6A.

4.14.1 Construction

4.14.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 7A at INEEL include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at INEEL, with standards and guidelines is presented as Table 4–127. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Table 4–127. Evaluation of INEEL Air Pollutant Concentrations Associated With Construction Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.81	304	3
	1 hour	40,000	4.90	1220	3.1
Nitrogen dioxide	Annual	100	0.164	11.2	11
PM_{10}	Annual	50	0.127	3.13	6.3
	24 hours	150	4.84	43.8	29
Sulfur dioxide	Annual	80	0.0143	6.01	7.5
	24 hours	365	0.183	137	38
	3 hours	1,300	0.734	592	46
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0.00001	0.029	24

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; ID DHW 1995.

Total vehicle emissions associated with activities at INEEL would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at INEEL relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 12 km [7.5 mi]), noise emissions from construction equipment would not be expected to annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 1-dB increase in noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

Potential air quality impacts of construction under Alternative 7A at SRS are the same as those for Alternative 6A at SRS (see Section 4.10.1.1). Noise impacts are the same as those for Alternative 6A at SRS (see Section 4.10.1.1).

4.14.1.2 Waste Management

At SRS, construction impacts of this alternative would be the same as for Alternative 6A. See Section 4.10.1.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

Table 4–128 compares the wastes generated during construction of surplus plutonium disposition facilities at INEEL with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during construction of surplus plutonium disposition facilities at INEEL would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the INEEL hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities at INEEL would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at INEEL.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of the pit conversion and MOX facilities at INEEL would be managed on the site at the Idaho Nuclear Technology and Engineering Center (INTEC) Sewage Treatment Plant, even though it is likely that much of this waste

Table 4–128. Potential Waste Management Impacts of Construction Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	27	NA	NA	NA
Nonhazardous				
Liquid	15,300	9[c]	NA	<1[d]
Solid	860	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of the FPF sanitary sewer.
[d] Percent of capacity of the INTEC Sewage Treatment Plant.
Key: FPF, Fuel Processing Facility; INTEC, Idaho Nuclear Technology and Engineering Center; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 9 percent of the 166,000-m^3/yr (217,000-yd^3/yr) capacity of the FPF sanitary sewer and less than 1 percent of the 3.2 million-m^3/yr (4.2 million-yd^3/yr) capacity of the INTEC Sewage Treatment Plant. Therefore, management of these wastes at INEEL should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.14.1.3 Socioeconomics

Construction-related employment requirements for Alternative 7A would be as indicated in Table 4–129.

Table 4–129. Construction Employment Requirements for Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	MOX	Immobilization	Total
2001	102	0	0	102
2002	154	290	312	756
2003	92	508	448	1,048
2004	0	334	282	616
2005	0	170	0	170
2006	0	160	0	160

Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.
Source: UC 1998f, 1998g, 1998l, 1998m.

At its peak in 2003, construction of the pit conversion and MOX facilities at INEEL under this alternative would require 600 construction workers and generate another 612 indirect jobs in the region. As the total employment requirement of 1,212 direct and indirect jobs represents less than 0.8 percent of the total projected REA workforce, it should have no major impact on the REA. It should also have a minimal impact on community services provided within the INEEL ROI. In fact, it should help offset the approximately 13 percent reduction in INEEL's total labor force (i.e., from 8,300 to 7,250 workers) projected for the years 1997–2005.

Employment requirements for construction of a new immobilization facility at SRS under Alternative 7A would be the same as those for Alternative 6A (see Section 4.10.1.3).

4.14.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–130. According to recent radiation surveys (Mitchell et al. 1997; UC 1998f, 1998g, 1998l, 1998m) conducted at the INEEL INTEC area and the SRS F-Area, construction workers at either site could receive doses above natural background radiation levels as a result of exposure to radiation deriving from other activities, past or present, at the site. Regardless of location, construction worker exposures would be limited to ensure that doses are kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Table 4–130. Potential Radiological Impacts on Construction Workers of Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	MOX[b]	INEEL Total	Immobilization[c]
Total dose (person-rem/yr)	0.55	1.4	2.0	1.4
Annual latent fatal cancers[d]	2.2×10^{-4}	5.5×10^{-4}	7.7×10^{-4}	5.6×10^{-4}
Average worker dose (mrem/yr)	4.7[e]	4.7[e]	4.7[f]	4
Annual latent fatal cancer risk	1.9×10^{-6}	1.9×10^{-6}	1.9×10^{-6}	1.6×10^{-6}

[a] An estimated average of 116 workers would be associated with annual construction and modification operations.
[b] An estimated average of 292 workers would be associated with annual construction operations.
[c] An estimated average of 347 workers would be associated with annual construction operations at the new facility location adjacent to APSF. The number would be the same for immobilization in either ceramic or glass.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Value is based on the number of expected construction workdays per year and an 8-hr workday.
[f] Represents an average of the doses for both facilities.
Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: Mitchell et al. 1997; ICRP 1991; NAS 1990; UC 1998f, 1998g, 1998l, 1998m.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at INEEL under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

4.14.1.5 Facility Accidents

Construction of plutonium disposition facilities at INEEL and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,852 person-years of construction labor and standard industrial accident rates, approximately 280 cases of nonfatal occupational injury or illness and 0.40 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.14.1.6 Environmental Justice

As discussed in the other parts of Section 4.14.1, construction under Alternative 7A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 7A at INEEL and SRS would have no significant impacts on minority or low-income populations.

4.14.2 Operations

4.14.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 7A at INEEL were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the plutonium disposition facilities, with standards and guidelines is presented as Table 4–131. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated, for example, HEPA filtration has been included in the design of these facilities.

Table 4–131. Evaluation of INEEL Air Pollutant Concentrations Associated With Operations Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.703	303	3.0
	1 hour	40,000	2.82	1,220	3.1
Nitrogen dioxide	Annual	100	0.141	11.1	11
PM_{10}	Annual	50	0.00798	3.01	6
	24 hours	150	0.0854	39.1	26
Sulfur dioxide	Annual	80	0.305	6.31	7.9
	24 hours	365	3.05	140	38
	3 hours	1,300	16.4	607	47
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	6,350	0.197	0.197	0.0031

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; ID DHW 1995.

For a discussion of how the operation of the pit conversion and MOX facilities at INEEL would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.2.4. There are no other NESHAP limits applicable to operation of these facilities.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of these facilities would be a small fraction of the PSD Class II area increments as summarized in Table 4–132. INEEL is near a PSD Class I area, Craters of the Moon National Monument. The contribution to air pollutant concentrations for this area are estimated to be 0.01 $\mu g/m^3$ or less for nitrogen dioxide and PM_{10}. For sulfur dioxide the annual value is 0.015 $\mu g/m^3$, the 24-hour value is 0.16 $\mu g/m^3$ and the 3-hour value is 0.69 $\mu g/m^3$. These values are all well under the Class I PSD increments.

Table 4–132. Evaluation of INEEL Air Pollutant Increases Associated With Operations Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)[a]	PSD Class I Area Allowable Increment ($\mu g/m^3$)	Percent of Class I Increment[a]	Increase in Concentration[b]	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Class II Increment
Nitrogen dioxide	Annual	0.00643	2.5	0.26	0.141	25	0.56
PM_{10}	Annual	0.00037	4	0.0093	0.00798	17	0.047
	24 hours	0.00474	8	0.059	0.0854	30	0.28
Sulfur dioxide	Annual	0.0149	2	0.74	0.305	20	1.5
	24 hours	0.158	5	3.2	3.05	91	3.4
	3 hours	0.694	25	2.8	16.4	512	3.2

[a] At nearest Class I area.
[b] At nearest public access area.
Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

Total vehicle emissions associated with activities at INEEL would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at INEEL relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 12 km [7.5 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such the as disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Potential air quality impacts of operation of the new immobilization facility under Alternative 7A at SRS are the same as those for Alternative 6A (see Section 4.10.2.1). Noise impacts are the same as those for Alternative 6A at SRS (see Section 4.10.2.1).

The combustion of fossil fuels associated with Alternative 7A would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.14.2.2 Waste Management

At SRS, impacts of operations for this alternative would be the same as for Alternative 6A. See Section 4.10.2.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

Table 4–133 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at INEEL. No HLW would be generated by the facilities. Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at INEEL are described in the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final EIS* (DOE 1995a).

Table 4–133. Potential Waste Management Impacts of Operations Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	64	1	<1	<1 of WIPP
LLW	94	<1	1	<1
Mixed LLW	3	<1	<1	NA
Hazardous	<3	<1	2	NA
Nonhazardous				
Liquid	66,000	40[d]	NA	2[e]
Solid	<1,950	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of the FPF sanitary sewer.
[e] Percent of capacity of the INTEC Sewage Treatment Plant.
Key: FPF, Fuel Processing Facility; INTEC, Idaho Nuclear Technology and Engineering Center; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned Waste Characterization Facility at INEEL.

TRU wastes generated by the pit conversion and MOX facilities at INEEL is estimated to be 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project. A total of 640 m^3 (837 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be less than 1 percent of the 177,300-m^3 (231,900-yd^3) storage capacity available at the Radioactive Waste Management Complex (RWMC). Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of 0.1 ha (0.25 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at INEEL should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated at INEEL and SRS would be 1 percent of the 143,000-m^3 (187,000-yd^3) contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

At INEEL, LLW would be packaged, certified, and accumulated at the pit and MOX facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 940 m^3 (1,230 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) treatment capacity of the Waste Experimental Reduction Facility (WERF), 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity of RWMC, and less than 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of RWMC. Using the 6,264 m^3/ha disposal land usage factor for INEEL published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.15-ha (0.37-acre) disposal space at INEEL. Therefore, impacts of the management of this additional LLW at INEEL should not be major.

At INEEL, mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan. Mixed LLW is currently treated on the site with some waste shipped to Envirocare of Utah for disposal. A new facility is planned for onsite disposal. Mixed LLW generation at the pit conversion and MOX facilities is estimated to be less than 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project, and less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity of RWMC. Therefore, the management of this additional waste at INEEL should not have a major impact on the mixed LLW management system.

Any hazardous wastes generated during operation of the pit conversion and MOX facilities at INEEL would be packaged for treatment at a combination of onsite and offsite facilities, with disposal occurring at offsite commercial facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) capacity of WERF and 2 percent of the 1,600-m^3 (2,090-yd^3) capacity of the hazardous waste storage buildings. Therefore, the management of these additional hazardous wastes at INEEL should not have a major impact on the hazardous waste management system.

If all TRU waste and mixed LLW generated at the surplus plutonium disposition facilities at INEEL were processed in the Advanced Mixed Waste Treatment Project, this additional waste would be 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of that facility. If all TRU waste, LLW, and mixed LLW generated at the surplus plutonium disposition facilities at INEEL were stored at RWMC, this additional waste would be 1 percent of the 112,400-m^3 (147,000-yd^3) capacity of that facility. If all LLW and hazardous wastes generated at the surplus plutonium disposition facilities at INEEL were treated at WERF, this additional waste would be less than 1 percent of the 49,610-m^3 (64,890-yd^3) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at INEEL.

At INEEL, nonhazardous wastewater generated by the pit conversion and MOX facilities would be treated if necessary before being discharged to the FPF sanitary sewer system, which connects to the INTEC Sewage Treatment Plant. Nonhazardous liquid waste generated by the pit conversion and MOX facilities at INEEL is estimated to be 40 percent of the 166,000-m^3/yr (217,000-yd^3/yr) capacity of the FPF sanitary sewer and 2 percent of the 3.2 million-m^3/yr (4.2 million-yd^3/yr) capacity of the INTEC Sewage Treatment Plant. Therefore, management of nonhazardous liquid waste at INEEL should not have a major impact on the treatment system.

4.14.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and MOX facilities at INEEL in 2007 under Alternative 7A, an estimated 708 new workers would be required to operate them (UC 1998l, 1998m). This level of employment would be expected to generate another 1,897 indirect jobs within the region. As this total employment requirement of 2,605 new direct and indirect jobs represents about 1.5 percent of the total projected REA workforce, it should have no major impact on the REA. It could have a small effect on community services provided within the ROI. In fact, it should help to offset the nearly 13 percent decline in INEEL employment (i.e., from 8,300 to 7,250 workers) projected for the years 1997–2010.

Employment requirements for operation of the immobilization facility at SRS under Alternative 7A would be the same as those for Alternative 6A (see Section 4.10.2.3).

4.14.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–134 reflects the potential radiological impacts on three individual receptor groups at INEEL and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 2.2 person-rem at INEEL and 2.3×10^{-3} person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 0.011 around INEEL and 1.2×10^{-5} around SRS. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at INEEL would be 0.016 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 8.0×10^{-8}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 2.4×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.2×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Table 4–134. Potential Radiological Impacts on the Public of Operations Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	MOX	INEEL Total	Immobilization Ceramic	Immobilization Glass
Population within 80 km for year 2010					
Dose (person-rem)	2.2	0.014	2.2	2.3×10^{-3}	2.2×10^{-3}
Percent of natural background[a]	3.3×10^{-3}	2.1×10^{-5}	3.3×10^{-3}	1.0×10^{-6}	1.0×10^{-6}
10-year latent fatal cancers	0.011	7.0×10^{-5}	0.011	1.2×10^{-5}	1.1×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.015	1.2×10^{-3}	0.016	2.4×10^{-5}	2.2×10^{-5}
Percent of natural background[a]	4.2×10^{-3}	3.3×10^{-4}	4.5×10^{-3}	8.1×10^{-6}	7.5×10^{-6}
10-year latent fatal cancer risk	7.5×10^{-8}	6.0×10^{-9}	8.0×10^{-8}	1.2×10^{-10}	1.1×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	0.012	7.7×10^{-5}	0.012	2.9×10^{-6}	2.8×10^{-6}
10-year latent fatal cancer risk	6.0×10^{-8}	3.9×10^{-10}	6.0×10^{-8}	1.5×10^{-11}	1.4×10^{-11}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL (182,800) and the SRS APSF (785,400) in 2010.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.
Source: Appendix J.

Doses to involved workers from normal operations are given in Table 4–135; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 170, 175, and 174 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–135. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–135. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	MOX	INEEL Total	Immobilization (Ceramic or Glass)
Number of badged workers	341	350	691	232
Total dose (person-rem/yr)	170	175	345	174
10-year latent fatal cancers	0.68	0.70	1.4	0.70
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998f, 1998g, 1998l, 1998m.

Hazardous Chemical Impacts. Ethylene glycol should be released as a result of operations at the INEEL under this alternative. The Hazard Index (4×10^{-5}) would be much lower than 1, indicating that adverse, noncancer health effects should not be incurred. No carcinogenic chemicals would be released as a result of operations.

4.14.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility in FPF and the MOX facility at INEEL are presented in Tables 4–136 and 4–137. The potential consequences from operation of the immobilization facility at SRS would be equivalent to those included in Alternative 3A (see Tables 4–41 and 4–42). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Table 4–136. Accident Impacts of Pit Conversion Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Fire	Unlikely	6.4×10^{-6}	2.5×10^{-9}	1.1×10^{-6}	5.3×10^{-10}	2.1×10^{-4}	1.0×10^{-7}
Explosion	Unlikely	1.7×10^{-3}	6.7×10^{-7}	2.8×10^{-4}	1.4×10^{-7}	5.5×10^{-2}	2.7×10^{-5}
Leaks/spills of nuclear material	Extremely unlikely	2.3×10^{-6}	9.3×10^{-10}	3.9×10^{-7}	1.9×10^{-10}	7.7×10^{-5}	3.8×10^{-8}
Tritium release	Extremely unlikely	1.8×10^{-1}	7.1×10^{-5}	3.0×10^{-2}	1.5×10^{-5}	5.9	2.9×10^{-3}
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	1.6×10^{-3}	7.9×10^{-7}	8.5×10^{-2}	4.2×10^{-5}
Design basis earthquake	Unlikely	2.1×10^{-4}	8.2×10^{-8}	3.4×10^{-5}	1.7×10^{-8}	6.8×10^{-3}	3.4×10^{-6}
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-1}	4.5×10^{-5}	2.9×10^{-3}	1.5×10^{-6}	3.6×10^{-1}	1.8×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	2.6×10^{2}	1.0×10^{-1}	6.7	3.3×10^{-3}	8.4×10^{2}	4.2×10^{-1}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value that assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.

Source: Calculated using the source terms in Table K–9 and the MACCS2 computer code.

Table 4–137. Accident Impacts of MOX Facility Under Alternative 7A: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in New Construction and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.2×10^{-1}	4.6×10^{-5}	2.4×10^{-3}	1.2×10^{-6}	1.1×10^{-1}	5.4×10^{-5}
Explosion in sintering furnace	Extremely unlikely	3.6×10^{-3}	1.4×10^{-6}	8.5×10^{-5}	4.2×10^{-8}	1.2×10^{-2}	5.9×10^{-6}
Fire	Extremely unlikely	2.2×10^{-5}	8.8×10^{-9}	5.2×10^{-7}	2.6×10^{-10}	7.2×10^{-5}	3.6×10^{-8}
Design basis earthquake	Unlikely	5.1×10^{-4}	2.1×10^{-7}	1.2×10^{-5}	6.0×10^{-9}	1.7×10^{-3}	8.3×10^{-7}
Beyond-design-basis fire	Beyond extremely unlikely	6.4×10^{-2}	2.6×10^{-5}	1.6×10^{-3}	8.2×10^{-7}	2.1×10^{-1}	1.0×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	6.0×10^{2}	2.4×10^{-1}	1.5×10^{1}	7.7×10^{-3}	1.9×10^{3}	9.7×10^{-1}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value that assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) on exposure to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.

Source: Calculated using the source terms in Table K–9 and the MACCS2 computer code.

Public. The most severe consequences of a design basis accident for the pit conversion facility would be associated with a tritium release and for the MOX facility, a nuclear criticality. Bounding radiological consequences for the MEI are from the tritium release at INEEL, which would result in a dose of 0.03 rem, corresponding to an LCF probability of 1.5×10^{-5}. A nuclear criticality of 10^{19} fissions would result in an MEI dose of 2.4×10^{-3} rem at the MOX facility at INEEL. Among the general population in the environs of INEEL, an estimated 2.9×10^{-3} LCF could occur as a result of the bounding tritium release accident. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year. For a discussion of the most severe consequences of a design basis accident for the immobilization facility, see Section 4.4.2.5.

A beyond-design-basis earthquake at INEEL could result in the collapse of the pit conversion facility in FPF and the MOX facility, and an estimated 1.4 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of such an earthquake is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

The beyond-design-basis accident at SRS would be equivalent to that discussed in Section 4.10.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 7.1×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at INEEL and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,161 person-years of labor and the standard DOE occupational accident rates, approximately 325 cases of nonfatal occupational injury or illness and 0.33 fatality could be expected for the duration of operations.

4.14.2.6 Transportation

Under Alternative 7A, transportation to and from INEEL would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to the Oak Ridge Reservation (ORR) for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at INEEL for fabrication into MOX fuel pellets.

It is assumed that depleted uranium hexafluoride needed for MOX fuel would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide (see Section 4.3.2.6). After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at INEEL. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in, this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at SRS under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to DWPF in S-Area. This intrasite transportation—from F-Area to S-Area—could require the temporary shutdown of roads on SRS. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at DWPF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 7A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.14.1.2 and 4.14.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In all, approximately 2,500 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 7.4 million km (4.6 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 53 person-rem; the dose to the public, 63 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.021 LCF among transportation workers and 0.032 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.025.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of plutonium pits from one of DOE's storage locations to the pit conversion facility with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. The accident could result in a dose of 29 person-rem to the public for an LCF risk of 0.015 and 32 rem to the hypothetical MEI for an LCF risk of 0.016. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 7A are as follows: a radiological dose to the population of 21 person-rem, resulting in a total population risk of 0.011 LCF; and traffic accidents resulting in 0.084 traffic fatalities.

4.14.2.7 Environmental Justice

As discussed in other parts of Section 4.14.2, routine operations conducted under Alternative 7A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near INEEL would be approximately 1 in 11 million (see Table 4–134); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near INEEL and SRS from accident-free operations would increase by approximately 0.011 and 1.2×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.14.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–41, 4–42, 4–136, and 4–137). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.14.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 7A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

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4.15 ALTERNATIVE 7B

Alternative 7B would involve constructing and operating the pit conversion and MOX facilities at INEEL and the immobilization facility at SRS. The pit conversion facility would be located in the existing FPF building, and the MOX facility would be located in a new building. The immobilization facility would be located in the existing Building 221–F in F-Area. Activities at INEEL would be the same as under Alternative 7A and activities at SRS would be the same as under Alternative 6C.

4.15.1 Construction

4.15.1.1 Air Quality and Noise

Potential air quality impacts of construction under Alternative 7B at INEEL are the same as those for Alternative 7A (see Section 4.14.1.1). Noise impacts are the same as those for Alternative 7A at INEEL (see Section 4.14.1.1).

Potential air quality impacts of construction under Alternative 7B at SRS are the same as those for Alternative 6C (see Section 4.12.1.1). Noise impacts are the same as those for Alternative 6C at SRS (see Section 4.12.1.1).

4.15.1.2 Waste Management

At INEEL, construction impacts of this alternative would be the same as for Alternative 7A. See Section 4.14.1.2 for a description of the impacts of this alternative on the waste management infrastructure at INEEL.

At SRS, construction impacts of this alternative would be the same as for Alternative 6C. See Section 4.12.1.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.15.1.3 Socioeconomics

Construction-related employment requirements for Alternative 7B would be as indicated in Table 4–138.

Table 4–138. Construction Employment Requirements for Alternative 7B: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in Building 221–F and DWPF at SRS

Year	Pit Conversion	MOX	Immobilization	Total
2001	102	0	0	102
2002	154	290	248	692
2003	92	508	400	1,000
2004	0	334	330	664
2005	0	170	0	170
2006	0	160	0	160

Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.
Source: UC 1998i, 1998j, 1998l, 1998m.

Employment requirements for construction of the pit conversion and MOX facilities at INEEL under this alternative would be the same as those for Alternative 7A (see Section 4.14.1.3).

Employment requirements for construction at SRS under Alternative 7B, involving modification of Building 221–F for plutonium conversion and immobilization, would be the same as those for Alternative 6C (see Section 4.12.1.3).

4.15.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. Summaries of radiological impacts of construction activities are presented in Table 4–139 for workers at risk. According to recent radiation surveys (Mitchell et al. 1997; UC 1998i, 1998j, 1998l, 1998m) conducted at the INEEL INTEC area and the SRS F-Area, construction workers at either site could receive doses above natural background radiation levels as a result of other ongoing or past activities. Regardless of location, construction worker exposures would be limited to ensure that doses are maintained as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Table 4–139. Potential Radiological Impacts on Construction Workers of Alternative 7B: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion[a]	MOX[b]	INEEL Total	Immobilization[c]
Total dose (person-rem/yr)	0.55	1.4	2.0	4.7
Annual latent fatal cancers[d]	2.2×10^{-4}	5.5×10^{-4}	7.7×10^{-4}	1.9×10^{-3}
Average worker dose (mrem/yr)	4.7[e]	4.7[e]	4.7[f]	15
Annual latent fatal cancer risk	1.9×10^{-6}	1.9×10^{-6}	1.9×10^{-6}	6.0×10^{-6}

[a] An estimated average of 116 workers would be associated with annual construction and modification operations.
[b] An estimated average of 292 workers would be associated with annual construction operations.
[c] There would be 315 workers associated with construction and modification of the existing Building 221–F. The number would be the same for immobilization in either ceramic or glass.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Value is based on the number of expected construction workdays per year and an 8-hr workday.
[f] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.

Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: Mitchell et al. 1997; ICRP 1991; NAS 1990; UC 1998i, 1998j, 1998l, 1998m.

Hazardous Chemical Impacts. Because the estimated airborne concentration of benzene delivered to the maximally exposed member of the public at the INEEL under this alternative would be the same as that for Alternative 7A, the estimated cancer risk associated with this exposure would also be the same.

4.15.1.5 Facility Accidents

Construction of plutonium disposition facilities at INEEL and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,788 person-years of construction labor and standard industrial accident rates, approximately 280 cases of nonfatal occupational injury or illness and 0.39 fatality could be expected (DOL 1997a, 1997b). As all construction would take place prior to introduction of the radiological process inventory, no noteworthy radiological accidents should occur.

4.15.1.6 Environmental Justice

As discussed in the other parts of Section 4.15.1, construction under Alternative 7B would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 7B at INEEL and SRS would have no significant impacts on minority or low-income populations.

4.15.2 Operations

4.15.2.1 Air Quality and Noise

Potential air quality impacts of operation of facilities under Alternative 7B at INEEL are the same as those for Alternative 7A (see Section 4.14.2.1). Noise impacts are the same as those for Alternative 7A at INEEL (see Section 4.14.2.1).

Potential air quality impacts of operation of the immobilization facility under Alternative 7B at SRS are the same as those for Alternative 6A (see Section 4.10.2.1). Noise impacts are the same as those for Alternative 6A at SRS (see Section 4.10.2.1).

The combustion of fossil fuels associated with Alternative 7B would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.15.2.2 Waste Management

At INEEL, impacts of operations for this alternative would be the same as for Alternative 7A. Therefore, see Section 4.14.2.2 for a description of the impacts of this alternative on the waste management infrastructure at INEEL.

At SRS, impacts of operations for this alternative would be the same as for Alternative 6C. Therefore, see Section 4.12.2.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.15.2.3 Socioeconomics

Employment requirements for operation of the pit conversion and MOX facilities at INEEL under Alternative 7B would be the same as those for Alternative 7A (see Section 4.14.2.3).

Employment requirements for operation of the immobilization facility at SRS under Alternative 7B would be the same as those for Alternative 6C (see Section 4.12.2.3).

4.15.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–140 reflects the potential radiological impacts on three individual receptor groups at INEEL and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operations. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–140. Potential Radiological Impacts on the Public of Operations Under Alternative 7B: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	MOX	INEEL Total	Immobilization Ceramic	Immobilization Glass
Population within 80 km for year 2010					
Dose (person-rem)	2.2	0.014	2.2	2.3×10^{-3}	2.2×10^{-3}
Percent of natural background[a]	3.3×10^{-3}	2.1×10^{-5}	3.3×10^{-3}	1.0×10^{-6}	1.0×10^{-6}
10-year latent fatal cancers	0.011	7.0×10^{-5}	0.011	1.2×10^{-5}	1.1×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.015	1.2×10^{-3}	0.016	2.4×10^{-5}	2.2×10^{-5}
Percent of natural background[a]	4.2×10^{-3}	3.3×10^{-4}	4.5×10^{-3}	8.1×10^{-6}	7.5×10^{-6}
10-year latent fatal cancer risk	7.5×10^{-8}	6.0×10^{-9}	8.0×10^{-8}	1.2×10^{-10}	1.1×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	0.012	7.7×10^{-5}	0.012	2.9×10^{-6}	2.8×10^{-6}
10-year latent fatal cancer risk	6.0×10^{-8}	3.9×10^{-10}	6.0×10^{-8}	1.5×10^{-11}	1.4×10^{-11}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 230,500 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL (182,800) and SRS Building 221–F (781,500) in 2010.

Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.

Source: Appendix J.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 2.2 person-rem at INEEL and 2.3×10^{-3} person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 0.011 around INEEL and 1.2×10^{-5} around SRS. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at INEEL would be 0.016 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 8.0×10^{-8}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 2.4×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.2×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–141; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 170, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–141. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits and ALARA programs (which would include worker rotations).

Table 4–141. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 7B: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	MOX	INEEL Total	Immobilization (Ceramic or Glass)
Number of badged workers	341	350	691	258
Total dose (person-rem/yr)	170	175	345	194
10-year latent fatal cancers	0.68	0.70	1.4	0.77
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of doses for both facilities.

Key: DWPF, Defense Waste Processing Facility; FPF, Fuel Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998i, 1998j, 1998l, 1998m.

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at the INEEL under this alternative would be the same as that for Alternative 7A, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released as a result of operations.

4.15.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit and MOX facilities at INEEL are equivalent to those included in Alternative 7A (see Tables 4–136 and 4–137), and the potential consequences from operation of the immobilization facility at SRS, equivalent to those included in Alternative 3B (see Tables 4–51 and 4–52). Details on the specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The design basis accidents for the immobilization facility in Building 221–F at SRS are discussed in Section 4.5.2.5. The design basis accidents for the pit conversion facility in FPF and the MOX facility at INEEL are discussed in Section 4.14.2.5.

The beyond-design-basis accident at INEEL would be equivalent to that discussed in Section 4.14.2.5. The beyond-design-basis accident at SRS would be equivalent to that discussed in Section 4.12.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the design basis earthquake at SRS. The consequences of such an accident would include an LCF probability of 4.6×10^{-3}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at INEEL and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,447 person-years of labor and the standard DOE occupational accident rates, approximately 334 cases of nonfatal occupational injury or illness and 0.33 fatality could be expected for the duration of operations.

4.15.2.6 Transportation

Because the only difference between Alternative 7A and 7B is the location of the immobilization facility within F-Area at SRS, the transportation required for Alternative 7B would be the same as that for Alternative 7A. Therefore, the transportation risks associated with Alternative 7B are equivalent to those discussed in Section 4.14.2.6.

4.15.2.7 Environmental Justice

As discussed in other parts of Section 4.15.2, routine operations conducted under Alternative 7B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near INEEL would be approximately 1 in 12 million (see Table 4–140); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near INEEL and SRS from accident-free operations would increase by approximately 0.011 and 1.2×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.15.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–51, 4–52, 4–136, and 4–137). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.15.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 7B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

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4.16 ALTERNATIVE 8

Alternative 8 would involve constructing and operating the pit conversion and MOX facilities at INEEL and the immobilization facility at Hanford. The pit conversion facility would be located in the existing FPF building, and the MOX facility would be located in a new building. The immobilization facility would be located in the existing FMEF building in the 400 Area. Activities at INEEL would be the same as under Alternative 7A.

4.16.1 Construction

4.16.1.1 Air Quality and Noise

Potential air quality impacts of construction under Alternative 8 at INEEL are the same as those for Alternative 7A (see Section 4.14.1.1). Noise impacts are the same as those for Alternative 7A at INEEL (see Section 4.14.1.1).

Sources of potential air quality impacts of construction under Alternative 8 at Hanford include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations at Hanford, including the contribution from construction activities, with standards and guidelines is presented as Table 4–142. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat from current emissions during the planned construction period because of an expected decrease in overall site employment.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from construction equipment would not be expected to annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 1-dB increase in noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

Table 4–142. Evaluation of Hanford Air Pollutant Concentrations Associated With Construction Under Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.224	34.3	0.34
	1 hour	40,000	1.52	49.8	0.13
Nitrogen dioxide	Annual	100	0.0173	0.267	0.27
PM_{10}	Annual	50	0.00248	0.0204	0.041
	24 hours	150	0.0903	0.86	0.57
Sulfur dioxide	Annual	50	0.00174	1.63	3.1
	24 hours	260	0.0194	8.93	3.4
	3 hours	1,300	0.132	29.7	2.3
	1 hour	700	0.395	33.3	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.00248	0.0204	0.034
	24 hours	150	0.0903	0.860	0.57
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0	0.000006	0.0050

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

4.16.1.2 Waste Management

At INEEL, construction impacts of this alternative would be the same as for Alternative 7A. See Section 4.14.1.2 for a description of the impacts of this alternative on the waste management infrastructure at INEEL.

Table 4–143 compares the wastes generated during modification of the FMEF building at Hanford with the existing treatment, storage, and disposal capacity for the various waste types.

It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year modification period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during modification. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during modification of the FMEF building at Hanford would be typical of those generated during modification of an industrial facility. Any hazardous wastes generated during modification would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the modification period should not have a major impact on the Hanford hazardous waste management system.

Table 4–143. Potential Waste Management Impacts of Construction Under Alternative 8: Immobilization in FMEF and HLWVF at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	4	NA	NA	NA
Nonhazardous				
Liquid	3,700	2[c]	NA	2[d]
Solid	150	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year modification period.
[c] Percent of capacity of the 400 Area sanitary sewer.
[d] Percent of capacity of the WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); WPPSS, Washington Public Power Supply System.

Nonhazardous solid wastes generated during modification of the FMEF building at Hanford would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at Hanford.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during modification of the FMEF building at Hanford would be managed on the site at the WPPSS Sewage Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during modification is estimated to be 2 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and 2 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, management of these wastes at Hanford should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

4.16.1.3 Socioeconomics

Construction-related employment requirements for Alternative 8 would be as indicated in Table 4–144.

Table 4–144. Construction Employment Requirements for Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford

Year	Pit Conversion	MOX	Immobilization	Total
2001	102	0	0	102
2002	154	290	167	611
2003	92	508	268	868
2004	0	334	236	570
2005	0	170	0	170
2006	0	160	0	160

Key: FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility.
Source: UC 1998b, 1998c, 1998l, 1998m.

At its peak in 2003, construction of the pit conversion and MOX facilities at INEEL under this alternative would require 600 construction workers and generate another 612 indirect jobs in the region. The total employment requirement of 1,212 direct and indirect jobs represents only about 0.7 percent of the total projected INEEL workforce, and thus would have no major impact on the REA. It should also have little effect on community services provided within the INEEL REA. In fact, it should help offset the approximately 13 percent reduction in INEEL's total workforce (i.e., from 8,300 to 7,250 workers) projected for the years 1997–2005.

At its peak in 2003, construction of the immobilization facility at Hanford would require 268 construction workers and generate another 275 indirect jobs in the region. The total employment requirement of 543 direct and indirect jobs represents less than 0.2 percent of the total projected REA workforce, and thus should have no major impacts on the REA. This requirement should also have little effect on community services currently offered in the ROI. In fact, it should help offset the roughly 15 percent reduction in Hanford employment (i.e., from 12,900 to 11,000 workers) projected for the years 1997–2005.

4.16.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–145. According to recent radiation surveys (Mitchell et al. 1997; Antonio 1998) conducted in the INEEL INTEC area and the Hanford 400 Area, construction workers at INEEL could receive small doses above natural background radiation levels as a result of other ongoing or past activities; no doses above natural background levels would be expected at Hanford. Construction worker exposures would be limited to ensure that doses are kept as low as is reasonably achievable, and workers may be monitored (badged) as appropriate.

Table 4–145. Potential Radiological Impacts on Construction Workers of Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion[a]	MOX[b]	INEEL Total	Immobilization[c]
Total dose (person-rem/yr)	0.55	1.4	2.0	0
Annual latent fatal cancers[d]	2.2×10^{-4}	5.5×10^{-4}	7.7×10^{-4}	0
Average worker dose (mrem/yr)	4.7[e]	4.7[e]	4.7[f]	0
Annual latent fatal cancer risk	1.9×10^{-6}	1.9×10^{-6}	1.9×10^{-6}	0

[a] An estimated average of 116 workers would be associated with annual construction and modification operations.
[b] An estimated average of 292 workers would be associated with annual construction operations.
[c] An estimated average of 244 workers would be associated with annual construction and modification operations. The number would be the same for immobilization in either ceramic or glass.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Value is based on the number of expected construction workdays per year and an 8-hr workday.
[f] Represents an average of doses for both facilities.
Key: FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: Antonio 1998; ICRP 1991; Mitchell et al. 1997; NAS 1990.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at the INEEL under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at Hanford under this alternative has been estimated at 5 chances in 100 million (5×10^{-11}) over the lifetime of the maximally exposed member of the public.

4.16.1.5 Facility Accidents

Construction of plutonium disposition facilities at INEEL and Hanford could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,481 person-years of construction labor and standard industrial accident rates, approximately 250 cases of nonfatal occupational injury or illness and 0.35 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.16.1.6 Environmental Justice

As discussed in the other parts of Section 4.16.1, construction under Alternative 8 would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 8 at INEEL and Hanford would have no significant impacts on minority or low-income populations.

4.16.2 Operations

4.16.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 8 at INEEL are the same as those for Alternative 7A (see Section 4.14.2.1). Noise impacts are the same as those for Alternative 7A at INEEL (see Section 4.14.2.1).

Potential air quality impacts of the operation of the immobilization facility under Alternative 8 at Hanford were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the immobilization facility, with standards and guidelines is presented as Table 4–146. Concentrations for immobilization in the ceramic form are presented because they would be greater than those for the glass form. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of the facility.

For a discussion of how the operation of the immobilization facility at Hanford would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAP limits applicable to operation of this facility.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of the immobilization facility would be a small fraction of the PSD Class II area increments as summarized in Table 4–147.

Table 4–146. Evaluation of Hanford Air Pollutant Concentrations Associated With Operations Under Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.283	34.4	0.34
	1 hour	40,000	1.61	49.9	0.13
Nitrogen dioxide	Annual	100	0.015	0.265	0.27
PM_{10}	Annual	50	0.00108	0.019	0.038
	24 hours	150	0.012	0.782	0.52
Sulfur dioxide	Annual	50	0.001	1.63	3.1
	24 hours	260	0.0111	8.92	3.4
	3 hours	1,300	0.0752	29.7	2.3
	1 hour	700	0.226	33.1	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.00108	0.019	0.032
	24 hours	150	0.012	0.782	0.52
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	420	0	0	0

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Key: FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; WDEC 1994.

Table 4–147. Evaluation of Hanford Air Pollutant Increases Associated With Operations Under Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.015	25	0.06
PM_{10}	Annual	0.00108	17	0.0064
	24 hours	0.012	30	0.04
Sulfur dioxide	Annual	0.001	20	0.005
	24 hours	0.0111	91	0.012
	3 hours	0.0752	512	0.015

Key: FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.

Source: EPA 1997b.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

The location of the facility at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of this facility would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of this facility would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

The combustion of fossil fuels associated with Alternative 8 would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.16.2.2 Waste Management

At INEEL, impacts of operations for this alternative would be the same as for Alternative 7A. See Section 4.14.2.2 for a description of the impacts of this alternative on the waste management infrastructure at INEEL.

Table 4–148 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at Hanford. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation at Hanford should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* that is being prepared by the DOE Richland Operations Office (DOE 1997c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

Table 4–148. Potential Waste Management Impacts of Operations Under Alternative 8: Immobilization in FMEF and HLWVF at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	95	5	6	1 of WIPP
LLW	60	NA	NA	<1
Mixed LLW	1	<1	<1	<1
Hazardous	30	NA	NA	NA
Nonhazardous				
Liquid	23,000	10[d]	NA	10[e]
Solid	230	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of the 400 Area sanitary sewer.
[e] Percent of the capacity of WPPSS Sewage Treatment Facility.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant; WPPSS, Washington Public Power Supply System.

TRU waste generation at the immobilization facility at Hanford is estimated to be 5 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 950-m^3 (1,240-yd^3) TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 6 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.14 ha (0.35 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at Hanford should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated at INEEL and Hanford would be 1 percent of the 143,000-m^3 (187,000-yd^3) contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

At Hanford, LLW would be packaged, certified, and accumulated at the immobilization facility before transfer for additional treatment and disposal in existing onsite facilities. A total of 600-m^3 (780-yd^3) LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) capacity of the LLW Burial Grounds and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480 m^3/ha disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 m^3 (780 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

At Hanford, mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan. Mixed LLW generation at the immobilization facility is estimated to be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (22,000-yd^3) capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system. If all TRU waste and mixed LLW generated at the surplus plutonium disposition facilities at Hanford were processed in the Waste Receiving and Processing Facility, this additional waste would be 5 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of that facility.

At Hanford, any hazardous wastes generated during operation of the immobilization facility would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operation period should not have a major impact on Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at Hanford.

At Hanford, nonhazardous wastewater generated by the immobilization facility would be treated if necessary before being discharged to the 400 Area sanitary sewer system, which connects to the WPPSS Sewage Treatment Facility. Nonhazardous liquid waste generated by the immobilization facility at Hanford is estimated to be 10 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 10 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the WPPSS Sewage Treatment Facility (Mecca 1997). Therefore, management of nonhazardous liquid waste at Hanford should not have a major impact on the treatment system.

4.16.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and the MOX facilities at INEEL in 2007 under Alternative 8, an estimated 708 new workers would be required to operate them (UC 1998l, 1998m). This employment level should generate another 1,897 indirect jobs within the region. As this total employment requirement of 2,605 direct and indirect jobs represents about 1.5 percent of the total projected REA workforce, it should have no major impact on the REA. It should also have a negligible effect on community services provided within the INEEL ROI. In fact, it should reduce to 4.1 percent the 13 percent decline in INEEL's total workforce (i.e., from 8,300 to 7,250 workers) projected for the years 1997–2010.

After construction, startup, and testing of the immobilization facility at Hanford in 2007 under Alternative 8, an estimated 264 new workers would be required to operate it (UC 1998b, 1998c). This level of employment should generate another 668 related jobs in the region. The total employment requirement of 932 direct and indirect jobs represents less than 0.3 percent of the projected REA workforce, and should have no major impact on the REA. Some of the new jobs created under this alternative would be filled from the ranks of the unemployed, currently 11 percent of the REA's population.

In the ROI, however, this employment requirement could have minor impacts on community services, for it should coincide with an overall increase in site employment in connection with construction of the tank waste remediation system. Assuming that 91 percent of the new employees associated with this alternative resided in the ROI, an increase of 848 new jobs in the projected workforce would precipitate an overall population increase of approximately 1,614 persons. This increase, in conjunction with the population growth forecast by the State of Washington, would engender increased construction of local housing units. Given the current population-to-student ratio in the ROI, a population of this size would be expected to include 334 students, and local school districts would have to increase the number of classrooms to accommodate them.

Community services in the ROI would be expected to change to reflect the population growth as follows: 21 teachers would be added to maintain the current student-to-teacher ratio of 16:1; 2 police officers would be added to maintain the current officer-to-population ratio of 1.6:1,000; 5 firefighters would be added to maintain the current firefighter-to-population ratio of 3.4:1,000; and 2 physicians would be added to maintain the current physician-to-population ratio of 1.4:1,000. Thus, an additional 31 positions would have to be created to maintain community services at current levels. The ratio of hospital beds to population in the ROI would remain at 2.1 beds per 1,000 persons. However, average school enrollment would increase to 93.3 percent from the current rate of 92.5 percent unless additional classrooms were built. None of the projected changes should have a major impact on the level of community services currently being offered in the ROI.

4.16.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–149 reflects the potential radiological impacts on three individual receptor groups at INEEL and Hanford: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operations. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–149. Potential Radiological Impacts on the Public of Operations Under Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	MOX	INEEL Total	Immobilization	
				Ceramic	Glass
Population within 80 km for year 2010					
Dose (person-rem)	2.2	0.014	2.2	7.8×10^{-3}	7.1×10^{-3}
Percent of natural background[a]	3.3×10^{-3}	2.1×10^{-5}	3.3×10^{-3}	6.7×10^{-6}	6.1×10^{-6}
10-year latent fatal cancers	0.011	7.0×10^{-5}	0.011	3.9×10^{-5}	3.6×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.015	1.2×10^{-3}	0.016	1.1×10^{-4}	9.7×10^{-5}
Percent of natural background[a]	4.2×10^{-3}	3.3×10^{-4}	4.5×10^{-3}	3.7×10^{-5}	3.2×10^{-5}
10-year latent fatal cancer risk	7.5×10^{-8}	6.0×10^{-9}	8.0×10^{-8}	5.5×10^{-10}	4.9×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	0.012	7.7×10^{-5}	0.012	2.0×10^{-5}	1.8×10^{-5}
10-year latent fatal cancer risk	6.0×10^{-8}	3.9×10^{-10}	6.0×10^{-8}	1.0×10^{-10}	9.0×10^{-11}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem. The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL (182,800) and Hanford (387,800) in 2010.

Key: FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility.

Source: Appendix J.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 2.2 person-rem at INEEL and 7.8×10^{-3} person-rem at Hanford. The corresponding number of LCFs in the population from 10 years of operation would be 0.011 around INEEL and 3.9×10^{-5} around Hanford. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at INEEL would be 0.016 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 8.0×10^{-8}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at Hanford would be 1.1×10^{-4} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 5.5×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–150; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers; 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 170, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–150. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–150. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 8: Pit Conversion in FPF and MOX in New Construction at INEEL, and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	MOX	INEEL Total	Immobilization (Ceramic or Glass)
Number of badged workers	341	350	691	258
Total dose (person-rem/yr)	170	175	345	194
10-year latent fatal cancers	0.68	0.70	1.4	0.77
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: FMEF, Fuels and Materials Examination Facility; FPF, Fuel Processing Facility; HLWVF, high-level-waste vitrification facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998b, 1998c, 1998l, 1998m.

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol for the maximally exposed member of the public at the INEEL under this alternative is the same as that estimated for Alternative 7A, the estimated noncancer risks associated with exposure to this compound are also the same as that discussed for Alternative 7A. No carcinogenic chemicals would be released as a result of operations.

No hazardous chemicals would be released as a result of operations at Hanford under this alternative; thus, no cancer or adverse noncancer health effects would occur.

4.16.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion and MOX facilities at INEEL are equivalent to those included in Alternative 7A (see Tables 4–136 and 4–137), and the potential consequences from operation of the immobilization facility at Hanford, equivalent to those included in Alternative 2 (see Tables 4–28 and 4–29). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for the pit conversion facility in FPF and the MOX facility at INEEL are discussed in Section 4.14.2.5. A nuclear criticality of 10^{19} fissions in the immobilization facility at Hanford would result in an MEI dose of 3.4×10^{-3} rem, corresponding to an LCF probability of 1.7×10^{-6}. Among the general population in the environs of Hanford, an estimated 2.7×10^{-3} LCF could occur as a result of this criticality accident. The frequency of such an accident at Hanford is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

A beyond-design-basis earthquake at Hanford could result in total collapse of the immobilization facility, with up to an estimated 6.1 LCFs. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude at Hanford is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

The beyond-design-basis accident at INEEL would be equivalent to that discussed in Section 4.14.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. The consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 7.1×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operation activities at INEEL and Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,359 person-years of labor and the standard DOE occupational accident rates, approximately 331 cases of nonfatal occupational injury or illness and 0.33 fatality could be expected for the duration of operations.

4.16.2.6 Transportation

Under Alternative 8, transportation to and from INEEL would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at INEEL for fabrication into MOX fuel pellets.

It is assumed that depleted uranium hexafluoride needed for MOX fuel would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide (see Section 4.3.2.6). After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at INEEL. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at Hanford under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at Hanford. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to HLWVF in 200 Area. This intrasite transportation—from 400 Area to 200 Area—could require the temporary shutdown of roads on Hanford. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at HLWVF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 8. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.16.1.2 and 4.16.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In all, approximately 2,300 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 6.2 million km (3.9 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 26 person-rem; the dose to the public, 38 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.010 LCF among transportation workers and 0.019 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.019.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of plutonium pits from one of DOE's storage locations to the pit conversion facility with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. The accident could result in a dose of 29 person-rem to the public for an LCF risk of 0.015 and 32 rem to the hypothetical MEI for an LCF risk of 0.016. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 8 are as follows: a radiological dose to the population of 21 person-rem, resulting in a total population risk of 0.010 LCF; and traffic accidents resulting in 0.070 traffic fatalities.

4.16.2.7 Environmental Justice

As discussed in other parts of Section 4.16.2, routine operations conducted under Alternative 8 would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near INEEL would be approximately 1 in 12 million (see Table 4–149); the likelihood for the MEI residing near Hanford would be essentially zero. The number of LCFs expected among the general population residing near INEEL and Hanford from accident-free operations would increase by approximately 0.011 and 3.9×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.16.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–28, 4–29, 4–136, and 4–137). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.16.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 8 would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

Citation

Previous Section

4.17 ALTERNATIVE 9A

Alternative 9A would involve constructing and operating the pit conversion and MOX facilities in Zone 4 at Pantex and the immobilization facility in a new building in F-Area at SRS. Activities at SRS would be the same as under Alternative 6A.

4.17.1 Construction

4.17.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 9A at Pantex include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from Pantex construction activities, with standards and guidelines is presented as Table 4–151. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Actual short-term concentrations of particulate matter are expected to be lower than those estimated because the concentrations were based on very conservative emission factors for heavy construction activities. The concentrations of toxic air pollutants such as benzene show little change from No Action (see the discussion of these concentrations in Section 4.2.1.3). Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Total vehicle emissions associated with activities at Pantex would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at Pantex relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 1.6 km [1.0 mi]), noise emissions from construction equipment would not be expected to annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 2-dB increase in traffic noise levels along roads used to access the site, and thus would not result in increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

Potential air quality impacts of construction under Alternative 9A at SRS are the same as those for Alternative 6A (see Section 4.10.1.1). Noise impacts are the same as those for Alternative 6A at SRS (see Section 4.10.1.1).

Table 4–151. Evaluation of Pantex Air Pollutant Concentrations Associated With Construction Under Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	5.65	625	6.3
	1 hour	40,000	35.3	3030	7.6
Nitrogen dioxide	Annual	100	0.646	2.59	2.6
PM_{10}	Annual	50	0.468	9.26	19
	24 hours	150	10	99.5	66
Sulfur dioxide	Annual	80	0.0472	0.0472	0.059
	24 hours	365	0.567	0.567	0.16
	3 hours	1,300	2.47	2.47	0.19
	30 minutes	1,048	10.1	10.1	0.96
Other regulated pollutants					
Total suspended particulates	3 hours	200	88.7	88.7[b]	44
	1 hour	400	362	362[b]	91
Hazardous and other toxic compounds					
Other toxics[e]	24 hours	3[c]	0.00091	7.8[d]	260
	1 hour	75[c]	0.0162	19.4	26

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates are not listed for existing sources in the source document. Only the contribution from sources associated with the alternative are represented.
[c] Texas Natural Resource Conservation Commission effects-screening levels are "tools" used by the Toxicology and Risk Assessment Staff to evaluate impacts of air pollutant emissions. They are not ambient air standards. If ambient levels of air contaminants exceed the screening levels, it does not necessarily indicate a problem, but would trigger a more in-depth review. The levels are set where no adverse effect is expected.
[d] Twenty-four-hour concentration for existing sources was estimated from the 1-hr concentration.
[e] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; TNRCC 1997a, 1997b.

4.17.1.2 Waste Management

At SRS, construction impacts of this alternative would be the same as for Alternative 6A. See Section 4.10.1.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

Table 4–152 compares the wastes generated during construction of surplus plutonium disposition facilities at Pantex with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during construction of surplus plutonium disposition facilities at Pantex would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted

Table 4–152. Potential Waste Management Impacts of Construction at Pantex Under Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	61	NA	NA	NA
Nonhazardous				
Liquid	18,300	NA	NA	2[c]
Solid	940	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Percent of capacity of the Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the Pantex hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities at Pantex would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Pantex.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of the pit conversion and MOX facilities at Pantex would be managed on the site by the Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 2 percent of the 946,250-m^3/yr (1,237,700-yd^3/yr) capacity of the Wastewater Treatment Facility. Therefore, management of these wastes at Pantex should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.17.1.3 Socioeconomics

Construction-related employment requirements for Alternative 9A would be as indicated in Table 4–153.

At its peak in 2003, construction of the new pit conversion and MOX facilities at Pantex under this alternative would require 783 construction workers and generate another 661 indirect jobs in the region. As this total employment requirement of 1,444 direct and indirect jobs represents only about 0.5 percent of the projected REA workforce, it should have no major impact on the REA. Moreover, it should have little effect on community services provided within the ROI. In fact, it should help offset the nearly 40 percent reduction in Pantex employment (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2005.

Employment requirements for construction of a new immobilization facility at SRS under Alternative 9A would be the same as those for Alternative 6A (see Section 4.10.1.3).

Table 4–153. Construction Employment Requirements for Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	MOX	Immobilization	Total
2001	298	0	0	298
2002	452	290	312	1,054
2003	275	508	448	1,231
2004	0	334	282	616
2005	0	170	0	170
2006	0	160	0	160

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998f, 1998g, 1998k, 1998n.

4.17.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–154. According to a recent radiation survey (DOE 1997e) conducted in the Zone 4 area at Pantex, construction workers would not be expected to receive any additional radiation exposure above natural background levels in the area. Data indicate, however, that a construction worker in F-Area at SRS could be exposed to radiation deriving from other activities, past or present, at the site. Regardless of location, construction worker exposures would be limited to ensure that doses are kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Table 4–154. Potential Radiological Impacts on Construction Workers of Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	MOX[b]	Pantex Total	Immobilization[c]
Total dose (person-rem/yr)	0	0	0	1.4
Annual latent fatal cancers[d]	0	0	0	5.6×10^{-4}
Average worker dose (mrem/yr)	0	0	0[e]	4
Annual latent fatal cancer risk	0	0	0	1.6×10^{-6}

[a] An estimated average of 342 workers would be associated with annual construction operations.
[b] An estimated average of 292 workers would be associated with annual construction operations.
[c] An estimated average of 347 workers would be associated with annual construction operations at the new facility location adjacent to APSF. The number would be the same for immobilization in either ceramic or glass.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for both facilities.
Key: APSF, Actinide Processing and Storage Facility; DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses will be reduced to levels that are as low as is reasonably achievable.
Source: DOE 1997e; ICRP 1991; NAS 1990; UC 1998f, 1998g, 1998k, 1998n.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at Pantex under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

4.17.1.5 Facility Accidents

Construction of plutonium disposition facilities at Pantex and SRS could result in worker injuries or fatalities. DOE–required industrial safety programs would be in place to reduce the risks. Given the estimated 3,529 person-years of construction labor and standard industrial accident rates, approximately 350 cases of nonfatal occupational injury or illness and 0.49 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.17.1.6 Environmental Justice

As discussed in the other parts of Section 4.17.1, construction under Alternative 9A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 9A at Pantex and SRS would have no significant impacts on minority or low-income populations.

4.17.2 Operations

4.17.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 9A at Pantex were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the plutonium disposition facilities, with standards and guidelines is presented as Table 4–155. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

For a discussion of how the operation of the pit conversion and MOX facilities at Pantex would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.3.4. There are no other NESHAP limits applicable to these facilities.

The increases in air pollutant concentrations from operation of these facilities for nitrogen dioxide, PM_{10}, and sulfur dioxide are a small fraction of the prevention of significant deterioration Class II area increments as summarized in Table 4–156.

Total vehicle emissions associated with activities at Pantex would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of these facilities at Pantex relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 1.6 km [1.0 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite

Table 4–155. Evaluation of Pantex Air Pollutant Concentrations Associated With Operations Under Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.687	620	6.2
	1 hour	40,000	3.79	3,000	7.5
Nitrogen dioxide	Annual	100	0.0725	2.02	2
PM_{10}	Annual	50	0.00514	8.80	18
	24 hours	150	0.056	89.5	60
Sulfur dioxide	Annual	80	0.00264	0.00264	0.0033
	24 hours	365	0.0314	0.0314	0.0086
	3 hours	1,300	0.137	0.137	0.011
	30 minutes	1,048	0.55	0.55	0.053
Other regulated pollutants					
Total suspended particulates	3 hours	200	0.237	0.237[b]	0.12
	1 hour	400	0.783	0.783[b]	0.20
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	26[c]	0.217	0.217	0.83
	1 hour	260[c]	5.3	5.3	2

a The more stringent of the Federal and State standards is presented if both exist for the averaging period.

b Three- and 1-hr concentrations for total suspended particulates are not listed for existing sources in the source document. Only the contribution from sources associated with the alternative are represented.

c Effects-screening level of the Texas Natural Resource Conservation Commission. Such levels are not ambient air standards, but merely "tools" used by the Toxicology and Risk Assessment staff to evaluate impacts of air pollutant emissions. Thus, exceedance of the screening levels by ambient air contaminants does not necessarily indicate a problem. That circumstance however, would prompt a more thorough evaluation.

Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; TNRCC 1997a, 1997b.

Table 4–156. Evaluation of Pantex Air Pollutant Increases Associated With Operations Under Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0725	25	0.29
PM_{10}	Annual	0.00514	17	0.030
	24 hours	0.056	30	0.19
Sulfur dioxide	Annual	0.00264	20	0.0132
	24 hours	0.0314	91	0.035
	3 hours	0.137	512	0.027

Key: DWPF, Defense Waste Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 2-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

Potential air quality impacts of the operation of the new immobilization facility under Alternative 9A at SRS are the same as those for Alternative 6A (see Section 4.10.2.1). Noise impacts are the same as those for Alternative 6A at SRS (see Section 4.10.2.1).

The combustion of fossil fuels associated with Alternative 9A would result in the emission of carbon dioxide which is one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.17.2.2 Waste Management

At SRS, impacts of operations for this alternative would be the same as for Alternative 6A. See Section 4.10.2.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

Table 4–157 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at Pantex. No HLW would be generated by the facilities.

Table 4–157. Potential Waste Management Impacts of Operations at Pantex Under Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]: Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	64	NA	NA	<1 of WIPP
LLW	94	13	39	<1 of NTS
Mixed LLW	3	NA	NA	NA
Hazardous	<3	<1	NA	NA
Nonhazardous				
Liquid	50,000	NA	NA	5[d]
Solid	<1,950	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of the Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); NTS, Nevada Test Site; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment and storage of radioactive, hazardous, mixed, and nonhazardous wastes at Pantex are described in the *Final EIS for the Continued Operation of Pantex and Associated Storage of Nuclear Weapon Components* (DOE 1996b).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRU Waste Package Transporter (TRUPACT) for shipment to WIPP would occur at new facilities at Pantex.

TRU waste generation at the pit conversion and MOX facilities at Pantex, is estimated to be a total of 640 m^3 (837 yd^3) over the 10-year operation period. Because TRU waste is not currently stored at Pantex, storage space would be provided in the pit conversion and MOX facilities. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, storage areas of approximately 260 m^2 (2,800 ft^2) would be required in the pit conversion facility, and 660 m^2 (7,100 ft^2) would be required in the MOX facility. This would be 1.5 percent of the 17,345 m^2 (186,700 ft^2) of floor space available in the pit conversion facility, and 5.1 percent of the 13,008 m^2 (140,017 ft^2) of floor space in the MOX facility. Therefore, impacts of the management of TRU waste at Pantex should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU wastes generated at Pantex and SRS would be 1 percent of the 143,000-m^3 (187,000-yd^3) contact-handled TRU waste that DOE plans to dispose of at WIPP and I percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW generated at Pantex would be treated, packaged, certified, and accumulated at the pit conversion and MOX facilities before transfer for additional treatment and disposal in onsite and offsite facilities. LLW generation at the pit conversion facility is estimated to be 13 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility. Waste would be stored on the site on an interim basis before being shipped for offsite disposal. If the shipment of LLW to offsite disposal were delayed, about 940 m^3 (1,230 yd^3) of LLW may need to be stored at Pantex. This is about 39 percent of the approximately 2,400-m^3 (3,100-yd^3) of existing storage capacity at Pantex. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.13 ha (0.32 acre) is required. Therefore, impacts of the storage of additional quantities of LLW at Pantex should not be major. If a new LLW storage facility were needed, appropriate NEPA documentation would be prepared.

LLW from Pantex is currently shipped to NTS for disposal. The 940 m^3 (1,230 yd^3) of additional LLW from operation of the pit conversion and MOX facilities at Pantex would be 5 percent of the 20,000-m^3 (26,000-yd^3) LLW disposed of at NTS in 1995 and less than 1 percent of the 500,000-m^3 (650,000-yd^3) disposal capacity at NTS. Using the 6,085 m^3/ha disposal land usage factor for NTS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), the additional LLW from Pantex would require 0.15 ha (0.37 acre) of disposal space at NTS or a similar facility. Therefore, impacts of the management of this additional LLW at NTS should not be major. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996c).

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Pantex. Pantex currently ships mixed LLW to Envirocare of Utah and Diversified Scientific Services, Inc., of Tennessee. These facilities or other treatment or disposal facilities that meet DOE criteria would be used to manage the 30 m^3 (39 yd^3) of waste that would be generated. Therefore, the management of this additional waste at Pantex should not have a major impact on the mixed LLW management system.

Any hazardous wastes generated during operation at Pantex would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. Because these wastes would be less than 1 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility, the additional waste load generated during the operation period should not have a major impact on Pantex hazardous waste management system. If all LLW and hazardous wastes generated at the pit conversion and MOX facilities at Pantex were processed in the planned Hazardous Waste Treatment and Processing Facility, this additional waste would be 13 percent of the 750-m^3/yr (980-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at Pantex.

Nonhazardous wastewater generated by the pit conversion and MOX facilities would be treated if necessary before being discharged to the Pantex Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at Pantex is estimated to be 5 percent of the 946,250-m^3/yr (1,237,700-yd^3/yr) capacity of the Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at Pantex should not have a major impact on the treatment system.

4.17.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and MOX facilities at Pantex in 2007 under Alternative 9A, an estimated 750 new workers would be required to operate them (UC 1998k, 1998n). This level of employment would be expected to generate another 2,540 indirect jobs within the region. The total employment requirement of 3,290 direct and indirect jobs in 2007 represents less than 1.2 percent of the projected workforce in the REA, and thus should have no major impact on the REA. It should also have little effect on community services within the Pantex ROI. In fact, it should help offset the 40 percent reduction in the Pantex labor force (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2010.

Employment requirements for operation of the immobilization facility at SRS under Alternative 9A would be the same as those for Alternative 6A (see Section 4.10.2.3).

4.17.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–158 reflects the potential radiological impacts on three individual receptor groups at Pantex and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed

Table 4–158. Potential Radiological Impacts on the Public of Operations Under Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	MOX	Pantex Total	Immobilization Ceramic	Immobilization Glass
Population within 80 km for year 2010					
Dose (person-rem)	0.58	0.010	0.59	2.3×10^{-3}	2.2×10^{-3}
Percent of natural background[a]	5.8×10^{-4}	1.0×10^{-5}	5.9×10^{-4}	1.0×10^{-6}	1.0×10^{-6}
10-year latent fatal cancers	2.9×10^{-3}	5.0×10^{-5}	3.0×10^{-3}	1.2×10^{-5}	1.1×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.062	5.5×10^{-3}	0.068	2.4×10^{-5}	2.2×10^{-5}
Percent of natural background[a]	0.019	1.7×10^{-3}	0.021	8.1×10^{-6}	7.5×10^{-6}
10-year latent fatal cancer risk	3.1×10^{-7}	2.8×10^{-8}	3.4×10^{-7}	1.2×10^{-10}	1.1×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	1.9×10^{-3}	3.3×10^{-5}	1.9×10^{-3}	2.9×10^{-6}	2.8×10^{-6}
10-year latent fatal cancer risk	9.5×10^{-9}	1.7×10^{-10}	9.7×10^{-9}	1.5×10^{-11}	1.4×10^{-11}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and the SRS APSF (785,400) in 2010.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Source: Appendix J.

member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operations. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of all three plutonium disposition facilities, the total population dose in the year 2010 would be 0.59 person-rem at Pantex and 2.3×10^{-3} person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 3.0×10^{-3} around Pantex and 1.2×10^{-5} around SRS. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at Pantex would be 0.068 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.4×10^{-7}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 2.4×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.2×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–159; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192, 175, and 174 person-rem, respectively. The risks and numbers of latent fatal cancers among the different workers from

Table 4–159. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	MOX	Pantex Total	Immobilization (Ceramic or Glass)
Number of badged workers	383	350	733	232
Total dose (person-rem/yr)	192	175	367	174
10-year latent fatal cancers	0.77	0.70	1.5	0.70
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998f, 1998g, 1998k, 1998n.

10 years of operation are included in Table 4–159. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Ethylene glycol should be released as a result of operations at Pantex under this alternative. The Hazard Index (5×10^{-5}) would be much lower than 1, indicating that adverse, noncancer health effects should not be incurred. No carcinogenic chemicals would be released as a result of operations.

4.17.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are equivalent to those described for Alternative 4A (see Table 4–66) and the potential consequences from operation of the immobilization facility at SRS are equivalent to those included in Alternative 3A (see Tables 4–41 and 4–42). The potential impacts of such accidents from operation of the MOX facility at Pantex are presented in Table 4–160. Details on the method of analysis, assumptions and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for the MOX facility would be a nuclear criticality. A nuclear criticality of 10^{19} fissions would result in an MEI dose of 9.3×10^{-3} rem at the MOX facility at Pantex, corresponding to an LCF probability of 4.6×10^{-6}. Among the general population in the environs of Pantex, an estimated 9.2×10^{-4} LCF could occur as a result of the MOX criticality accident. The frequency of such an accident at Pantex is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year. The most severe consequences of a design basis accident for the pit conversion facility and the immobilization facility are discussed in Section 4.6.2.5 and 4.4.2.5, respectively.

A beyond-design-basis earthquake at Pantex could result in collapse of the pit conversion and MOX facilities and an estimated 4.9 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude at Pantex is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Table 4–160. Accident Impacts of MOX Facility Under Alternative 9A: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	3.9×10^{-2}	1.5×10^{-5}	9.3×10^{-3}	4.6×10^{-6}	1.8	9.2×10^{-4}
Explosion in sintering furnace	Extremely unlikely	8.9×10^{-4}	3.6×10^{-7}	1.3×10^{-4}	6.7×10^{-8}	4.2×10^{-2}	2.1×10^{-5}
Fire	Extremely unlikely	5.4×10^{-6}	2.2×10^{-9}	8.1×10^{-7}	4.1×10^{-10}	2.6×10^{-4}	1.3×10^{-7}
Design basis earthquake	Unlikely	1.3×10^{-4}	5.1×10^{-8}	1.9×10^{-5}	9.4×10^{-9}	5.9×10^{-3}	3.0×10^{-6}
Beyond-design-basis fire	Beyond extremely unlikely	1.6×10^{-2}	6.2×10^{-6}	2.5×10^{-3}	1.2×10^{-6}	7.2×10^{-1}	3.6×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	1.5×10^{2}	5.9×10^{-2}	2.3×10^{1}	1.2×10^{-2}	6.8×10^{3}	3.4
Aircraft crash[d]	Beyond extremely unlikely	2.1×10^{2}	8.2×10^{-2}	3.3×10^{1}	1.6×10^{-2}	9.5×10^{3}	4.7

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value that assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
[d] For the aircraft crash accident, the dose at 1,000 m (3,281 ft) is beyond the range of applicability of the standard probability coefficient for determining the likelihood of fatal cancer (i.e., 4×10^{-4} latent cancer fatality per rem). The standard coefficient would tend to overstate the cancer fatality risk at the stated dose. Also, the dose may be in the range where subacute injury is an additional concern.

Key: DWPF, Defense Waste Processing Facility.
Source: Calculated using the source terms in Table K–12 and the MACCS2 computer code.

A beyond-design-basis aircraft crash at Pantex, involving a large commercial or military jet aircraft was also evaluated based on public interest. This crash could result in penetration of the surplus plutonium disposition facilities by a crash-induced missile such as a jet turbine shaft causing a release of plutonium resulting in LCFs among the general population. Penetration of the MOX facility could result in 4.7 LCFs. Penetration of the pit conversion facility would be equivalent to the accident described in Section 4.6.2.5. Other possible consequences of such a crash include immediate fatality to the aircraft occupants, as well as serious injuries and fatalities to persons in the facility and the surrounding area who are hit by aircraft or building debris. The frequency of such an airplane crash is estimated to be less than 1 in 1,000,000 per year.

The beyond-design-basis accident at SRS would be equivalent to that discussed in Section 4.4.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 5.8×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Pantex and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,581 person-years of labor and the standard DOE occupational accident rates, approximately 339 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.17.2.6 Transportation

Under Alternative 9A, transportation to and from Pantex would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at Pantex for fabrication into MOX fuel pellets.

It is assumed that depleted uranium hexafluoride needed for MOX fuel would be shipped via commercial truck to the uranium conversion facility, where it would converted into uranium dioxide (see Section 4.3.2.6). After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at Pantex. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at SRS under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to DWPF in S-Area. This intrasite transportation—from F–Area to S–Area—could require the temporary shutdown of roads on SRS. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at DWPF, it would eventually be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displace HLW—would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 9A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.17.1.2 and 4.17.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

However, TRU waste generated at Pantex was not covered by the WM PEIS ROD as there was no such waste at Pantex at the time the ROD was issued, and none was likely to be generated in ongoing site operations. Location of the pit conversion facility at Pantex would result in the generation of TRU waste, as described in Section 4.17.2.2. Moreover, a fairly large increase in the amount of LLW at Pantex (i.e., 39 percent of the site's current storage capacity) could be expected under this alternative. Currently, this type of waste is shipped to the NTS for disposal. In order to account for the transportation of TRU waste from Pantex to WIPP, and LLW from Pantex to NTS, additional shipments are analyzed in this SPD EIS.

In all, approximately 2,000 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 5.9 million km (3.7 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 53 person-rem; the dose to the public, 62 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.021 LCF among transportation workers and 0.031 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.020.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of surplus nonpit plutonium from a DOE storage facility to SRS with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. Because surplus nonpit plutonium shipments include plutonium oxide, an accident involving plutonium oxide is conservatively used to estimate the impacts of the maximum foreseeable accident. The accident could result in a dose of 145 person-rem to the public for an LCF risk of 0.07 and 159 rem to the hypothetical MEI for an LCF risk of 0.08. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 9A are as follows: a radiological dose to the population of 21 person-rem, resulting in a total population risk of 0.010 LCF; and traffic accidents resulting in 0.061 traffic fatalities.

4.17.2.7 Environmental Justice

As discussed in other parts of Section 4.17.2, routine operations conducted under Alternative 9A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million (see Table 4–158); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near Pantex and SRS from accident-free operations would increase by approximately 3.0×10^{-3} and 1.2×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.17.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–41, 4–42, 4–66, and 4–160). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.17.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 9A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

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4.18 ALTERNATIVE 9B

Alternative 9B would involve constructing and operating the pit conversion and MOX facilities in Zone 4 at Pantex and the immobilization facility in the existing Building 221–F in F-Area at SRS. Activities at Pantex would be the same as under Alternative 9A and activities at SRS would be the same as under Alternative 6C.

4.18.1 Construction

4.18.1.1 Air Quality and Noise

Potential air quality impacts of construction under Alternative 9B at Pantex are the same as those for Alternative 9A (see Section 4.17.1.1). Noise impacts are the same as those for Alternative 9A at Pantex (see Section 4.17.1.1).

Potential air quality impacts of construction under Alternative 9B at SRS are the same as those for Alternative 6C (see Section 4.12.1.1). Noise impacts are the same as those for Alternative 6C at SRS (see Section 4.12.1.1).

4.18.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as for Alternative 9A. See Section 4.17.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At SRS, construction impacts of this alternative would be the same as for Alternative 6C. See Section 4.12.1.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.18.1.3 Socioeconomics

Construction-related employment requirements for Alternative 9B would be as indicated in Table 4–161.

Table 4–161. Construction Employment Requirements for Alternative 9B: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Year	Pit Conversion	MOX	Immobilization	Total
2001	298	0	0	298
2002	452	290	248	990
2003	275	508	400	1,183
2004	0	334	330	664
2005	0	170	0	170
2006	0	160	0	160

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998i, 1998j, 1998k, 1998n.

Employment requirements for construction of the new pit conversion and MOX facilities at Pantex under this alternative would be the same as those for Alternative 9A (see Section 4.17.1.3).

Employment requirements for construction of the immobilization facility at SRS under this alternative would be the same as those for Alternative 6C (see Section 4.12.1.3).

4.18.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–162. According to a recent radiation survey (DOE 1997e) conducted in the Zone 4 area at Pantex, construction workers would not be expected to receive any additional radiation exposure above natural background levels in the area. At the SRS F-Area, data indicate, however, that a construction worker in F-Area at SRS could be exposed to radiation deriving from other activities, past or present, at the site. Regardless of location, construction worker exposures would be limited to ensure that doses are kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Table 4–162. Potential Radiological Impacts on Construction Workers of Alternative 9B: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion[a]	MOX[b]	Pantex Total	Immobilization[c]
Total dose (person-rem/yr)	0	0	0	4.7
Annual latent fatal cancers[d]	0	0	0	1.9×10^{-3}
Average worker dose (mrem/yr)	0	0	0[e]	15
Annual latent fatal cancer risk	0	0	0	6.0×10^{-6}

[a] An estimated average of 342 workers would be associated with annual construction operations.
[b] An estimated average of 292 workers would be associated with annual construction operations.
[c] There would be 315 workers associated with construction and modification of the existing Building 221–F. The number would be the same for immobilization in either ceramic or glass.
[d] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[e] Represents an average of the doses for both facilities.
Key: DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1997e; ICRP 1991; NAS 1990; 1998i, 1998j, 1998k, 1998n.

Hazardous Chemical Impacts. Because the estimated airborne concentration of benzene delivered to the maximally exposed member of the public at Pantex under this alternative would be the same as that for Alternative 9A, the estimated cancer risk associated with this exposure would also be the same.

4.18.1.5 Facility Accidents

Construction of plutonium disposition facilities at Pantex and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 3,465 person-years of construction labor and standard industrial accident rates, approximately 340 cases of nonfatal occupational injury or illness and 0.49 fatality could be expected (DOL 1997a, 1997b). As all construction would take place prior to introduction of the radiological process inventory, no radiological accidents should occur.

4.18.1.6 Environmental Justice

As discussed in the other parts of Section 4.18.1, construction under Alternative 9B would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 9B at Pantex and SRS would have no significant impacts on minority or low-income populations.

4.18.2 Operations

4.18.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 9B at Pantex are the same as those for Alternative 9A (see Section 4.17.2.1). Noise impacts are the same as those for Alternative 9A at Pantex (see Section 4.17.2.1).

Potential air quality impacts of the operation of the immobilization facility under Alternative 9B at SRS are the same as those for Alternative 6C (see Section 4.12.2.1). Noise impacts are the same as those for Alternative 6C at Pantex (see Section 4.12.2.1).

The combustion of fossil fuels associated with Alternative 9B would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.18.2.2 Waste Management

At Pantex, impacts of operations for this alternative would be the same as for Alternative 9A. See Section 4.17.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At SRS, impacts of operations for this alternative would be the same as for Alternative 6C. See Section 4.12.2.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.18.2.3 Socioeconomics

Employment requirements for operation of the pit conversion and MOX facilities at Pantex under Alternative 9B would be the same as those for Alternative 9A (see Section 4.17.2.3).

Employment requirements for operation of the immobilization facility at SRS under Alternative 9B at SRS would be the same as those for Alternative 6C (see Section 4.12.2.3).

4.18.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows:

Radiological Impacts. Table 4–163 reflects the potential radiological impacts on three individual receptor groups at Pantex and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts all the projected aggregate LCF risk to these groups from 10 years of operations. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–163. Potential Radiological Impacts on the Public of Operations Under Alternative 9B: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	MOX	Pantex Total	Immobilization Ceramic	Immobilization Glass
Population within 80 km for year 2010					
Dose (person-rem)	0.58	0.010	0.59	2.3×10^{-3}	2.2×10^{-3}
Percent of natural background[a]	5.8×10^{-4}	1.0×10^{-5}	5.9×10^{-4}	1.0×10^{-6}	1.0×10^{-6}
10-year latent fatal cancers	2.9×10^{-3}	5.0×10^{-5}	3.0×10^{-3}	1.2×10^{-5}	1.1×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.062	5.5×10^{-3}	0.068	2.4×10^{-5}	2.2×10^{-5}
Percent of natural background[a]	0.019	1.7×10^{-3}	0.021	8.1×10^{-6}	7.5×10^{-6}
10-year latent fatal cancer risk	3.1×10^{-7}	2.8×10^{-8}	3.4×10^{-7}	1.2×10^{-10}	1.1×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	1.9×10^{-3}	3.3×10^{-5}	1.9×10^{-3}	2.9×10^{-6}	2.8×10^{-6}
10-year latent fatal cancer risk	9.5×10^{-9}	1.7×10^{-10}	9.7×10^{-9}	1.5×10^{-11}	1.4×10^{-11}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 230,500 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and SRS Building 221–F (781,500) in 2010.

Key: DWPF, Defense Waste Processing Facility.

Source: Appendix J.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 0.59 person-rem at Pantex and 2.3×10^{-3} person-rem at SRS. The corresponding number of LCFs in the population from 10 years of operation would be 3.0×10^{-3} around Pantex and 1.2×10^{-5} around SRS. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at Pantex would be 0.068 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.4×10^{-7}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 2.4×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.2×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–164; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion and MOX facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192, 175, and 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–164. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–164. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 9B: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	MOX	Pantex Total	Immobilization (Ceramic or Glass)
Number of badged workers	383	350	733	258
Total dose (person-rem/yr)	192	175	367	194
10-year latent fatal cancers	0.77	0.70	1.5	0.77
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998i, 1998j, 1998k, 1998n.

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at Pantex under this alternative would be the same as that under Alternative 9A, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released as a result of operations.

4.18.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are equivalent to those included in Alternative 4A (see Table 4–66); potential consequences from operation of the MOX facility at Pantex would be equivalent to those included in Alternative 9A (see Table 4–160); and potential consequences from operation of the immobilization facility at SRS, equivalent to those included in Alternative 3B (see Tables 4–51 and 4–52). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The design basis accidents at SRS are discussed in Section 4.5.2.5. The design basis accidents for the pit conversion and MOX facility at Pantex are discussed in Sections 4.6.2.5 and 4.17.2.5, respectively.

The beyond-design-basis accidents at Pantex would be equivalent to those discussed in Section 4.17.2.5. The beyond-design-basis accident at SRS would be equivalent to that discussed in Section 4.12.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. The consequences for this worker were estimated to be highest for the design basis earthquake at SRS. The consequences of such an accident would include an LCF probability of 4.6×10^{-3}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Pantex and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,867 person-years of labor and the standard DOE occupational accident rates, approximately 348 cases of nonfatal occupational injury or illness and 0.35 fatality could be expected for the duration of operations.

4.18.2.6 Transportation

Because the only difference between Alternative 9A and 9B is the location of the immobilization facility within F-Area at SRS, the transportation required for Alternative 9B would be the same as that for Alternative 9A. Therefore, the transportation risks associated with Alternative 9B are equivalent to those discussed in Section 4.17.2.6.

4.18.2.7 Environmental Justice

As discussed in other parts of Section 4.18.2, routine operations conducted under Alternative 9B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million (see Table 4–163); the likelihood for the MEI residing near SRS would be essentially zero. The number of LCFs expected among the general population residing near Pantex and SRS from accident-free operations would increase by approximately 3.0×10^{-3} and 1.2×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.18.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–51, 4–52, 4–66, and 4–160). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.18.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 9B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.19 ALTERNATIVE 10

Alternative 10 would involve constructing and operating the pit conversion and MOX facilities in Zone 4 at Pantex and the immobilization facility in the existing FMEF building in the 400 Area at Hanford. Activities at Pantex would be the same as under Alternative 9A and activities at Hanford would be the same as under Alternative 8.

4.19.1 Construction

4.19.1.1 Air Quality and Noise

Potential air quality and noise impacts of construction under Alternative 10 at Pantex are the same as those for Alternative 9A (see Section 4.17.1.1).

Potential air quality and noise impacts of construction under Alternative 10 at Hanford are the same as those for Alternative 8 (see Section 4.16.1.1).

4.19.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as for Alternative 9A. See Section 4.17.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At Hanford, construction impacts of this alternative would be the same as for Alternative 8. See Section 4.16.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford.

4.19.1.3 Socioeconomics

Construction-related employment requirements for Alternative 10 would be as indicated in Table 4–165.

Table 4–165. Construction Employment Requirements for Alternative 10: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Year	Pit Conversion	MOX	Immobilization	Total
2001	298	0	0	298
2002	452	290	167	909
2003	275	508	268	1,051
2004	0	334	236	570
2005	0	170	0	170
2006	0	160	0	160

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: UC 1998b, 1998c, 1998k, 1998n.

Employment requirements for construction of the new pit conversion and MOX facilities at Pantex under this alternative would be the same as those for Alternative 9A (see Section 4.17.1.3).

Employment requirements for construction of the immobilization facility at Hanford under this alternative would be the same as those for Alternative 8 (see Section 4.16.1.3).

4.19.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. According to recent radiation surveys (DOE 1997e; Antonio 1998) conducted in the Zone 4 area at Pantex and 400-Area at Hanford, construction workers would not be expected to receive any additional radiation exposure above natural background levels in those areas. Nonetheless, if deemed necessary, construction workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. The probability of excess latent cancer incidence associated with exposure to benzene released as a result of construction activities at Pantex under this alternative has been estimated to be much less than 1 chance in 1 million over the lifetime of the maximally exposed member of the public.

No hazardous chemicals would be released at Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.19.1.5 Facility Accidents

Construction of plutonium disposition facilities at Pantex and Hanford could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 3,158 person-years of construction labor and standard industrial accident rates, approximately 310 cases of nonfatal occupational injury or illness and 0.44 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.19.1.6 Environmental Justice

As discussed in the other parts of Section 4.19.1, construction under Alternative 10 would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 10 at Pantex and Hanford would have no significant impacts on minority or low-income populations.

4.19.2 Operations

4.19.2.1 Air Quality and Noise

Potential air quality and noise impacts of the operation of facilities under Alternative 10 at Pantex are the same as those for Alternative 9A (see Section 4.17.2.1).

Potential air quality and noise impacts of the operation of the immobilization facility under Alternative 10 at Hanford are the same as those for Alternative 8 (see Section 4.16.2.1).

The combustion of fossil fuels associated with Alternative 10 would result in the emission of carbon dioxide, which is one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative represent less than 9×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes.

4.19.2.2 Waste Management

At Pantex, impacts of operations for this alternative would be the same as for Alternative 9A. See Section 4.17.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At Hanford, impacts of operations for this alternative would be the same as for Alternative 8. See Section 4.16.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford.

4.19.2.3 Socioeconomics

Employment requirements for operation of the pit conversion and MOX facilities at Pantex under Alternative 10 would be the same as those for Alternative 9A (see Section 4.17.2.3).

Employment requirements for operation of the immobilization facility at Hanford under Alternative 10 would be the same as those for Alternative 8 (see Section 4.16.2.3).

4.19.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–166 reflects the potential radiological impacts on three individual receptor groups at Pantex and Hanford: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operations. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–166. Potential Radiological Impacts on the Public of Operations Under Alternative 10: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	MOX	Pantex Total	Immobilization: Ceramic	Immobilization: Glass
Population within 80 km for year 2010					
Dose (person-rem)	0.58	0.010	0.59	7.8×10^{-3}	7.1×10^{-3}
Percent of natural background[a]	5.8×10^{-4}	1.0×10^{-5}	5.9×10^{-4}	6.7×10^{-6}	6.1×10^{-6}
10-year latent fatal cancers	2.9×10^{-3}	5.0×10^{-5}	3.0×10^{-3}	3.9×10^{-5}	3.6×10^{-5}
Maximally exposed individual					
Annual dose (mrem)	0.062	5.5×10^{-3}	0.068	1.1×10^{-4}	9.7×10^{-5}
Percent of natural background[a]	0.019	1.7×10^{-3}	0.021	3.7×10^{-5}	3.2×10^{-5}
10-year latent fatal cancer risk	3.1×10^{-7}	2.8×10^{-8}	3.4×10^{-7}	5.5×10^{-10}	4.9×10^{-10}
Average exposed individual within 80 km[b]					
Annual dose (mrem)	1.9×10^{-3}	3.3×10^{-5}	1.9×10^{-3}	2.0×10^{-5}	1.8×10^{-5}
10-year latent fatal cancer risk	9.5×10^{-9}	1.7×10^{-10}	9.7×10^{-9}	1.0×10^{-10}	9.0×10^{-11}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and Hanford (387,800) in 2010.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Source: Appendix J.

Given incident-free operation of all three facilities, the total population dose in the year 2010 would be 0.59 person-rem at Pantex and 7.8×10^{-3} person-rem at Hanford. The corresponding number of LCFs in the population from 10 years of operation would be 3.0×10^{-3} around Pantex and 3.9×10^{-5} around Hanford. The total dose to the maximally exposed member of the public from annual operation of the pit conversion and MOX facilities at Pantex would be 0.068 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.4×10^{-7}. The impacts on the average individual would be lower. The dose to the maximally exposed member of the public from annual operation of the immobilization facility at Hanford would be 1.1×10^{-4} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 5.5×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–167; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit 194 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–167. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–167. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 10: Pit Conversion and MOX in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	MOX	Pantex Total	Immobilization (Ceramic or Glass)
Number of badged workers	383	350	733	258
Total dose (person-rem/yr)	192	175	367	194
10-year latent fatal cancers	0.77	0.70	1.5	0.77
Average worker dose (mrem/yr)	500	500	500[a]	750
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998b, 1998c, 1998k, 1998n.

Hazardous Chemical Impacts. Because the estimated airborne concentration of ethylene glycol delivered to the maximally exposed member of the public at Pantex under this alternative would be the same as that estimated under Alternative 9A, the estimated noncancer risks associated with exposure to this compound would also be the same. No carcinogenic chemicals would be released as a result of operations.

No hazardous chemicals would be released as a result of operations at Hanford under this alternative; thus, no cancer or adverse noncancer health effects would occur.

4.19.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are equivalent to those included in Alternative 4A (see Table 4–66); potential consequences from operation of the MOX facilities at Pantex would be equivalent to those included in Alternative 9A (see Table 4–160); and potential consequences from operation of the immobilization facility at Hanford, equivalent to those included in Alternative 2 (see Tables 4–28 and 4–29). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident at the pit conversion facility are discussed in Section 4.6.2.5. The most severe design basis accident, a nuclear criticality, at the immobilization and MOX facilities are discussed in Sections 4.3.2.5 and 4.17.2.5, respectively.

The beyond-design-basis accidents at Pantex would be equivalent to those discussed in Section 4.17.2.5. The beyond-design-basis accident at Hanford would be equivalent to that discussed in Section 4.16.2.5.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. The consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 5.8×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Pantex and Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 10,779 person-years of labor and the standard DOE occupational accident rates, approximately 345 cases of nonfatal occupational injury or illness and 0.34 fatality could be expected for the duration of operations.

4.19.2.6 Transportation

Under Alternative 10, transportation to and from Pantex would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at Pantex for fabrication into MOX fuel pellets.

It is assumed that depleted uranium hexafluoride needed for MOX fuel would be shipped via commercial truck to the uranium conversion facility, where it would converted into uranium dioxide (see Section 4.3.2.6). After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the MOX facility at Pantex. This material would be blended with plutonium dioxide at the MOX facility, fabricated into MOX fuel pellets, and placed in MOX fuel rods. After fabrication, the MOX fuel rods would be shipped to a domestic reactor site, where they would be placed in fuel assemblies and irradiated. Shipments of unirradiated MOX fuel rods would be made in an SST because unirradiated MOX fuel in large enough quantities is subject to the same security concerns as pure weapons-grade plutonium. It is assumed in this transportation analysis that the reactor would be up to 4,000 km (2,500 mi) from the MOX facility.

Immobilization at Hanford under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at Hanford. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to HLWVF in 200 Area. This intrasite transportation—from 400 Area to 200 Area—could require the temporary shutdown of roads on Hanford. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

Use of the preferred ceramic (versus glass) matrix for immobilization would also require a small amount of depleted uranium dioxide (i.e., less than 10 t [11 tons] per year). It is assumed that this depleted uranium dioxide would be produced and shipped in the same manner as the depleted uranium dioxide needed by the MOX facility.

After the immobilized plutonium was encased by HLW at HLWVF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 125 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 10. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.19.1.2 and 4.19.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

However, TRU waste generated at Pantex was not covered by the WM PEIS ROD as there was no such waste at Pantex at the time the ROD was issued, and none was likely to be generated in ongoing site operations. Location of the pit conversion and MOX facilities at Pantex would result in the generation of TRU waste, as described in Section 4.19.2.2. Moreover, a fairly large increase in the amount of LLW at Pantex (i.e., 39 percent of the site's current storage capacity) could be expected under this alternative. Currently, this type of waste is shipped to the NTS for disposal. In order to account for the transportation of TRU waste from Pantex to WIPP, and LLW from Pantex to NTS, additional shipments are analyzed in this SPD EIS.

In all, approximately 1,900 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 4.8 million km (3.0 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 25 person-rem; the dose to the public, 36 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.010 LCF among transportation workers and 0.018 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.013.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of surplus nonpit plutonium from a DOE storage facility to Hanford with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. Because surplus nonpit plutonium shipments include plutonium oxide, an accident involving plutonium oxide is conservatively used to estimate the impacts of the maximum foreseeable accident. The accident could result in a dose of 145 person-rem to the public for an LCF risk of 0.07 and 159 rem to the hypothetical MEI for an LCF risk of 0.08. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 10 are as follows: a radiological dose to the population of 20 person-rem, resulting in a total population risk of 0.010 LCF; and traffic accidents resulting in 0.053 traffic fatalities.

4.19.2.7 Environmental Justice

As discussed in other parts of Section 4.19.2, routine operations conducted under Alternative 10 would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million (see Table 4–166); the likelihood for the MEI residing near Hanford would be essentially zero. The number of LCFs expected among the general population residing near Pantex and Hanford from accident-free operations would increase by approximately 3.0×10^{-3} and 3.9×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.19.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–28, 4–29, 4–66, and 4–160). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.19.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 10 would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.20 ALTERNATIVE 11A

Alternative 11A would involve constructing and operating the pit conversion and immobilization facilities in the existing FMEF building in the 400 Area at Hanford. Under this alternative, all surplus plutonium is immobilized; none is fabricated into MOX fuel.

4.20.1 Construction

4.20.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 11A at Hanford, including modification of FMEF for pit disassembly and conversion and plutonium conversion and immobilization, were analyzed as described in Appendix F.1. Sources of construction impacts include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at Hanford, with standards and guidelines is presented as Table 4–168. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Emissions from trucks carrying materials and wastes and employee vehicles are estimated to increase about 3 percent over the No Action emissions. Total vehicle emissions associated with activities at Hanford would likely decrease somewhat from current emissions during the planned construction period because of a decrease in overall site employment.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise impacts should not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

Table 4–168. Evaluation of Air Pollutant Concentrations Associated with Construction Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.501	34.6	0.35
	1 hour	40,000	3.41	51.7	0.13
Nitrogen dioxide	Annual	100	0.0372	0.287	0.29
PM_{10}	Annual	50	0.0315	0.049	0.10
	24 hours	150	0.413	1.18	0.79
Sulfur dioxide	Annual	50	0.00307	1.63	3.1
	24 hours	260	0.0341	8.94	3.4
	3 hours	1,300	0.232	29.8	2.3
	1 hour	700	0.696	33.6	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.0796	0.0975	0.16
	24 hours	150	0.948	1.72	1.1
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0	0.000006	0.005

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

4.20.1.2 Waste Management

Table 4–169 compares the wastes generated during modification of the FMEF building at Hanford with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year modification period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during modification. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during modification of the FMEF building would be typical of those generated during modification of an industrial facility. Any hazardous wastes generated during modification would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the modification period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid wastes generated during modification of the FMEF building would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at Hanford.

Table 4–169. Potential Waste Management Impacts of Construction Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	17	NA	NA	NA
Nonhazardous				
Liquid	5,900	3[c]	NA	3[d]
Solid	178	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year modification period.
[c] Percent of capacity of the 400 Area's sanitary sewer.
[d] Percent of capacity of WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); WPPSS, Washington Public Power Supply System.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during modification of the FMEF building would be managed at the WPPSS Sewage Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during modification is estimated to be 3 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and 3 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, management of these wastes should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

4.20.1.3 *Socioeconomics*

Construction-related employment requirements for Alternative 11A would be as indicated in Table 4–170.

Table 4–170. Construction Employment Requirements for Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Year	Pit Conversion	Immobilization	Total
2001	77	0	77
2002	116	167	283
2003	71	268	339
2004	0	236	236

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: UC 1998a, 1998b, 1998c.

At its peak in 2003, construction of the pit conversion and immobilization facilities at Hanford under this alternative would require 339 construction workers and generate another 348 indirect jobs in the region. The total employment requirement of 687 direct and indirect jobs represents less than 0.2 percent of the projected REA workforce, and thus should have no major impact on the REA. This requirement should also have a negligible impact on community services currently offered in the ROI. In fact, it should help offset the approximately 15 percent reduction in Hanford employment (i.e., from 12,900 to 11,000 workers) projected for the years 1997–2005.

4.20.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. According to a recent radiation survey (Antonio 1998) conducted in the 400 Area, a construction worker would not be expected to receive doses above natural background levels. Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.20.1.5 Facility Accidents

Construction of plutonium disposition facilities at Hanford could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 935 person-years of construction labor and standard industrial accident rates, approximately 93 cases of nonfatal occupational injury or illness and 0.13 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.20.1.6 Environmental Justice

As discussed in the other parts of Section 4.20.1, construction under Alternative 11A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 11A at Hanford would have no significant impacts on minority or low-income populations.

4.20.2 Operations

4.20.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 11A at Hanford were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including those from the plutonium disposition facilities, with standards and guidelines is presented as Table 4–171. Concentrations for immobilization in the ceramic form are presented because they would be greater than those for the glass form. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

For a discussion of how the operation of the pit conversion and immobilization facilities at Hanford would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAP limits applicable to operation of these facilities.

The increased concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide are a small fraction of the PSD Class II area increments as summarized in Table 4–172.

Table 4–171. Evaluation of Air Pollutant Concentrations Associated With Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.772	34.9	0.35
	1 hour	40,000	4.31	52.6	0.13
Nitrogen dioxide	Annual	100	0.0316	0.282	0.28
PM_{10}	Annual	50	0.00149	0.0194	0.039
	24 hours	150	0.0166	0.787	0.52
Sulfur dioxide	Annual	50	0.00128	1.63	3.1
	24 hours	260	0.0142	8.92	3.4
	3 hours	1,300	0.0966	29.7	2.3
	1 hour	700	0.29	33.2	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.00149	0.0194	0.032
	24 hours	150	0.0166	0.787	0.52
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	420	0	0[b]	0

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] No sources of this pollutant have been identified at the site.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

Table 4–172. Evaluation of Air Pollutant Increases Associated With Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0316	25	0.13
PM_{10}	Annual	0.00149	17	0.0088
	24 hours	0.0166	30	0.055
Sulfur dioxide	Annual	0.00128	20	0.0064
	24 hours	0.0142	91	0.016
	3 hours	0.0966	512	0.019

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

The combustion of fossil fuels associated with Alternative 11A would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 4×10^{-6} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing machines (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus should not result in any increased in annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

4.20.2.2 Waste Management

Table 4–173 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at Hanford. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies. More detailed descriptions of waste management impacts are presented in Appendix H. The methods used to estimate these impacts are described in Appendix F.8.

Table 4–173. Potential Waste Management Impacts of Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	144	8	8	1 of WIPP
LLW	140	NA	NA	<1
Mixed LLW	2	<1	<1	<1
Hazardous	32	NA	NA	NA
Nonhazardous				
Liquid	65,000	28[d]	NA	28[e]
Solid	2,030	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of the 400 Area sanitary sewer.
[e] Percent of capacity of WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant; WPPSS, Washington Public Power Supply System.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* that is being prepared by the DOE Richland Operations Office (DOE 1997c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation at surplus plutonium disposition facilities is estimated to be 8 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,440 m^3 (1,880 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 8 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.21 ha (0.52 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at Hanford should not be major.

The 1,440 m^3 (1,880 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the new facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,400 m^3 (1,830 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) capacity of the LLW Burial Grounds and 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480 m^3/ha disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,400 m^3 (1,830 yd^3) of waste would require 0.40-ha (0.99-acre) disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Mixed LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (21,970-yd^3) capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at the should not have a major impact on the mixed LLW management system.

If all TRU waste and mixed LLW generated at the surplus plutonium disposition facilities were processed in the Waste Receiving and Processing Facility, this additional waste would be 8 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of that facility.

Any hazardous wastes generated during operations would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operation period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous process wastewater would be treated if necessary before being discharged with sanitary wastewater to the 400 Area sanitary sewer system, which connects to the WPPSS Sewage Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at Hanford is estimated to be 28 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 28 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the WPPSS Sewage Treatment Facility (Mecca 1997). Therefore, management of nonhazardous liquid waste at Hanford should not have a major impact on the treatment system.

4.20.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and immobilization facilities at Hanford in 2007 under Alternative 11A, an estimated 704 new workers would be required to operate them (UC 1998a, 1998b, 1998c). This level of employment should generate another 1,782 indirect jobs in the region. The total employment requirement of 2,486 direct and indirect jobs represents only about 0.6 percent of the projected REA workforce, and thus should have no major impact on the REA. Some of the new jobs created under this alternative would be filled from the ranks of the unemployed, currently 11 percent of the REA's population.

In the ROI, however, this employment requirement could have minor impacts on community services, for it should coincide with an overall increase in site employment in connection with construction of the tank waste remediation system. Assuming that 91 percent of the new employees associated with this alternative resided in the ROI, an increase of 2,262 new jobs in the workforce would result in an overall population increase of approximately 4,305 persons. This increase, in conjunction with the population growth forecast by the State of Washington, would engender increased construction of local housing units. Given the current population-to-student ratio in the ROI, a population of this size would be expected to include 890 students, and local school districts would presumably have to increase the number of classrooms to accommodate them.

Therefore, community services in the ROI would be expected to change to reflect the population growth as follows: 56 teachers would be added to maintain the current student-to-teacher ratio of 16:1; 7 police officers would be added to maintain the current officer-to-population ratio of 1.6:1,000; 14 firefighters would be added to maintain the current firefighter-to-population ratio of 3.4:1,000; and 6 physicians would be added to maintain the current physician-to-population ratio of 1.4:1,000. According to estimates, then, an additional 82 positions would have to be created to maintain community services at current levels. The ratio of hospital beds to population in the ROI would remain at 2.1 beds per 1,000 persons. Moreover, the average school enrollment would increase to 94.6 percent from the current rate of 92.5 percent unless additional classrooms were built. None of these projected changes should have major impacts on the level of community services currently offered in the ROI.

4.20.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–174 reflects the potential radiological impacts on three individual receptor groups: the population living within 80 km (50 mi) of Hanford in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–174. Potential Radiological Impacts on the Public of Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	Immobilization: Ceramic	Immobilization: Glass	Total[a]
Population within 80 km for year 2010				
Dose (person-rem)	6.9	0.016	0.015	6.9
Percent of natural background[b]	5.9×10^{-3}	1.4×10^{-5}	1.3×10^{-5}	5.9×10^{-3}
10-year latent fatal cancers	0.034	8.0×10^{-5}	7.5×10^{-5}	0.034
Maximally exposed individual				
Annual dose (mrem)	0.017	2.2×10^{-4}	2.0×10^{-4}	0.017
Percent of natural background[b]	5.7×10^{-3}	7.3×10^{-5}	6.7×10^{-5}	5.8×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	1.1×10^{-9}	1.0×10^{-9}	8.6×10^{-8}
Average individual within 80 km[c]				
Annual dose (mrem)	0.017	4.1×10^{-5}	3.9×10^{-5}	0.017
10-year latent fatal cancer risk	8.5×10^{-8}	2.1×10^{-10}	2.0×10^{-10}	8.6×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities. This total includes the higher of the values for the ceramic and glass immobilization alternatives.
[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: Appendix J.

Given incident-free operation of both facilities, the total population dose in the year 2010 would be 6.9 person-rem. The corresponding number of LCFs in this population from 10 years of operation would be 0.034. The dose to the maximally exposed member of the public from annual operation of both facilities would be 0.017 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 8.6×10^{-8}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–175; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit

Table 4–175. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	290	673
Total dose (person-rem/yr)	192	218	410
10-year latent fatal cancers	0.77	0.87	1.6
Average worker dose (mrem/yr)	500	750	608[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998a, 1998b, 1998c.

conversion facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192 and 218 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–175. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operations at Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.20.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Hanford are substantially equivalent to those included in Alternative 2 (see Table 4–27), and the potential consequences of such accidents from operation of the immobilization facility at Hanford are presented in Tables 4–176 and 4–177. The design layout for the 50-t (55-ton) immobilization alternatives would be the same as for the 17-t (19-ton) immobilization alternatives, with the result being that the throughput of the facility would be lower. To be conservative, the 50-t (55-ton) immobilization scenario has been used as the nominal case throughout the accident analysis, so the results referenced from the earlier accident sections are directly applicable here. The plutonium conversion portion of the facility (i.e., the part of the process when nonpit plutonium is converted to plutonium dioxide), however, would operate at the design rate regardless of whether the alternative processes 17 t (19 ton) or 50 t (55 ton), both cases would involve the same material throughput. The consequences and frequencies of the analyzed accidents associated with plutonium conversion are thus identical for both.

For the immobilization portion of the facility, the frequencies of process-specific accidents (e.g., melter spill) would be higher for the 50-t (55-ton) alternatives, as more operations would be performed over time. This difference, however, would be smaller than the frequency range used for scenario characterization. Thus, for all practical purposes, the analytical results for the two different sets of immobilization alternatives are the same.

For the earthquake scenarios, the difference would depend on whether the 50-t (55-ton) alternatives involved operation with higher throughput or more shifts. If it involved higher throughput, then more material would be vulnerable to an earthquake during operations, and the contribution of the immobilization portion of the

Table 4–176. Accident Impacts of Alternative 11A: Ceramic Immobilization in FMEF at Hanford (50-t Case)

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	Unlikely	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	Unlikely	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Glovebox fire (sintering furnace)	Extremely unlikely	1.7×10^{-6}	6.8×10^{-10}	2.6×10^{-7}	1.3×10^{-10}	8.3×10^{-4}	4.1×10^{-7}
Design basis earthquake	Unlikely	3.9×10^{-4}	1.6×10^{-7}	5.9×10^{-5}	3.0×10^{-8}	1.9×10^{-1}	9.6×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	1.7×10^{-2}	6.8×10^{-6}	6.5×10^{-4}	3.2×10^{-7}	1.6	6.8×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	1.4×10^{2}	5.7×10^{-2}	5.4	2.7×10^{-3}	1.3×10^{4}	5.6

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value that assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: FMEF, Fuels and Materials Examination Facility; HYDOX, hydride oxidation.

facility to the source term would be marginally greater. If it involved more shifts, then the contribution of the immobilization portion of the facility to the source term would be the same for an earthquake that occurred during operations, but an earthquake would be more likely to occur during operations. The bounding source term for the immobilization portion of the facility in the analyzed earthquake scenarios is the same for the two sets of alternatives (the 50-t [55-ton] alternatives versus the 17-t [19-ton] alternatives with fewer shifts). The frequency of that source term differs marginally, but the difference is smaller than the frequency range used for scenario characterization. Thus, for all practical purposes, the analytical results for the two are the same.

More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The accident scenarios and consequences for the bounding tritium release and criticality accidents would remain the same as discussed in Section 4.3.2.5.

Table 4–177. Accident Impacts of Alternative 11A: Glass Immobilization in FMEF at Hanford (50-t Case)

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	Unlikely	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	Unlikely	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Melter eruption	Unlikely	1.6×10^{-6}	6.3×10^{-10}	2.4×10^{-7}	1.2×10^{-10}	7.7×10^{-4}	3.8×10^{-7}
Melter spill	Unlikely	3.7×10^{-7}	1.5×10^{-10}	5.6×10^{-8}	2.8×10^{-11}	1.8×10^{-4}	9.0×10^{-8}
Design basis earthquake	Unlikely	3.5×10^{-4}	1.4×10^{-7}	5.2×10^{-5}	2.6×10^{-8}	1.7×10^{-1}	8.4×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	3.1×10^{-3}	1.2×10^{-6}	1.2×10^{-4}	5.8×10^{-8}	2.8×10^{-1}	1.2×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	1.3×10^{2}	5.0×10^{-2}	4.8	2.4×10^{-3}	1.2×10^{4}	5.0

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value that assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: FMEF, Fuels and Materials Examination Facility; HYDOX, hydride oxidation.

A beyond-design-basis earthquake at Hanford could result in the collapse of FMEF and an estimated 15 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude at Hanford is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. The consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 1.2×10^{-4}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 7,334 person-years of labor and the standard DOE occupational accident rates, approximately 235 cases of nonfatal occupational injury or illness and 0.23 fatality could be expected for the duration of operations.

4.20.2.6 Transportation

Under Alternative 11A, transportation to and from Hanford would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred within the FMEF building at Hanford for immobilization.

It is assumed that depleted uranium hexafluoride needed for immobilization would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide. After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the immobilization facility at Hanford.

Immobilization at Hanford under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., Hanford, INEEL, LANL, RFETS, and SRS) to the immobilization facility at Hanford. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to HLW in the 200 Area. This intrasite transportation—from 400 Area to 200 Area—could require the temporary shutdown of roads on Hanford. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

After the immobilized plutonium was encased by HLW at HLWVF, it would eventually be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 340 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 11A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.20.1.2 and 4.20.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In all, approximately 2,000 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 3.4 million km (2.1 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 59 person-rem; the dose to the public, 61 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.024 LCF among transportation workers and 0.031 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.010.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of plutonium pits from one of DOE's storage locations to the pit conversion facility with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. The accident could result in a dose of 29 person-rem to the public for an LCF risk of 0.015 and rem to the hypothetical MEI for an LCF risk of 0.016. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 11A are as follows: a radiological dose to the population of 1 person-rem, resulting in a total population risk of 5.0×10^{-4} LCF; and traffic accidents resulting in 0.051 traffic fatalities.

4.20.2.7 Environmental Justice

As discussed in other parts of Section 4.20.2, routine operations conducted under Alternative 11A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 12 million (see Table 4–174). The number of LCFs expected among the general population residing near Pantex from accident-free operations would increase by approximately 0.034.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.20.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–27, 4–176, and 4 –177). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the site pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.20.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 11A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

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4.21 ALTERNATIVE 11B

Alternative 11B would involve constructing and operating the pit conversion facility in Zone 4 at Pantex and the immobilization facility at Hanford. The immobilization facility would be located in the existing FMEF building in the 400 Area. Under this alternative, all surplus plutonium would be immobilized; none would be fabricated into MOX fuel.

4.21.1 Construction

4.21.1.1 Air Quality and Noise

Potential air quality and noise impacts of construction of the pit conversion facility under Alternative 11B at Pantex would be the same as those for Alternative 4A (see Section 4.6.1.1).

Potential air quality and noise impacts of construction of the immobilization facility under Alternative 11B at Hanford would be the same as those for Alternative 8 (see Section 4.16.1.1).

4.21.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as those for Alternative 4A. See Section 4.6.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At Hanford, construction impacts of this alternative would be the same as those for Alternative 8. See Section 4.16.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford.

4.21.1.3 Socioeconomics

Construction-related employment requirements under Alternative 11B would be as indicated in Table 4–178.

Table 4–178. Construction Employment Requirements Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Year	Pit Conversion	Immobilization	Total
2001	298	0	298
2002	452	167	619
2003	275	268	543
2004	0	236	236

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: UC 1998b, 1998c, 1998k.

At its peak in 2002, construction of the new pit conversion facility at Pantex under this alternative would require 452 construction workers and generate another 381 indirect jobs in the region. As this total employment requirement of 833 direct and indirect jobs represents only 0.3 percent of the projected REA workforce, it should have no major impact on the REA. Moreover, it should have little impact on community services within the ROI. In fact, it should help offset the nearly 40 percent reduction in the Pantex total workforce (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2005.

At its peak in 2003, construction of the immobilization facility at Hanford would require 268 construction workers and should generate another 275 indirect jobs in the region. This total employment requirement of 543 direct and indirect jobs represents only 0.1 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have little effect on the community services currently offered in the ROI. In fact, it should help offset the nearly 15 percent reduction in Hanford's workforce (i.e., from 12,900 to approximately 11,000 workers) projected for the years 1997–2005.

4.21.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. According to results of recent radiation surveys (DOE 1997e, Antonio 1998) conducted in the Zone 4 area at Pantex and the 400 Area at Hanford, construction workers would not be expected to receive any additional radiation exposure above natural background levels in those areas. Nonetheless, if deemed necessary, construction workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at Pantex or Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.21.1.5 Facility Accidents

Construction of plutonium disposition facilities at Pantex and Hanford could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 1,696 person-years of construction labor and standard industrial accident rates, approximately 170 cases of nonfatal occupational injury or illness and 0.24 fatality could be expected. As all construction would be in nonradiological areas, no radiological accidents should occur during construction.

4.21.1.6 Environmental Justice

As discussed in the other parts of Section 4.21.1, construction under Alternative 11B would pose no significant risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities at Pantex and Hanford under Alternative 11B would have no significant impacts on minority or low-income populations.

4.21.2 Operations

4.21.2.1 Air Quality and Noise

Potential air quality impacts of the operation of the new pit conversion facility under Alternative 11B at Pantex are the same as those for Alternative 4A (see Section 4.6.2.1). Noise impacts are the same as those for Alternative 4A at Pantex (see Section 4.6.2.1).

Potential air quality impacts from the operation of the immobilization facility under Alternative 11B at Hanford were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from operations of the immobilization facility, with standards and guidelines is presented as Table 4–179. Concentrations for immobilization in the ceramic form are presented because they are greater than those for the glass form.

Table 4–179. Evaluation of Air Pollutant Concentrations at Hanford Associated With Operations Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Carbon monoxide	8 hours	10,000	0.628	34.7	0.35
	1 hour	40,000	3.33	51.6	0.13
Nitrogen dioxide	Annual	100	0.015	0.265	0.27
PM_{10}	Annual	50	0.00108	0.019	0.038
	24 hours	150	0.012	0.782	0.52
Sulfur dioxide	Annual	50	0.001	1.63	3.3
	24 hours	260	0.0111	8.92	3.4
	3 hours	1,300	0.0753	29.7	2.3
	1 hour	700[b]	0.226	33.1	4.7
Total suspended particulates	Annual	60	0.00108	0.019	0.032
	24 hours	150	0.012	0.782	0.52

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; WDEC 1994.

Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the standards for PM_{10} and total suspended particulates attributable to natural sources would be expected to continue. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of the facility.

For a discussion of how the operation of the immobilization facility at Hanford would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAP limits applicable to operation of this facility.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide resulting from operation of the immobilization facility would be a small fraction of the PSD Class II area increments, as summarized in Table 4–180.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

The location of this facility at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operation would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of this facility would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. No noise impacts are expected to affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with

Table 4–180. Evaluation of Air Pollutant Increases at Hanford Associated With Operations Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.015	25	0.06
PM_{10}	Annual	0.00108	17	0.0063
	24 hours	0.012	30	0.04
Sulfur dioxide	Annual	0.001	20	0.005
	24 hours	0.0111	91	0.012
	3 hours	0.0753	512	0.015

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

operation of this facility would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus should not result in any increased annoyance of the public.

The combustion of fossil fuels associated with Alternative 11B would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 6×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.21.2.2 Waste Management

At Pantex, operations impacts of this Alternative would be the same as those for Alternative 4A. See Section 4.6.2.2 for a description of the impacts of this Alternative on the waste management infrastructure at Pantex.

Table 4–181 reflects a comparison of the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operation of the immobilization facility at Hanford. Although HLW would be used in the immobilization process, no HLW would be generated by the facilities. Waste generation at Hanford should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading of the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

Table 4–181. Potential Waste Management Impacts of Operations at Hanford Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford[a]

Waste Type[b]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[c]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[d]	126	7	7	1 of WIPP
LLW	80	NA	NA	<1
Mixed LLW	1	<1	<1	<1
Hazardous	30	NA	NA	NA
Nonhazardous				
Liquid	25,000	11[e]	NA	11[f]
Solid	230	NA	NA	NA

[a] Information summarized from Appendix H.
[b] See definitions in Appendix F.8.
[c] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[d] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[e] Percent of capacity of 400 Area sanitary sewer.
[f] Percent of capacity of WPPSS Sewage Treatment Facility.
Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant; WPPSS, Washington Public Power Supply System.

TRU waste generation at the immobilization facility at Hanford has been estimated at 7 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,260 m^3 (1,648 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 7 percent of the 17,000-m^3 (22,200-yd^3) storage capacity at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums that can to be stacked two high, and adding a 50 percent factor for aisle space, a storage area of about 0.18 ha (0.44 acre) would be required. Therefore, impacts from the management of additional quantities of TRU waste at Hanford should not to be major.

The 1,440 m^3 (1,884 yd^3) of additional TRU wastes generated by surplus plutonium disposition facilities at Pantex and Hanford would be 1 percent of the 143,000-m^3 (187,000-yd^3) contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of the disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

At Hanford, LLW would be packaged, certified, and accumulated at the immobilization facility before transfer for additional treatment and disposal in existing onsite facilities. A total of 800 m^3 (1,050 yd^3) of LLW would be generated over the operation period. According to estimates, LLW generation at surplus plutonium disposition facilities would be less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) capacity of the LLW Burial Grounds and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Judging from the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 800 m^3 (1,050 yd^3) of waste would require 0.23 ha (0.57 acre) of disposal space at Hanford. Therefore, impacts from the management of this additional LLW at Hanford should not be major.

At Hanford, mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan. Mixed LLW generation at the immobilization facilities would in all likelihood be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (22,000-yd^3) capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system. If all TRU waste and mixed LLW generated at the surplus plutonium disposition facilities at Hanford were processed in the Waste Receiving and Processing Facility, this additional waste would be 7 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of that facility.

At Hanford, any hazardous wastes generated during operation of the immobilization facility would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operation period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management systems at Hanford.

At Hanford, nonhazardous wastewater generated by the immobilization facilities would be treated if necessary before being discharged to the 400 Area sanitary sewer system, which connects to the WPPSS Sewage Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities would be an estimated 11 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 11 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the WPPSS Sewage Treatment Facility (Mecca 1997). Therefore, management of nonhazardous liquid waste at Hanford should not have a major impact on the treatment system.

4.21.2.3 Socioeconomics

Under Alternative 11B, operation of the pit conversion facility at Pantex would begin in 2004 and should require 400 workers (UC 1998k) . This level of employment should generate another 1,355 indirect jobs within the region. As the total employment requirement of 1,755 direct and indirect jobs represents only 0.7 percent of the projected REA workforce, there should be no major impact on the REA. Moreover, the additional required workers should not markedly impact community services within the Pantex ROI. In fact, they should help offset the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2005.

Startup and operation of the immobilization facility at Hanford in 2005 under Alternative 11B would require an estimated 304 workers (UC 1998b, 1998c). This level of employment would be expected to generate another 770 related jobs in the region. The total employment requirement of 1,074 direct and indirect jobs represents less than 0.3 percent of the projected REA workforce, and thus should have no major impact on the REA. Some of the new jobs created under this alternative could be filled from the ranks of unemployed, currently 11 percent of the REA's population.

However, this employment requirement could have minor impacts on community services in the ROI, as it should coincide with an expected increase in overall site employment for construction of the tank waste remediation system. Assuming that 91 percent of the new employees associated with this alternative resided in the ROI, an increase of 1,074 new jobs within the workforce would result in an overall population increase of approximately 2,122 persons. This population increase, in conjunction with the normal population growth forecast by the State of Washington, would engender increased construction of local housing units. Given the current population-to-student ratio in the ROI, a population of this size would be expected to include 440 students, and local school districts would increase the number of classrooms to accommodate them.

Community services in the ROI would be expected to change to accommodate the population growth as follows: 28 teachers would be added to maintain the current student-to-teacher ratio of 16:1; 3 police officers would be added to maintain the current officer-to-population ratio of 1.6:1,000; 7 firefighters would be added to maintain the current firefighter-to-population ratio of 3.4:1,000; and 3 physicians would be added to maintain the current physician-to-population ratio of 1.4:1,000. Thus, an additional 41 positions would have to be created to maintain community services at current levels. Hospitals in the ROI would experience a drop from 2.1 to 2.0 beds per 1,000 persons unless additional beds were provided. Moreover, average school enrollment would increase to 93.5 percent from the current 92.5 percent unless additional classrooms were built. None of these projected changes would have a major impact on the level of community services currently offered in the ROI.

4.21.2.4 Human Health Risk

During normal operation of the plutonium disposition facilities, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to and potential health effects on the public and workers for this alternative would be as follows:

Radiological Impacts. Presented in Table 4–182 are the potential radiological impacts on three individual receptor groups for Pantex and Hanford: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of both disposition facilities, the total population dose in the year 2010 would be 0.60 person-rem. The corresponding number of LCFs in the populations around Pantex and Hanford from 10 years of operation would be 3.0×10^{-3}. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization facilities at Hanford would be 2.2×10^{-4} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.1×10^{-9}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–183; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities is estimated to be 192 and 218 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–183. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–182. Potential Radiological Impacts on the Public of Operations Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	Immobilization: Ceramic	Immobilization: Glass
Population within 80 km for year 2010			
Dose (person-rem)	0.58	0.016	0.015
Percent of natural background[a]	5.8×10^{-4}	1.4×10^{-5}	1.3×10^{-5}
10-year latent fatal cancers	2.9×10^{-3}	8.0×10^{-5}	7.5×10^{-5}
Maximally exposed individual			
Annual dose (mrem)	0.062	2.2×10^{-4}	2.0×10^{-4}
Percent of natural background[a]	0.019	7.3×10^{-5}	6.7×10^{-5}
10-year latent fatal cancer risk	3.1×10^{-7}	1.1×10^{-9}	1.0×10^{-9}
Average exposed individual within 80 km[b]			
Annual dose (mrem)	1.9×10^{-3}	4.1×10^{-5}	3.9×10^{-5}
10-year latent fatal cancer risk	9.5×10^{-9}	2.1×10^{-10}	2.0×10^{-10}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and Hanford (387,800) in 2010.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Source: Appendix J.

Table 4–183. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	290	673
Total dose (person-rem/yr)	192	218	410
10-year latent fatal cancers	0.77	0.87	1.6
Average worker dose (mrem/yr)	500	750	(a)
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	(a)

[a] This value holds no statistical relevance because the facilities are at different sites.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998b, 1998c, 1998k.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operations at Pantex or Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.21.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are presented in Table 4–66. The potential consequences of such accidents from operation of the immobilization facility at Hanford are equivalent to those described for Alternative 11A (see Tables 4–176 and 4–177). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for this alternative would be associated with a tritium release from the pit conversion facility (see Section 4.6.2.5). At Hanford, the design basis accidents for the immobilization facility would be equivalent to those described for Alternative 11A (see Section 4.20.2.5).

A beyond-design-basis earthquake at Pantex could result in collapse of the pit conversion facility and an estimated 1.5 LCFs among the general population. A similar earthquake at Hanford could result in a total collapse of FMEF with an estimated 6.1 LCFs. In the event of such an earthquake, additional radiological impacts could be expected from the other operations at Pantex or Hanford, as well as catastrophic nonradiological impacts from the collapse of buildings, offices, and other structures. The frequency of a beyond-design-basis earthquake is estimated at between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the tritium release. The consequences of such an accident would include an LCF probability of 5.8×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operation activities at Pantex and Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 7,334 person-years of labor and the standard DOE occupational accidents rates, approximately 235 cases of nonfatal occupational injury or illness and 0.23 fatality could be expected for the duration of operations.

4.21.2.6 Transportation

Under Alternative 11B, transportation to and from Pantex would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be shipped to Hanford for immobilization.

It is assumed that depleted uranium hexafluoride needed for immobilization would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide. After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the immobilization facility at Hanford.

Immobilization at Hanford under this alternative would require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at Hanford. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to HLWVF in 200 Area. This intrasite transportation—from 400 Area to 200 Area—could require the temporary shutdown of roads on Hanford. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

After the immobilized plutonium was encased by HLW at HLWVF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 340 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 11A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.21.1.2 and 4.21.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

However, TRU waste generated at Pantex was not covered by the WM PEIS ROD as there was no such waste at Pantex at the time the ROD was issued, and none was likely to be generated in ongoing site operations. Location of the pit conversion facility at Pantex would result in the generation of TRU waste, as described in Section 4.21.2.2. Moreover, a fairly large increase in the amount of LLW at Pantex (i.e., 25 percent of the site's current storage capacity) could be expected under this alternative. Currently, this type of waste is shipped to the NTS for disposal. In order to account for the transportation of TRU waste from Pantex to WIPP, and LLW from Pantex to NTS, additional shipments are analyzed in this SPD EIS.

In all, approximately 1,900 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 2.8 million km (1.7 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 60 person-rem; the dose to the public, 62 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.024 LCF among transportation workers and 0.031 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.0090.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of surplus nonpit plutonium from a DOE storage facility to Hanford with an accident in a rural population zone under neutral (average) weather conditions. Because surplus nonpit plutonium shipments include plutonium oxide, an accident involving plutonium oxide is conservatively used to estimate the impacts of the maximum foreseeable accident. The accident could result in a dose of 145 person-rem to the public for an LCF risk of 0.07 and 159 rem to the hypothetical MEI for an LCF risk of 0.08. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 11B are as follows: a radiological dose to the population of 3 person-rem, resulting in a total population risk of 1.5×10^{-3} LCF; and traffic accidents resulting in 0.048 traffic fatalities.

4.21.2.7 Environmental Justice

As discussed in other parts of Section 4.21.2, routine operations conducted under Alternative 11B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million (see Table 4–182); the likelihood for the MEI residing near Hanford would be essentially zero. The number of LCFs expected among the general population residing near Pantex and Hanford from accident-free operations would increase by approximately 2.9×10^{-3} and 8.0×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.21.2.5). A beyond-design-basis earthquake at the sites would be expected to result in LCFs among the general population (see Tables 4–66, 4–176, and 4–177). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.21.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 11B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

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4.22 ALTERNATIVE 12A

Alternative 12A would involve constructing and operating the pit conversion and immobilization facilities in new buildings in F-Area at SRS. Under this alternative, all surplus plutonium is immobilized; none is fabricated into MOX fuel.

4.22.1 Construction

4.22.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 12A at SRS include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from SRS construction activities, with standards and guidelines is presented as Table 4–184. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Table 4–184. Evaluation of Air Pollutant Concentrations Associated With Construction Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.46	65.5	0.66
	1 hour	40,000	6.63	285	0.71
Nitrogen dioxide	Annual	100	0.0509	9.35	9.4
PM_{10}	Annual	50	0.0526	4.19	8.4
	24 hours	150	2.3	58.7	39
Sulfur dioxide	Annual	80	0.00492	15.1	19
	24 hours	365	0.121	219	60
	3 hours	1,300	0.727	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.108	14.8	20
Hazardous and other toxic compounds					
Other toxics[b]	24 hours	150	0	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The proposed location of the surplus plutonium disposition facilities at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. Noise would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Traffic associated with construction of these facilities would likely produce less than a 1-dB increase in noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

4.22.1.2 Waste Management

Table 4–185 compares the wastes generated during construction of surplus plutonium disposition facilities at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–185. Potential Waste Management Impacts of Construction Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	61	NA	NA	NA
Nonhazardous				
Liquid	15,100	5[c]	NA	1[d]
Solid	1,820	NA	NA	NA

a See definitions in Appendix F.8.
b Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
c Percent of capacity of the F-Area's sanitary sewer.
d Percent of capacity of Central Sanitary Wastewater Treatment Facility.

Key: DWPF, Defense Waste Processing Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Hazardous wastes generated during construction of surplus plutonium disposition facilities would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of surplus plutonium disposition facilities would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 5 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.22.1.3 Socioeconomics

Construction-related employment requirements for Alternative 12A would be as indicated in Table 4–186.

Table 4–186. Construction Employment Requirements for Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	Immobilization	Total
2001	274	0	274
2002	417	312	729
2003	256	448	704
2004	0	282	282

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998e, 1998f, 1998g.

At its peak in 2002, construction of new pit conversion and immobilization facilities at SRS under this alternative would require 729 construction workers and generate another 585 indirect jobs in the region. This total employment requirement of 1,314 direct and indirect jobs in 2002 represents less than 0.5 percent of the projected REA workforce, and thus should have no major impacts on the REA. It should also have little effect on community services currently offered in the ROI. In fact, it should help offset the 20 percent reduction in SRS employment (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.22.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–187. Construction worker exposure to radiation deriving from other activities at the site, past or present, would be limited to ensure that doses are kept as low as is reasonably achievable. To this end, construction workers would be monitored (badged) as appropriate.

Table 4–187. Potential Radiological Impacts on Construction Workers of Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	Immobilization[b]	Total
Total dose (person-rem/yr)	1.3	1.4	2.7
Annual latent fatal cancers[c]	5.2×10^{-4}	5.6×10^{-4}	1.1×10^{-3}
Average worker dose (mrem/yr)	4	4	4[d]
Annual latent fatal cancer risk	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] An estimated average of 316 workers would be associated with annual construction operations.
[b] An estimated average of 347 workers would be associated with annual construction operations at the new facility location adjacent to APSF. The number would be the same for immobilization in either ceramic or glass.
[c] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[d] Represents an average of the doses for both facilities.
Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998e, 1998f, 1998g.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.22.1.5 Facility Accidents

Construction of pit conversion and immobilization facilities at SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 1,989 person-years of construction labor and standard industrial accident rates, approximately 200 cases of nonfatal occupational injury or illness and 0.28 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.22.1.6 Environmental Justice

As discussed in the other parts of Section 4.22.1, construction under Alternative 12A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 12A at SRS would have no significant impacts on minority or low-income populations.

4.22.2 Operations

4.22.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 12A at SRS were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including those from the plutonium disposition facilities, with standards and guidelines is presented as Table 4–188. Concentrations for immobilization in the ceramic form are presented because they would be greater than those for the glass form. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

Table 4–188. Evaluation of Air Pollutant Concentrations Associated with Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.389	64.4	0.64
	1 hour	40,000	1.56	280	0.70
Nitrogen dioxide	Annual	100	0.0318	9.33	9.3
PM_{10}	Annual	50	0.00209	4.14	8.3
	24 hours	150	0.0326	56.4	38
Sulfur dioxide	Annual	80	0.0473	15.1	19
	24 hours	365	0.649	220	60
	3 hours	1,300	1.71	963	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.00209	14.7	20
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	650	0	0.195	0.03

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

For a discussion of how the operation of the pit conversion and immobilization facilities at SRS would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAP limits applicable to operation of these facilities.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide are a small fraction of the PSD Class II area increments as summarized in Table 4–189.

Table 4–189. Evaluation of Air Pollutant Increases Associated With Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0318	25	0.13
PM_{10}	Annual	0.00209	17	0.012
	24 hours	0.0326	30	0.11
Sulfur dioxide	Annual	0.0473	20	0.24
	24 hours	0.649	91	0.71
	3 hours	1.71	512	0.33

Key: DWPF, Defense Waste Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The combustion of fossil fuels associated with Alternative 12A would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

The location of these facilities at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing machines (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise impacts would not affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

4.22.2.2 Waste Management

Table 4–190 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at SRS. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies, except for nonhazardous sanitary wastewater generation.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation at surplus plutonium disposition facilities is estimated to be 8 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,440 m^3 (1,880 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 4 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available

Table 4–190. Potential Waste Management Impacts of Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	144	8	4	1 of WIPP
LLW	140	1	NA	5
Mixed LLW	2	<1	1	NA
Hazardous	32	<1	6	NA
Nonhazardous				
Liquid	53,000	19[d]	NA	5[e]
Solid	2,030	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of the F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.21 ha (0.52 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,440 m^3 (1,880 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the new facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,400 m^3 (1,830 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,400 m^3 (1,830 yd^3) of waste would require 0.16 ha (0.40 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste would be packaged at the generating facility for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr

(23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the surplus plutonium disposition facilities were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous wastewater would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at SRS is estimated to be 19 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 5 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.22.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and immobilization facilities in 2005 under Alternative 12A, an estimated 671 new workers would be required to operate them (UC 1998e, 1998f, 1998g.) This level of employment would generate another 1,200 indirect jobs in the region. The total employment requirement of 1,871 direct and indirect jobs represents less than 0.7 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have a negligible impact on community services currently offered in the ROI. In fact, it should decrease to 28.9 percent the 33.3 percent reduction in SRS's total workforce (i.e., 15,000 to 10,000 workers) projected for the years 1997–2010.

4.22.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows.

Radiological Impacts. Table 4–191 reflects the potential radiological impacts on three individual receptor groups: the population living within 80 km (50 mi) of SRS in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of both facilities, the total population dose in the year 2010 would be 1.6 person-rem. The corresponding number of LCFs in this population from 10 years of operation would be 8.0×10^{-3}. The dose to the maximally exposed member of the public from annual operation of both facilities would be 3.8×10^{-3} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.9×10^{-8}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and

Table 4–191. Potential Radiological Impacts on the Public of Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	Immobilization Ceramic	Immobilization Glass	Total[a]
Population within 80 km for year 2010				
Dose (person-rem)	1.6	4.9×10^{-3}	4.5×10^{-3}	1.6
Percent of natural background[b]	6.9×10^{-4}	2.1×10^{-6}	1.9×10^{-6}	6.9×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	2.5×10^{-5}	2.3×10^{-5}	8.0×10^{-3}
Maximally exposed individual				
Annual dose (mrem)	3.7×10^{-3}	5.0×10^{-5}	4.5×10^{-5}	3.8×10^{-3}
Percent of natural background[b]	1.3×10^{-3}	1.7×10^{-5}	1.5×10^{-5}	1.3×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	2.5×10^{-10}	2.3×10^{-10}	1.9×10^{-8}
Average exposed individual within 80 km[c]				
Annual dose (mrem)	2.0×10^{-3}	6.3×10^{-6}	5.7×10^{-6}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	3.2×10^{-11}	2.9×10^{-11}	1.0×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities. This total includes the higher of the values for the ceramic and glass immobilization alternatives.
[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS APSF (785,400) in 2010.
Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.
Source: Appendix J.

reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–192; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192 and 193 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–192. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operation activities at SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.22.2.5 Facility Accidents

The potential consequences of postulated bounding accidents from operation of the pit conversion facility at SRS are substantially equivalent to those of Alternative 3A (see Table 4–40), and the potential consequences of such accidents from operation of the immobilization facility in new construction and DWPF at SRS are as presented in Tables 4–193 and 4–194. The relationship between the accident analysis results for the 50-t (55-ton) alternatives and the 17-t (19-ton) immobilization alternatives is discussed in Section 4.20.2.5. More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Table 4–192. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	257	640
Total dose (person-rem/yr)	192	193	385
10-year latent fatal cancers	0.77	0.77	1.5
Average worker dose (mrem/yr)	500	750	600[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.
Key: DWPF, Defense Waste Processing Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998e, 1998f, 1998g.

Public. The most severe consequences of a design basis accident for the pit conversion facility and the immobilization facility would be equivalent to those discussed in Section 4.4.2.5.

A beyond-design-basis earthquake at SRS could result in collapse of the pit conversion and immobilization facilities, and an estimated 6.8 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude at SRS is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. The consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 7.0×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 6,981 person-years of labor and the standard DOE occupational accident rates, approximately

Table 4–193. Accident Impacts of Alternative 12A: Ceramic Immobilization in New Construction at SRS (50-t Case)

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	Unlikely	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Glovebox fire (sintering furnace)	Extremely unlikely	3.8×10^{-7}	1.5×10^{-10}	7.2×10^{-8}	3.6×10^{-11}	3.1×10^{-4}	1.5×10^{-7}
Design basis earthquake	Unlikely	8.8×10^{-5}	3.5×10^{-8}	1.7×10^{-5}	8.3×10^{-9}	7.2×10^{-2}	3.6×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.3×10^{1}	2.1×10^{-2}	2.1	1.0×10^{-3}	4.8×10^{3}	2.5

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: HYDOX, hydride oxidation.

223 cases of nonfatal occupational injury or illness and 0.22 fatality could be expected for the duration of operations.

4.22.2.6 Transportation

Under Alternative 12A, transportation to and from SRS would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at SRS for fabrication into MOX fuel pellets.

It is assumed that depleted uranium hexafluoride needed for immobilization would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide. After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the immobilization facility at SRS.

Table 4–194. Accident Impacts of Alternative 12A: Glass Immobilization in New Construction at SRS (50-t Case)

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	Unlikely	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Melter eruption	Unlikely	3.5×10^{-7}	1.4×10^{-10}	6.7×10^{-8}	3.3×10^{-11}	2.9×10^{-4}	1.4×10^{-7}
Melter spill	Unlikely	8.3×10^{-8}	3.3×10^{-11}	1.6×10^{-8}	7.8×10^{-12}	6.8×10^{-5}	3.3×10^{-8}
Design basis earthquake	Unlikely	7.7×10^{-5}	3.1×10^{-8}	1.5×10^{-5}	7.3×10^{-9}	6.4×10^{-2}	3.1×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	4.7×10^{1}	1.9×10^{-2}	1.8	9.1×10^{-4}	4.3×10^{3}	2.2

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: HYDOX, hydride oxidation.

Immobilization at SRS under this alternative would also require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to DWPF in S-Area. This intrasite transportation—from F-Area to S-Area—could require the temporary shutdown of roads on SRS. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

After the immobilized plutonium was encased by HLW at DWPF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 340 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 12A. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.22.1.2 and 4.22.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In all, approximately 2,100 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 4.1 million km (2.6 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 123 person-rem; the dose to the public, 127 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.049 LCF among transportation workers and 0.063 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.019.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: more than 1 in 10 million per year) is a shipment of surplus nonpit plutonium from a DOE storage facility to SRS with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. Because surplus nonpit plutonium shipments include plutonium oxide, an accident involving plutonium oxide is conservatively used to estimate the impacts of the maximum foreseeable accident. The accident could result in a dose of 29 person-rem to the public for an LCF risk of 0.015 and 32 rem to the hypothetical MEI for an LCF risk of 0.016. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 12A are as follows: a radiological dose to the population of 1.8 person-rem, resulting in a total population risk of 9.0×10^{-4} LCF; and traffic accidents resulting in 0.074 traffic fatality.

4.22.2.7 Environmental Justice

As discussed in other parts of Section 4.22.2, routine operations conducted under Alternative 12A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near SRS would be approximately 1 in 50 million (see Table 4–191). The number of LCFs expected among the general population residing near SRS from accident-free operations would increase by approximately 8.0×10^{-3}.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.22.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–40, 4–194, and 4–195). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.22.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 12A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

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4.23 ALTERNATIVE 12B

Alternative 12B would involve constructing and operating the pit conversion and immobilization facilities in F-Area at SRS. The immobilization facility would be located in the existing Building 221–F with the pit conversion facility located nearby in F-Area. Under this alternative, all surplus plutonium is immobilized; none is fabricated into MOX fuel.

4.23.1 Construction

4.23.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 12B at SRS result from emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from SRS construction activities, with standards and guidelines is presented as Table 4–195. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Table 4–195. Evaluation of Air Pollutant Concentrations Associated With Construction Under Alternative 12B: Pit Conversion in New Construction and Immobilization in Building 221–F and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.979	65	0.65
	1 hour	40,000	4.41	283	0.71
Nitrogen dioxide	Annual	100	0.033	9.33	9.3
PM_{10}	Annual	50	0.0412	4.18	8.4
	24 hours	150	1.15	57.5	38
Sulfur dioxide	Annual	80	0.0031	15.1	19
	24 hours	365	0.0762	219	60
	3 hours	1,300	0.456	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.0908	14.8	20
Hazardous and other toxic compounds					
Other toxics[b]	24 hours	150	0	31.7	21

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

Noise impacts are about the same or less than those for Alternative 12A at SRS (see Section 4.22.1.1).

4.23.1.2 Waste Management

Table 4–196 compares the wastes generated during construction of surplus plutonium disposition facilities at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that TRU waste and LLW would be generated during modification of Building 221-F. No mixed LLW would be generated. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario.

Table 4–196. Potential Waste Management Impacts of Construction Under Alternative 12B: Pit Conversion in New Construction and Immobilization in Building 221–F and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of [b]: Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	50	3	<1	<1
LLW	500	NA	NA	5
Hazardous	54	NA	NA	NA
Nonhazardous				
Liquid	14,500	5[d]	NA	1[e]
Solid	690	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.
[c] Modification is not expected to generate remotely handled TRU waste or mixed waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of the Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of the LLW is not routinely treated and stored on the site; it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor); TRU, transuranic.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive and hazardous wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be packaged, and certified to WIPP waste acceptance criteria at the modification site. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU wastes generated during modification of Building 221–F is estimated to be 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 150 m^3 (196 yd^3) of TRU waste would be generated during the modification period. If all the TRU waste were stored on the site, this would be less than 1 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. If additional storage space were needed, and assuming that the waste would be stored in 208-l (55-gal) drums that would be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of less than 0.1 ha (0.25 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 150 m^3 (196 yd^3) of TRU wastes generated during modification of Building 221–F would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the modification site before transfer for disposal in existing onsite facilities. A total of 1,500 m^3 (1,960 yd^3) of LLW would be generated during modification of Building 221–F. LLW generated during the modification period is estimated to be 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,500 m^3 (1,960 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Hazardous wastes generated during construction of surplus plutonium disposition facilities would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid wastes generated during construction of surplus plutonium disposition facilities would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during construction of surplus plutonium disposition facilities would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 5 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.23.1.3 Socioeconomics

Construction-related employment requirements for Alternative 12B are presented in Table 4–197.

At its peak in 2002, construction of new pit conversion and immobilization facilities at SRS under this alternative would require 665 construction workers and generate another 534 indirect jobs in the region. This total employment requirement of 1,199 direct and indirect jobs represents only about 0.4 percent of the projected REA workforce, and thus should have no major impact on the REA. The requirement should also

Table 4–197. Construction Employment Requirements for Alternative 12B: Pit Conversion in New Construction and Immobilization in Building 221–F and DWPF at SRS

Year	Pit Conversion	Immobilization	Total
2001	274	0	274
2002	417	248	665
2003	256	400	656
2004	0	330	330

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998e, 1998i, 1998j.

have little effect on the community services currently offered in the ROI. In fact, it should help offset the approximately 20 percent reduction in SRS employment (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.23.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented as Table 4–198. Construction worker exposure to radiation deriving from other activities at the site, past or present, would be limited to ensure that doses are kept as low as is reasonably achievable. To this end, construction workers would be monitored (badged) as appropriate.

Table 4–198. Potential Radiological Impacts on Construction Workers of Alternative 12B: Pit Conversion in New Construction and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion[a]	Immobilization[b]	Total
Total dose (person-rem/yr)	1.3	4.7	6.0
Annual latent fatal cancers[c]	5.2×10^{-4}	1.9×10^{-3}	2.4×10^{-3}
Average worker dose (mrem/yr)	4	15	9.5[d]
Annual latent fatal cancer risk	1.6×10^{-6}	6.0×10^{-6}	3.8×10^{-6}

[a] An estimated average of 316 workers would be associated with annual construction operations.
[b] There would be 315 workers associated with construction and modification of the existing Building 221–F. The number would be the same for immobilization in either ceramic or glass.
[c] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[d] Represents an average of the doses for both facilities.
Key: DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998e, 1998i, 1998j.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.23.1.5 Facility Accidents

Construction of a new pit conversion facility and modification of Building 221–F for plutonium conversion and immobilization at SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 1,925 person-years of construction labor and standard industrial accident rates, approximately 190 cases of nonfatal occupational injury or illness and 0.27 fatality could be expected (DOL 1997a, 1997b). As all construction would take place prior to introduction of the radiological process inventory, no noteworthy radiological accidents should occur.

4.23.1.6 Environmental Justice

As discussed in the other parts of Section 4.23.1, construction under Alternative 12B would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 12B at SRS would have no significant impacts on minority or low-income populations.

4.23.2 Operations

4.23.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 12B at SRS are about the same as those for Alternative 12A (see Section 4.22.2.1). Noise impacts would be similar to those for Alternative 12A (see Section 4.22.2.1).

The combustion of fossil fuels associated with Alternative 12B would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.23.2.2 Waste Management

Table 4–199 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at SRS. Although HLW would be used in the immobilization process, no HLW would be generated by the surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies.

Table 4–199. Potential Waste Management Impacts of Operations Under Alternative 12B: Pit Conversion in New Construction and Immobilization in Building 221–F and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	144	8	4	1 of WIPP
LLW	140	1	NA	5
Mixed LLW	2	<1	1	NA
Hazardous	32	<1	6	NA
Nonhazardous				
Liquid	55,000	20[d]	NA	5[e]
Solid	2,030	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of the F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commerical facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SDP EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation at surplus plutonium disposition facilities is estimated to be 8 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,440 m^3 (1,880 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 4 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.21 ha (0.52 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,440 m^3 (1,880 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the new facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,400 m^3 (1,830 yd^3) of LLW would be generated over the operation period. LLW generation at surplus plutonium disposition facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,400 m^3 (1,830 yd^3) of waste would require 0.16 ha (0.40 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste would be packaged at the generating facility for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the surplus plutonium disposition facilities were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous wastewater would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at SRS is estimated to be 20 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 5 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.23.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and immobilization facilities at SRS in 2005 under Alternative 12B, an estimated 712 new workers would be required to operate them (UC 1998e, 1998i, 1998j). This level of employment should generate another 1,273 indirect jobs in the region. As this total employment requirement of 1,985 direct and indirect jobs represents less than 0.7 percent of the projected REA workforce, it should have no major impacts on the REA. The requirement should also have little impact on community services currently offered in the ROI. In fact, it should help to offset the reduction in the total SRS workforce of 33 percent (i.e., 15,000 to 10,000 workers) projected for the years 1997–2010.

4.23.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under this alternative are as follows:

Radiological Impacts. Table 4–200 reflects the potential radiological impacts on three individual receptor groups: the population living within 80 km (50 mi) of SRS in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of both facilities, the total population dose in the year 2010 would be 1.6 person-rem. The corresponding number of LCFs in this population from 10 years of operation would be 8.0×10^{-3}. The dose to the maximally exposed member of the public from annual operation of both facilities would be 3.8×10^{-3} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.9×10^{-8}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Table 4–200. Potential Radiological Impacts on the Public of Operations Under Alternative 12B: Pit Conversion in New Construction and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	Immobilization Ceramic	Immobilization Glass	Total[a]
Population within 80 km for year 2010				
Dose (person-rem)	1.6	4.9×10^{-3}	4.4×10^{-3}	1.6
Percent of natural background[b]	6.9×10^{-4}	2.1×10^{-6}	1.9×10^{-6}	6.9×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	2.5×10^{-5}	2.2×10^{-5}	8.0×10^{-3}
Maximally exposed individual				
Annual dose (mrem)	3.7×10^{-3}	5.0×10^{-5}	4.6×10^{-5}	3.8×10^{-3}
Percent of natural background[b]	1.3×10^{-3}	1.7×10^{-5}	1.6×10^{-5}	1.3×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	2.5×10^{-10}	2.3×10^{-10}	1.9×10^{-8}
Average exposed individual within 80 km[c]				
Annual dose (mrem)	2.0×10^{-3}	6.3×10^{-6}	5.6×10^{-6}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	3.2×10^{-11}	2.8×10^{-11}	1.0×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities. This total includes the higher of the values for the ceramic and glass immobilization alternatives.
[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 231,000 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the facilities (about 783,000) in 2010.
Key: DWPF, Defense Waste Processing Facility.
Source: Appendix J.

Doses to involved workers from normal operations are given in Table 4–201; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192 and 218 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–201. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–201. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 12B: Pit Conversion in New Construction and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	290	673
Total dose (person-rem/yr)	192	218	410
10-year latent fatal cancers	0.77	0.87	1.6
Average worker dose (mrem/yr)	500	750	608[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.
Key: DWPF, Defense Waste Processing Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998e, 1998i, 1998j.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operation activities at SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.23.2.5 Facility Accidents

The potential consequences of postulated bounding accidents from operation of the pit conversion facility at SRS are equivalent to those of Alternative 3A (see Table 4–40). The potential consequences of operation of the immobilization facility in Building 221–F at SRS are presented in Tables 4–202 and 4–203. As discussed in Section 4.20.2.5, inventories could differ with the 50-t (55-ton) throughput associated with this alternative, but most of that material would not be at risk in accidents. More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The potential consequences of postulated bounding accidents from operation of the pit conversion facility at SRS are substantially equivalent to those discussed in Section 4.4.2.5, and the potential consequences of such accidents from operation of the immobilization facility in Building 221–F and DWPF at SRS are presented in Tables 4–202 and 4–203.

A beyond-design-basis earthquake at SRS could result in collapse of the pit conversion and immobilization facilities, and an estimated 6.8 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude at SRS is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. The consequences for this worker were estimated to be highest for the design basis earthquake. The consequences of such an accident would include an LCF probability of 4.2×10^{-3}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operations at SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 7,432 person-years of labor and the standard DOE occupational accident rates, approximately 238 cases of nonfatal occupational injury or illness and 0.24 fatality could be expected for the duration of operations.

Table 4–202. Accident Impacts of Alternative 12B: Ceramic Immobilization in Building 221–F at SRS (50-t Case)

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	4.2×10^{-1}	1.7×10^{-4}	8.0×10^{-2}	4.0×10^{-5}	3.4×10^{2}	1.7×10^{-1}
Glovebox fire (calcining furnace)	Extremely unlikely	3.3×10^{-5}	1.3×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	2.7×10^{-2}	1.3×10^{-5}
Hydrogen explosion	Unlikely	4.7×10^{-2}	1.9×10^{-5}	8.8×10^{-3}	4.4×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Glovebox fire (sintering furnace)	Extremely unlikely	1.9×10^{-4}	7.4×10^{-8}	3.5×10^{-5}	1.8×10^{-8}	1.5×10^{-1}	7.5×10^{-5}
Design basis earthquake	Unlikely	1.1×10^{1}	4.2×10^{-3}	4.1×10^{-1}	2.0×10^{-4}	9.6×10^{2}	4.9×10^{-1}
Beyond-design-basis fire	Beyond extremely unlikely	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.3×10^{1}	2.1×10^{-2}	2.1	1.0×10^{-3}	4.8×10^{3}	2.5

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value that assumes the accident has occurred.
Key: HYDOX, hydride oxidation.

4.23.2.6 Transportation

Because the only difference between Alternative 12A and 12B is the location of the immobilization facility within F-Area at SRS, the transportation required for Alternative 12B would be the same as that for Alternative 12A. Therefore, the transportation risks associated with Alternative 12B are equivalent to those discussed in Section 4.22.2.6.

4.23.2.7 Environmental Justice

As discussed in other parts of Section 4.23.2, routine operations conducted under Alternative 12B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near SRS would be approximately 1 in 50 million (see Table 4–200). The number of LCFs expected among the general population residing near SRS from accident-free operations would increase by approximately 8.0×10^{-3}.

Design basis accidents at the site would not be expected to cause cancer fatalities among the public (see Section 4.23.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the

Table 4–203. Accident Impacts of Alternative 12B: Glass Immobilization in Building 221–F at SRS (50-t Case)

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	4.2×10^{-1}	1.7×10^{-4}	8.0×10^{-2}	4.0×10^{-5}	3.4×10^{2}	1.7×10^{-1}
Glovebox fire (calcining furnace)	Extremely unlikely	3.3×10^{-5}	1.3×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	2.7×10^{-2}	1.3×10^{-5}
Hydrogen explosion	Unlikely	4.7×10^{-2}	1.9×10^{-5}	8.8×10^{-3}	4.4×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Melter eruption	Unlikely	1.7×10^{-4}	6.9×10^{-8}	3.3×10^{-5}	1.6×10^{-8}	1.4×10^{-1}	6.9×10^{-5}
Melter spill	Unlikely	4.0×10^{-5}	1.6×10^{-8}	7.7×10^{-6}	3.8×10^{-9}	3.3×10^{-2}	1.6×10^{-5}
Design basis earthquake	Unlikely	9.2	3.7×10^{-3}	3.6×10^{-1}	1.8×10^{-4}	8.5×10^{2}	4.3×10^{-1}
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	4.7×10^{1}	1.9×10^{-2}	1.8	9.1×10^{-4}	4.3×10^{3}	2.2

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: HYDOX, hydride oxidation.

general population (see Tables 4–40, 4–202, and 4–203). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.23.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 12B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.24 ALTERNATIVE 12C

Alternative 12C would involve constructing and operating the pit conversion facility in Zone 4 at Pantex and the immobilization facility at SRS. The immobilization facility would be located in a new building in F-Area. Activities at Pantex would be the same as described for Alternative 4A (see Section 4.6). Under this alternative, all surplus plutonium would be immobilized; none would be fabricated into MOX fuel.

4.24.1 Construction

4.24.1.1 Air Quality and Noise

Potential air quality and noise impacts of construction of the pit conversion facility under Alternative 12C at Pantex would be the same as those for Alternative 4A (see Section 4.6.1.1).

Potential air quality and noise impacts of construction of the immobilization facility of SRS under Alternative 12C would be the same as those for Alternative 6A (see Section 4.10.1.1).

4.24.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as those for Alternative 4A. See Section 4.6.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At SRS, construction impacts of this alternative would be the same as those for Alternative 6A.[1] See Section 4.10.1.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.24.1.3 Socioeconomics

Construction-related employment requirements under Alternative 12C would be as indicated in Table 4–204.

Table 4–204. Construction Employment Requirements Under Alternative 12C: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	Immobilization	Total
2001	298	0	298
2002	452	312	764
2003	275	448	723
2004	0	282	282

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998f, 1998g, 1998k.

At its peak in 2002, construction of the new pit conversion facility at Pantex under this alternative would require 452 construction workers and generate another 381 indirect jobs in the region. As the total employment requirement of 833 direct and indirect jobs represents only 0.3 percent of the projected REA workforce, it should have no major impact on the REA. It should also have little impact on community services within the ROI. In fact, it should help offset the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2005.

At its peak in 2003, construction of the immobilization facility at SRS would require 448 construction workers and generate another 355 indirect jobs in the region. The total employment requirement of 803 direct and indirect jobs represents less than 0.3 percent of the projected REA workforce, and thus should have no major impact on the REA. This requirement should also have little impact on community services within the ROI. In fact, it should help offset the nearly 20 percent reduction in SRS' overall labor force (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.24.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–205. According to a recent radiation survey (DOE 1997e) conducted in the Zone 4 area at Pantex, construction workers would not be expected to receive any additional radiation exposure above natural background levels in the area. Data indicate, however, that a construction worker in F-Area at SRS could receive exposures to radiation that derives from other activities, past or present, at the site. Regardless of location, construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Table 4–205. Potential Radiological Impacts on Construction Workers of Alternative 12C: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	Immobilization[b]
Total dose (person-rem/yr)	0	1.4
Annual latent fatal cancers[c]	0	5.6×10^{-4}
Average worker dose (mrem/yr)	0	4
Annual latent fatal cancer risk	0	1.6×10^{-6}

[a] An estimated average of 342 workers would be associated with annual construction operations.
[b] An estimated average of 347 workers would be associated with annual construction operations at the new facility location adjacent to APSF. The number would be the same for immobilization in either ceramic or glass.
[c] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1997e; ICRP 1991; NAS 1990; UC 1998f, 1998g, 1998k.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at Pantex or SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.24.1.5 Facility Accidents

Construction of a new plutonium disposition facilities at Pantex and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,067 person-years of construction labor and standard industrial accident rates, approximately 200 cases of nonfatal occupational injury or illness and 0.29 fatality could be expected. As all construction would be in nonradiological areas, no radiological accidents should occur during construction.

4.24.1.6 Environmental Justice

As discussed in the other parts of Section 4.24.1, construction under Alternative 12C would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities conducted under Alternative 12C at Pantex and SRS would have no significant impacts on minority or low-income populations.

4.24.2 Operations

4.24.2.1 Air Quality and Noise

Potential air quality and noise impacts of operation of the new pit conversion facility under Alternative 12C at Pantex would be the same as those for Alternative 4A (see Section 4.6.2.1).

Potential air quality impacts of the operation of the immobilization facility under Alternative 12C at SRS were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the immobilization facility, with standards and guidelines is presented as Table 4–206. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of this facility.

Table 4–206. Evaluation of SRS Air Pollutant Concentrations Associated With Operations Under Alternative 12C: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment[b] ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.299	64.3	0.64
	1 hour	40,000	1.2	280	0.70
Nitrogen dioxide	Annual	100	0.0093	9.31	9.3
PM_{10}	Annual	50	0.000697	4.14	8.3
	24 hours	150	0.0125	56.4	38
Sulfur dioxide	Annual	80	0.0166	15.1	19
	24 hours	365	0.229	219	60
	3 hours	1,300	0.613	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.000697	14.7	20

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Includes the higher of the concentrations for the ceramic and glass immobilization options.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996.

For a discussion of how the operation of the immobilizatiion facility at SRS would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAP limits applicable to operation of this facility.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of this facility at SRS would be a small fraction of the PSD Class II area increments, as summarized in Table 4–207.

Table 4–207. Evaluation of Air Pollutant Increases Associated With Operations at SRS Under Alternative 12C: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.0093	25	0.037
PM_{10}	Annual	0.000697	17	0.0041
	24 hours	0.0125	30	0.042
Sulfur dioxide	Annual	0.0166	20	0.083
	24 hours	0.229	91	0.25
	3 hours	0.613	512	0.12

Key: DWPF, Defense Waste Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of this facility at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operation would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of this facility would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. No noise impacts are expected to affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of this facility would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus should not result in any increased annoyance of the public.

The combustion of fossil fuels associated with Alternative 12C would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 8×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.24.2.2 Waste Management

Operational impacts of this alternative at Pantex would be the same as for Alternative 4A. See Section 4.6.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

Table 4–208 reflects a comparison of the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operation of the surplus plutonium disposition facilities at SRS.

Table 4–208. Potential Waste Management Impacts of Operations at SRS Under Alternative 12C: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Waste Type [a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of [b]: Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	126	7	4	1 of WIPP
LLW	80	<1	NA	3
Mixed LLW	1	<1	1	NA
Hazardous	30	<1	6	NA
Nonhazardous				
Liquid	28,000	10[d]	NA	3[e]
Solid	230	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared to estimated additional waste generation on an annual basis. All other storage and disposal capacities are compared to total estimated additional waste generation assuming a 10-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of capacity of F-Area sanitary sewer.
[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.
Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Although HLW would be used in the immobilization process, no HLW would be generated by the facilities. Waste generation at SRS should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore it is assumed the TRU waste would be stored onsite until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of the treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading of the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

According to estimates, TRU wastes generated at the immobilization facility at SRS would amount to 7 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,260 m^3 (1,648 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 4 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and adding a 50 percent factor for aisle space, a storage area of about 0.18 ha (0.44 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 1,440 m^3 (1,884 yd^3) of TRU wastes generated by the facilities at Pantex and SRS would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of the disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

At SRS, LLW would be packaged, certified, and accumulated at the immobilization facility before transfer for additional treatment and disposal in existing onsite facilities. A total of 800 m^3 (1,050 yd^3) of LLW would be generated over the operational period. LLW generation at surplus plutonium disposition facilities has been estimated at less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility and 3 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Judging from the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 800 m^3 (1,050 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

At SRS, mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan. Mixed LLW generated at the immobilization facility would in all likelihood be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incinerator Facility, and 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

At SRS, any hazardous wastes generated during operation of the immobilization facility would be packaged for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste were managed on the site, hazardous waste generation for this combination of facilities would be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. Management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the immobilization facility at SRS were treated in the Consolidated Incinerator Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

At SRS, nonhazardous wastewater generated by the immobilization facilities would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities would be an estimated 10 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer and 3 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.24.2.3 Socioeconomics

Under Alternative 12C, operation of the pit conversion facility at Pantex would begin in 2004 and should require 400 workers (UC 1998k). This level of employment should generate another 1,355 indirect jobs within the region. The total employment requirement of 1,755 direct and indirect jobs represents less than 0.7 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have little impact on community services within the Pantex ROI. In fact, it should help offset the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2010.

Startup and operation of the immobilization facility at SRS in 2005 under Alternative 12C would require an estimated 271 workers (UC 1998f, 1998g). This level of employment would be expected to generate another 485 indirect jobs within the region. The total employment requirement of 756 direct and indirect jobs represents less than 0.3 percent of the projected REA workforce, and thus should have no major impact on the REA. The additional required workers should also have little impact on community services within the ROI. In fact, they should help offset the 33 percent reduction in the total SRS workforce (i.e., 15,000 to 10,000 workers) projected for the years 1997–2010.

4.24.2.4 Human Health Risk

During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses, to and potential health effects on, the public and workers for this alternative are described below.

Radiological Impacts. Presented in Table 4–209 are the potential radiological impacts on three individual receptor groups for Pantex and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–209. Potential Radiological Impacts on the Public of Operations Under Alternative 12C: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	Immobilization	
		Ceramic	Glass
Population within 80 km for year 2010			
Dose (person-rem)	0.58	4.9×10^{-3}	4.5×10^{-3}
Percent of natural background[a]	5.8×10^{-4}	2.1×10^{-6}	1.9×10^{-6}
10-year latent fatal cancers	2.9×10^{-3}	2.5×10^{-5}	2.3×10^{-5}
Maximally exposed individual			
Annual dose (mrem)	0.062	5.0×10^{-5}	4.5×10^{-5}
Percent of natural background[a]	0.019	1.7×10^{-5}	1.5×10^{-5}
10-year latent fatal cancer risk	3.1×10^{-7}	2.5×10^{-10}	2.3×10^{-10}
Average exposed individual within 80 km[b]			
Annual dose (mrem)	1.9×10^{-3}	6.3×10^{-6}	5.7×10^{-6}
10-year latent fatal cancer risk	9.5×10^{-9}	3.2×10^{-11}	2.9×10^{-11}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and APSF (785,400) in 2010.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Source: Appendix J.

Given incident-free operation of both disposition facilities, the total population dose in the year 2010 would be 0.58 person-rem. The corresponding number of LCFs in the populations around Pantex and SRS from 10 years of operation would be 2.9×10^{-3}. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding risk of LCF to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 5.0×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 2.5×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–210; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192 and 193 person-rem, respectively.

Table 4–210. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 12C: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Involved Worker	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	257	640
Total dose (person-rem/yr)	192	193	385
10-year latent fatal cancers	0.77	0.77	1.5
Average worker dose (mrem/yr)	500	750	(a)
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	(a)

[a] This value holds no statistical relevance because the facilities are at different sites.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998f, 1998g, 1998k.

The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–210. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operations at Pantex or SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.24.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex would be equivalent to those of Alternative 4A (see Table 4–66); the potential consequences from operation of the immobilization facility at SRS, equivalent to those of Alternative 12A (see Tables 4–193 and 4–194).

Public. Thus, no LCFs would be expected among the public or the maximally exposed offsite individual from the design basis accidents at the facilities for Alternative 12C. For accidents for the pit conversion and immobilization facilities, see Sections 4.6.2.5 and 4.22.2.5, respectively.

The most severe consequences of design basis and beyond-design-basis accidents at the Pantex and SRS facilities would be equivalent to those described in Sections 4.6.2.5 and 4.22.2.5, respectively.

Noninvolved Worker. The noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be at a point 1,000 m (3,281 ft) downwind from the location of the accident. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. Those consequences would include an LCF probability of 5.8×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operation activities at Pantex and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 6,981 person-years of labor and the standard DOE occupational accident rates, approximately 223 cases of nonfatal occupational injury or illness and 0.22 fatality could be expected for the duration of operations.

4.24.2.6 Transportation

Under Alternative 12C, transportation to and from Pantex would include the shipment of plutonium pits and clean plutonium metal via SST from sites throughout the DOE complex to the pit conversion facility. During dismantlement of the pits, some HEU and classified pit parts would be recovered. The pit conversion facility would ship HEU via SST to ORR for storage and pit parts via SST to LANL. After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be shipped to SRS for immobilization.

It is assumed that depleted uranium hexafluoride needed for immobilization would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide. After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the immobilization facility at SRS.

Immobilization at SRS under this alternative would also require that surplus nonpit plutonium in various forms, excluding clean metal, be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SSTs.

Under the preferred alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to DWPF in S-Area. This intrasite transportation—from F-Area to S-Area—could require the temporary shutdown of roads on SRS. It would, however, provide for all the necessary security and for reduced risk to the public; SSTs would not be required.

After the immobilized plutonium was encased by HLW at DWPF, it would be shipped to a geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 340 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 12C. The WM PEIS documents an analysis of different options for the shipment of these canisters to a geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS, like the WM PEIS, takes the most conservative approach (i.e., the approach that results in the highest risk to the public): assumption that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.24.1.2 and 4.24.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

However, TRU waste generated at Pantex was not covered by the WM PEIS ROD as there was no such waste at Pantex at the time the ROD was issued, and none was likely to be generated in ongoing site operations. Location of the pit conversion facility at Pantex would result in the generation of TRU waste, as described in Section 4.6.2.2. Moreover, a fairly large increase in the amount of LLW at Pantex (i.e., 25 percent of the site's current storage capacity) could be expected under this alternative. Currently, this type of waste is shipped to NTS for disposal. In order to account for the transportation of TRU waste from Pantex to WIPP, and LLW from Pantex to NTS, additional shipments are analyzed in this SPD EIS.

In all, approximately 2,100 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 4.2 million km (2.6 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 122 person-rem; the dose to the public, 127 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.049 LCF among transportation workers and 0.064 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.018.

Impacts of Accidents During Ground Transportation. The maximum foreseeable offsite transportation accident under this Alternative (probability of occurrence: about 1 in 10 million per year) is a shipment of surplus nonpit plutonium from a DOE storage facility to SRS with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. Because surplus nonpit plutonium shipments include plutonium oxide, an accident involving plutonium oxide is conservatively used to estimate the impacts of the maximum foreseeable accident. The accident could result in a dose of 145 person-rem to the public for an LCF risk of 0.07 and 159 rem to the hypothetical MEI for an LCF risk of 0.08. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year.

Estimates of the total ground transportation accident risks under Alternative 12C are as follows: a radiological dose to the population of 4.6 person-rem, resulting in a total population risk of 2.3×10^{-3} LCF; and traffic accidents resulting in 0.074 traffic fatalities.

4.24.2.7 Environmental Justice

As discussed in other parts of Section 4.24.2, routine operations conducted under Alternative 12C would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million; the likelihood for the MEI residing near SRS would be essentially zero (see Table 4–209). The number of LCFs expected among the general population residing near Pantex and SRS from accident-free operations would increase by approximately 8.0×10^{-3} and 2.5×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.24.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–66, 4–193, and 4–194). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.24.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 12C would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

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4.25 ALTERNATIVE 12D

Alternative 12D would involve constructing and operating the pit conversion facility in Zone 4 at Pantex and the immobilization facility at SRS. The immobilization facility would be located in the existing Building 221–F in F-Area. Activities at Pantex would be the same as under Alternative 4A (Section 4.6). Under this alternative, all surplus plutonium would be immobilized; none would be fabricated into MOX fuel.

4.25.1 Construction

4.25.1.1 Air Quality and Noise

Sources of potential air quality and noise impacts of construction of the pit conversion facility under Alternative 12D at Pantex are the same as those for Alternative 4A (see Section 4.6.1.1).

Sources of potential air quality and noise impacts of construction of the immobilization facility under Alternative 12D at SRS are the same as those for Alternative 6C (see Section 4.12.1.1).

4.25.1.2 Waste Management

At Pantex, construction impacts from this alternative would be the same as those for Alternative 4A. See Section 4.6.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At SRS, construction impacts of this alternative would be the same as those for Alternative 6C. See Section 4.12.1.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.25.1.3 Socioeconomics

Construction-related employment requirements for Alternative 12D would be as indicated in Table 4–211.

Table 4–211. Construction Employment Requirements Under Alternative 12D: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Year	Pit Conversion	Immobilization	Total
2001	298	0	298
2002	452	248	700
2003	275	400	675
2004	0	330	330

Key: DWPF, Defense Waste Processing Facility.
Source: UC 19978, 1998j, 1998k.

At its peak in 2002, construction of the new pit conversion facility at Pantex under this alternative would require 452 construction workers and generate another 381 indirect jobs in the region. As the total employment requirement of 833 direct and indirect jobs represents only 0.3 percent of the projected REA workforce, it should have no major impact on the REA. It should also have little impact on community services within the ROI. In fact, it should help offset the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,900 to 1,750 workers) projected for the years 1997–2005.

At its peak in 2003, construction of the immobilization facility at SRS would require 400 construction workers and generate another 321 indirect jobs in the region. The total employment requirement of 721 direct and indirect jobs represents less than 0.3 percent of the projected REA workforce, and thus should have no major impacts on the REA. It should also have little impact on community services within the ROI. In fact, it should help offset the nearly 20 percent reduction in SRS employment (i.e., from 15,000 to 12,000 workers) projected for the years 1997–2005.

4.25.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–212. According to the results of a recent radiation survey (DOE 1997e) conducted in the Zone 4 area at Pantex, construction workers would not be expected to receive any additional radiation exposure above natural background levels in the area. Data indicate, however, that a construction worker in F-Area at SRS could be exposed to radiation that derives from other activities, past or present, at the site. Regardless of location, construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Table 4–212. Potential Radiological Impacts on Construction Workers Under Alternative 12D: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion[a]	Immobilization[b]
Total dose (person-rem/yr)	0	4.7
Annual latent fatal cancers[c]	0	1.9×10^{-3}
Average worker dose (mrem/yr)	0	15
Annual latent fatal cancer risk	0	6.0×10^{-6}

[a] An estimated average of 230 workers would be associated with annual construction operations.
[b] There would be 315 workers associated with construction and modification of the existing Building 221–F. The number would be the same for immobilization in either ceramic or glass.
[c] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
Key: DWPF, Defense Waste Processing Facility.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1997e; ICRP 1991; NAS 1990; UC 1998i, 1998j, 1998k.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at Pantex or SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.25.1.5 Facility Accidents

Construction of new plutonium disposition facilities at Pantex and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,003 person-years of construction labor and standard industrial accident rates, approximately 200 cases of nonfatal occupational injury or illness and 0.28 fatality could be expected. As all construction would take place prior to introduction of the radiological process inventory, no noteworthy radiological accidents should occur during construction.

4.25.1.6 Environmental Justice

As discussed in the other parts of Section 4.25.1, construction under Alternative 12D would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 12D at SRS would have no significant impacts on minority or low-income populations.

4.25.2 Operations

4.25.2.1 Air Quality and Noise

Potential air quality and noise impacts of operation of the new pit conversion facility under Alternative 12D at Pantex are the same as those for Alternative 4A (see Section 4.6.2.1).

Potential air quality impacts of the operation of the immobilization facility under Alternative 12D at SRS were analyzed using ISCST3. Operational impacts result from process emissions, emergency diesel generator testing, trucks moving material and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the immobilization facility, with standards and guidelines is presented as Table 4–213. Concentrations of air pollutants would likely increase at the site boundary but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of the facility.

Table 4–213. Evaluation of SRS Air Pollutant Concentrations Associated With Operations Under Alternative 12D: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	SPD Increment[b] ($\mu g/m^3$)	Site Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.31	64.3	0.64
	1 hour	40,000	1.21	280	0.70
Nitrogen dioxide	Annual	100	0.00968	9.31	9.3
PM_{10}	Annual	50	0.000724	4.14	8.3
	24 hours	150	0.013	56.4	38
Sulfur dioxide	Annual	80	0.0166	15.1	19
	24 hours	365	0.229	219	60
	3 hours	1,300	0.615	962	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.000724	14.7	20

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Includes the higher of the concentrations for the ceramic and glass immobilization options.

Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; SCDHEC 1996.

For a discussion of how the operation of the immobilization facility at SRS would affect the ability to continue to meet NESHAP limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAP limits applicable to operation of this facility.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of this facility at SRS would be a small fraction of the PSD Class II area increments, as summarized in Table 4–214.

Table 4–214. Evaluation of SRS Air Pollutant Increases Associated With Operations Under Alternative 12D: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration ($\mu g/m^3$)	PSD Class II Area Allowable Increment ($\mu g/m^3$)	Percent of Increment
Nitrogen dioxide	Annual	0.00968	25	0.039
PM_{10}	Annual	0.000724	17	0.0043
	24 hours	0.013	30	0.043
Sulfur dioxide	Annual	0.0166	20	0.083
	24 hours	0.229	91	0.25
	3 hours	0.615	512	0.12

Key: DWPF, Defense Waste Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The combustion of fossil fuels associated with Alternative 12D would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 8×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

The location of this facility at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operation would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of this facility would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. No noise impacts are expected to affect threatened and endangered species because there are no threatened and endangered species habitats near the facility site (see Section 4.26). Noise from traffic associated with operation of this facility would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus should not result in any increased annoyance of the public.

4.25.2.2 Waste Management

At Pantex, operational impacts of this alternative would be the same as those for Alternative 4A. See Section 4.6.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At SRS, operational impacts of this alternative would be the same as for those for Alternative 12C. See Section 4.24.2.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.25.2.3 Socioeconomics

Employment requirements for operation of the new pit conversion facility at Pantex under Alternative 12D would be the same as those for Alternative 4A (see Section 4.6.2.3).

Startup and operation of the immobilization facility at SRS in 2005 under Alternative 12D would require an estimated 312 workers (UC 1998i, 1998j). This level of employment would generate another 558 indirect jobs within the region. As the total employment requirement of 870 direct and indirect jobs represents only about 0.3 percent of the projected REA workforce, it should have no major impacts on the REA. The additional workers should also have little effect on community services within the ROI. In fact, they should help decrease the reduction in total site employment projected for the years 1997–2010 from 33.3 percent (i.e., 15,000 to 10,000 workers).

4.25.2.4 Human Health Risk

During normal operations, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers for this alternative are described below.

Radiological Impacts. Presented as Table 4–215 are the potential radiological impacts on three individual receptor groups for Pantex and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of both plutonium disposition facilities, the total population dose in the year 2010 would be 0.58 person-rem. The corresponding number of LCFs in the populations around Pantex and SRS from 10 years of operation would be 2.9×10^{-3}. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 5.0×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 2.5×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the Clean Air Act [NESHAP], and the Safe Drinking Water Act).

Doses to involved workers from normal operations are given in Table 4–216; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual

Table 4–215. Potential Radiological Impacts on the Public of Operations Under Alternative 12D: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	Immobilization Ceramic	Immobilization Glass
Population within 80 km for year 2010			
Dose (person-rem)	0.58	4.9×10^{-3}	4.4×10^{-3}
Percent of natural background[a]	5.8×10^{-4}	2.1×10^{-6}	1.9×10^{-6}
10-year latent fatal cancers	2.9×10^{-3}	2.5×10^{-5}	2.2×10^{-5}
Maximally exposed individual			
Annual dose (mrem)	0.062	5.0×10^{-5}	4.6×10^{-5}
Percent of natural background[a]	0.019	1.7×10^{-5}	1.6×10^{-5}
10-year latent fatal cancer risk	3.1×10^{-7}	2.5×10^{-10}	2.3×10^{-10}
Average exposed individual within 80 km[b]			
Annual dose (mrem)	1.9×10^{-3}	6.3×10^{-6}	5.6×10^{-6}
10-year latent fatal cancer risk	9.5×10^{-9}	3.2×10^{-11}	2.8×10^{-11}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 231,000 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS Building 221–F (781,500) in 2010.

Key: DWPF, Defense Waste Processing Facility.

Source: Appendix J.

operation are included in Table 4–216. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–216. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 12D: Pit Conversion in New Construction at Pantex, and Immobilization in Building 221–F and DWPF at SRS

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	290	673
Total dose (person-rem/yr)	192	218	410
10-year latent fatal cancers	0.77	0.87	1.6
Average worker dose (mrem/yr)	500	750	(a)
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	(a)

[a] This value holds no statistical relevance because the facilities are at different sites.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/year (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998i, 1998j, 1998k.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operations at Pantex or SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.25.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are equivalent to those of Alternative 4A (see Table 4–66); potential consequences of operation of the immobilization facility at SRS would be equivalent to those of Alternative 12B (see Tables 4–202 and 4–203).

Public. The design basis and beyond-design-basis accidents at Pantex and SRS would be equivalent to those discussed in Sections 4.6.2.5 and 4.5.2.5, respectively.

Noninvolved Worker. Consistent with the analysis presented in *the Storage and Disposition Final PEIS,* the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the design basis earthquake at SRS. The consequences of such an accident would include an LCF probability of 4.2×10^{-3}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved worker would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, the immediate emergency response actions should reduce the consequences to workers near the accident.

Nonradiological Accidents. Plutonium disposition operation activities at Pantex and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 7,432 person-years of labor and the standard DOE occupational accident rates, approximately 238 cases of nonfatal occupational injury or illness and 0.24 fatality could be expected for the duration of operations.

4.25.2.6 Transportation

Because the only difference between Alternative 12C and 12D is the location of the immobilization facility within F-Area at SRS, the transportation required for Alternative 12D would be the same as that for Alternative 12C. Therefore, the transportation risks associated with Alternative 12D are equivalent to those discussed in Section 4.24.2.6.

4.25.2.7 Environmental Justice

As discussed in other parts of Section 4.25.2, routine operations conducted under Alternative 12D would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million; the likelihood for the MEI residing near SRS would be essentially zero (see Table 4–215). The number of LCFs expected among the general population residing near Pantex and SRS from accident-free operations would increase by approximately 2.9×10^{-3} and 2.5×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.25.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–66, 4–202, and 4–203). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.25.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 12D would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the general public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

Next Section

4.26 ADDITIONAL ENVIRONMENTAL RESOURCE ANALYSES

4.26.1 Hanford

For Hanford, the maximum impacts on environmental resources would be experienced if Alternative 2 were implemented. Under this alternative, the pit conversion and immobilization facilities would be collocated in FMEF, and a new MOX facility would be built nearby. This alternative would require the maximum amount of ground disturbance, thereby maximizing the potential impacts on related resources such as geology and soils, ecological, and cultural. This alternative would also require the most water and place the maximum strain on infrastructure at the site. All the other Hanford alternatives evaluated in this SPD EIS would have fewer land and resource requirements, so none would result in greater impacts than those associated with Alternative 2.

4.26.1.1 Geology and Soils

4.26.1.1.1 Construction

Construction of all the surplus plutonium disposition facilities at Hanford with the MOX facility in a new building would have negligible impact on the geologic or soils resources. In the *Storage and Disposition Final PEIS*, hazards from the large-scale geologic conditions at Hanford were analyzed in detail. The analysis determined that these conditions pose an acceptable risk to the proposed long-term storage facilities. That decision is not revisited in this SPD EIS. More detailed descriptions of impacts of the potential geologic hazards at Hanford are included in the *Storage and Disposition Final PEIS* (DOE 1996a: 4-45–4-47).

The soils at Hanford are considered acceptable for standard construction techniques. Other than crushed rock, sand, and gravel, no economically viable geologic resources have been identified at Hanford. New construction could increase the use of crushed rock, sand, and gravel; however, large volumes of these materials are present, and the impact should be negligible. No soils at Hanford are currently classified as prime farmland.

4.26.1.1.2 Operations

Operation of all the facilities at Hanford would have no impact on the geologic or soils resources.

4.26.1.2 Water Resources

4.26.1.2.1 Construction

Surface water is not proposed to be used under any of the alternatives being evaluated for Hanford (UC 1998a, 1998b, 1998c, 1998d). Therefore, no impacts on water availability for downstream users would be expected.

According to estimates, construction of all the proposed surplus plutonium disposition facilities at Hanford would require a maximum of 63 million l/yr (16.6 million gal/yr) of water (UC 1998a, 1998b, 1998c, 1998d). When added to current usage, this represents about 26 percent of the 400 Area groundwater capacity. This volume also represents about 13 percent of the total capacity of the 400 Area water treatment plants, which are approved to withdraw 500 million l/yr (131.4 million gal/yr) of groundwater (Mecca 1997:180). This amount of water would not have a major affect on water availability to other users in the area. Wastewater would not be directly discharged to the groundwater aquifer. Therefore, no impacts on groundwater quality would be expected.

All wastewater would be held in the 400 Area water treatment facilities prior to discharge into the WPPSS treatment system, which is designed to meet National Pollution Discharge Elimination System (NPDES) permit limitations. Therefore, no impacts on water quality would be expected (Mecca 1997:180).

Proven construction techniques would be used to mitigate the impact of soil erosion on receiving streams. Because of the effectiveness of these techniques, no long-term impacts from soil erosion due to construction activities would be expected.

The proposed facilities would be constructed in the 400 Area and would be located outside the 100-year flood area and the probable-maximum-flood area. Flooding in the latter area is more severe than the 500-year flood (DOE 1996a:3-32; ERDA 1976:1-11). Therefore, the proposed facilities would neither affect nor be affected by flooding.

4.26.1.2.2 Operations

Surface water would not be used in the operation of the proposed surplus plutonium disposition facilities, and there would be no direct discharges of wastewater from the facilities (UC 1998a, 1998b, 1998c, 1998d). Therefore, no impact on surface water quality or availability would be expected from the proposed activities.

The annual maximum water usage for operation of all the proposed surplus plutonium disposition facilities at the 400 Area would be about 132 million l (34.5 million gal) (UC 1998a, 1998b, 1998c, 1998d). When added to current usage, this represents about 44 percent of the 400 Area groundwater capacity. This also represents about 26 percent of the capacity of the 400 Area water treatment plant, which has an approved capacity of 500 million l/yr (131.4 million gal/yr) (Mecca 1997:180). Because other uses for water from this facility are small, this increased flow would not cause the plant to exceed its approved withdrawal rate. There would be no impact on the availability of groundwater for other users if all of the facilities were operated at Hanford.

There would be no direct discharge of wastewater into the groundwater aquifer (UC 1998a, 1998b, 1998c, 1998d). All wastewater would be treated prior to discharge in facilities designed to meet NPDES permit limitations. Therefore, no impact on groundwater quality would be expected from the operation of all facilities at Hanford.

4.26.1.3 Ecological Resources

Ecological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. However, habitat disturbance would be minimal; the land area required for construction activities is small in relation to regionally available habitat, and construction would take place in previously disturbed or developed areas. Operational impacts would also be minimal because facility emissions to the environment would be processed in accordance with applicable permitting procedures. Therefore, impacts on nonsensitive and sensitive habitats, plant and animal species, and the overall biodiversity of the candidate site would be minimal.

4.26.1.3.1 Construction

Nonsensitive Habitat. Siting the three proposed surplus plutonium disposition facilities at Hanford would disturb a total of about 15 ha (37 acres) of land in the 400 Area. Some of this land (2.1 ha [5.2 acres]) would be used only temporarily as a laydown area during the 3-year construction phase for the immobilization facility, and some (4.7 ha [12 acres]) for the same purpose during the 5-year construction and startup phases for the MOX facility. The existing construction laydown area used to build FMEF would be used for the pit conversion facility (2 ha [4.9 acres]) (UC 1998a, 1998b, 1998c, 1998d). Vegetation in this area is characterized as post-fire shrub-steppe dominated by cheatgrass and small shrubs (Mecca 1997:Poston memo to Teal). Cheatgrass, a nonnative annual, would most likely recover the disturbed areas. This species can competitively exclude less vigorous native species that provide important food or shelter for insects, small mammals, and birds (DOE 1995a). The associated animal populations would be affected. Some of the less-mobile or established animals (e.g., mice, rabbits, snakes, and lizards) within the construction zone could perish during land-clearing activities and increased vehicular traffic. Furthermore, activities and noise associated with construction could cause larger mammals and birds to relocate to similar habitat in the area. Depending on the populations presently in those areas, the ecosystem dynamics could be altered, adding stress if food or shelter were limited. Prior to construction, the proposed site would be surveyed for nests of migratory birds in accordance with the Migratory Bird Treaty Act. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be drawn from groundwater sources (UC 1998a, 1998b, 1998c, 1998d).

Sensitive Habitat. Wetlands or critical habitat would not be affected because there are none in the construction zone. It is also unlikely that any federally listed threatened or endangered species would be affected because none have been sighted on or around the Central Plateau (DOE 1996e: 4-34). However, Washington State–classified special-status species associated with shrub-steppe habitat could be affected during land-clearing activities. Animal species include the burrowing owl, ferruginous hawk, golden eagle, long-billed curlew, sage thrasher, Swainson's hawk, pygmy rabbit, desert night snake, and striped whipsnake. It is doubtful that the loggerhead shrike and sage sparrow would be affected, because most of their habitat in the 400 Area has been destroyed by fire. Plant species (see Table 3–4) include crouching milkvetch, piper's daisy, squill onion, and stalked-pod milkvetch (DOE 1996e: 4-34; Dirkes and Hanf 1997:F.1–F.3; Mecca 1997:Poston memo to Teal). Preconstruction surveys and consultations with USFWS and the equivalent State agency would be conducted to ensure that impacts on sensitive species living in the vicinity of the 400 Area are negligible, and that appropriate mitigation actions are implemented as needed.

4.26.1.3.2 Operations

Nonsensitive Habitat. Activities associated with operation of the surplus plutonium disposition facilities could impact wildlife in the area due to noise and human presence. As a result, animal species could leave the area and take up residence in similar habitat nearby thus changing the ecosystem dynamics and adding stress to the habitat and its occupants. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters would be used (UC 1998a, 1998b, 1998c, 1998d). Aquatic resources should not be affected because groundwater would be used and liquid effluents would be sampled, treated, and disposed of in accordance with approved permits and procedures (UC 1998a, 1998b, 1998c, 1998d).

Sensitive Habitat. Operational impacts on wetlands or critical habitat would be unlikely because airborne and aqueous effluents would be controlled and permitted. It is also unlikely that any federally listed threatened or endangered species would be affected because none have been sighted on or around the Central Plateau (DOE 1996e: 4-34). However, Washington State–classified special-status species could be affected by noise or human activity during operations, as discussed for construction (DOE 1996e: 4-34; Dirkes and Hanf 1997:F.1–F.3; Mecca 1997a:Poston memo to Teal).

4.26.1.4 Cultural and Paleontological Resources

Prehistoric, historic, Native American, and paleontological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. The land area required for construction activities is fairly small, however, and any such resource disturbance would be minimized by confinement of the construction to previously disturbed or developed areas. Impacts of operations would be negligible because facility operations and security would restrict access to nearby prehistoric, historic, Native American, and paleontological resources. Continued compliance monitoring, before and after construction, would also help to limit or preclude impacts on these resources.

4.26.1.4.1 Construction

Siting all facilities at Hanford would disturb about 15 ha (37 acres) of land in the 400 Area. Some of this area (4.7 ha [12 acres]) would be used only temporarily as a laydown area during the 5-year construction and startup phases for the MOX facility, and some (2.1 ha [5.2 acres]), during the 3-year construction phase for the immobilization facility. The existing FMEF construction laydown area (2 ha [4.9 acres]) would be used for the pit conversion facility (UC 1998a, 1998b, 1998c, 1998d).

Cultural resource surveys have been conducted within the proposed construction areas in and adjacent to the 200 East and 400 Areas (DOE 1996a:3-49). No prehistoric archaeological resources have been identified within the proposed construction areas, and no historic resources in the 200 East or 400 Area. Accordingly, construction activities should not directly impact any prehistoric or historic resources. Preconstruction surveys (as required) and construction monitoring for previously unknown resources would be conducted within the framework of the *Hanford Cultural Resources Management Plan* (Battelle 1989).

Native American resources have not been identified within the construction areas in and adjacent to the 200 East and 400 Areas. For this reason, no direct impacts would be incurred. Thus far, no paleontological resources have been identified within the proposed construction areas; therefore, no direct impacts would be expected.

No indirect impacts on prehistoric, historic, Native American, or paleontological resources would occur under the proposed construction due to the lack of known resources in the vicinity. Consultations (see Chapter 5 for discussion) would be initiated with appropriate American Indian Tribal Governments on publication of this SPD EIS to address any concerns associated with the actions evaluated therein. Any potential for indirect visual impacts associated with potentially eligible historic structures in the 200 West Area would be assessed following completion of the ongoing evaluation by the Washington State Historic Preservation Officer consistent with the *Hanford Cultural Resources Management Plan* (Battelle 1989). Inadvertent discoveries of cultural resources will be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects).

4.26.1.4.2 Operations

Operation of the proposed surplus plutonium disposition facilities should have no direct impacts on cultural or paleontological resources. Once the facilities were operational, no direct land disturbance or other action with impact potential would be conducted beyond the facility's perimeter fence. Activities associated with operation of the proposed surplus plutonium disposition facilities should also have no indirect impacts on any known cultural or paleontological resources.

4.26.1.5 Land Use and Visual Resources

Land resources (land use and visual resources) could be affected by construction and operation of the proposed surplus plutonium disposition facilities. The land-use impact analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and land values, and other socioeconomic factors pertaining to land use. Land-use impacts would vary from site to site depending on existing facility land-use configurations, adjoining land uses, and other environmental and containment factors.

The visual resource impact analysis emphasized changes in the existing landscape character that could result from the proposed action. The visual resource assessment was based on the VRM methodology.

4.26.1.5.1 Construction

Use of the planned HLW vitrification facility and support facilities in the 200 East and 200 West Areas would be consistent with existing and future land uses as described in the *Hanford Site Development Plan* (DOE 1994). No changes in existing or future land uses at the 200 East Area would occur under Alternative 2.

Land area requirements at Hanford would include sufficient land for the modification of FMEF in the 400 Area to support operation of the pit conversion and immobilization facilities, and for construction of the MOX facility adjacent to FMEF (UC 1998a, 1998b, 1998c, 1998d). Table 4–217 provides an estimate of the total footprint area required, in terms of newly disturbed land, for construction and operation of the proposed surplus plutonium disposition facilities. The land required for the construction of facilities at Hanford under Alternative 2 would be about 15 ha (37 acres). This includes approximately 6.5 ha (16 acres) of new building footprints, new parking lots, and security areas that would remain in use throughout operations.

Table 4–217. Maximum New Facility and Construction Area Requirements at Hanford

Land Requirement	Pit Conversion (Existing)	Immobilization (Existing)	MOX (New)
Construction area[a] (ha)	2	2.1	4.7
New operational area (ha)	0.5	0	6

[a] For uses such as construction laydown, construction worker parking, and waste storage.
Source: UC 1998a, 1998b, 1998c, 1998d.

The remaining 8.8 ha (22 acres) would be needed temporarily during construction for laydown, temporary storage, and parking. Construction areas would not be used after the facilities became operational. A number of these construction areas exist within the FMEF area but are currently inactive. Land area requirements for Alternative 2 would not be major, and no long-term or permanent loss of land would result from construction and operation of the proposed surplus plutonium disposition facilities at Hanford.

4.26.1.5.2 Operations

The pit conversion and immobilization facilities would be in FMEF in the 400 Area (UC 1998a, 1998b, 1998c). Operation of these facilities in FMEF would conform to existing and future land uses as described in the *Hanford Site Development Plan* (DOE 1994). The 400 Area land is designated for reactor operations, which can include other operational uses such as pit disassembly, conversion, and immobilization. The MOX facility would be operated adjacent to FMEF in the 400 Area and would likewise conform to existing and future land uses as described in the *Hanford Site Development Plan* (DOE 1994; UC 1998d). Other Hanford land uses or special-status lands would not be affected by facility operations. There would also be no impact on Native American Treaty land-use rights from any of the Hanford alternatives.

The appearance of the modified FMEF and new facilities adjacent to FMEF would remain consistent with the industrialized landscape character and current Visual Resource Management (VRM) Class 5 designation of the 400 Area. In height and size, the proposed facilities would be similar to existing buildings in the 400 Area (UC 1998a, 1998b, 1998c, 1998d). Construction and operation of the surplus plutonium disposition facilities would not effect a change in any natural features of visual interest in the area. The nearest sensitive viewpoint is Gable Mountain, which is 4.5 km (2.8 mi) away.

4.26.1.6 Infrastructure

4.26.1.6.1 Construction

Existing Hanford infrastructure would be capable of supporting the construction requirements for the proposed surplus plutonium disposition facilities included in Alternative 2. As shown in Table 4–218, construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Only 1.1 km (0.68 mi) of road would be required for construction deliveries and access to new and temporary facilities (UC 1998a, 1998d); this would not have a major impact. The total requirement for fuel oil during construction might be higher than currently available storage, but the majority of fuel oil usage would be associated with construction vehicle usage; therefore, storage would not be limiting. Table 4–218 reflects estimates of the additional annual infrastructure requirements for construction of the proposed surplus plutonium disposition facilities. Site resource availability and possible additional resource requirements are also presented.

Table 4–218. Maximum Annual Additional Site Infrastructure Requirements for Construction in 400 Area at Hanford

	Facility Requirement					Additional
Resource	**Pit Conversion**	**Immobilization**	**MOX**	**Total**	**Availability[a]**	**Requirement**
Transportation						
Roads (km)	0.1	0	1.0	1.1	420	1.1
Railroads (km)	0	0	0	0	204	0
Electricity						
Energy consumption (MWh/yr)	1,700	14,000	750	16,450	53,700	0
Peak load (MW)	1.0	2.6	1.0	4.6	22.5	0
Fuel						
Natural gas (m^3/yr)	NA	NA	NA	NA	NA	0
Oil (l/yr)	85,000	57,000	228,000	370,000	NA[b]	0
Coal (t/yr)	NA	NA	NA	NA	NA[b]	0
Water (l/yr)	2,000,000	45,000,000	16,000,000	63,000,000	356,260,000	0

[a] Capacity minus current usage, a calculation based on data provided in Section 3.3.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: UC 1998a, 1998b, 1998c, 1998d.

4.26.1.6.2 Operations

Except for electricity, resources needed for operations under Alternative 2 are well within Hanford's capacity. The estimated total operational requirement for electricity is 63,700 MWh/yr, and availability to FMEF is 53,700 MWh/yr; hence, it appears that an additional 10,000 MWh/yr would be required. Additional electric power is already available in the 400 Area and could be easily supplied to a new building near FMEF (Sandberg 1998). The total fuel oil requirement for emergency generator testing during operations might also be higher than current site storage, but shortfalls could be met through additional procurements by normal contractual means. Table 4–219 reflects estimates of the additional annual resources required for operation of the proposed surplus plutonium disposition facilities. Available site resources and possible additional operational requirements are also presented.

Table 4–219. Maximum Annual Additional Site Infrastructure Requirements for Operations in 400 Area at Hanford

Resource	Facility Requirement: Pit Conversion	Immobilization[a]	MOX	Total	Availability[b]	Additional Requirement
Transportation						
Roads (km)	0	0	0	0	420	0
Railroads (km)	0	0	0	0	204	0
Electricity						
Energy consumption (MWh/yr)	28,000	11,500	24,200	63,700	53,700	10,000
Peak load (MW)	6.8	2.6	11.2	20.6	22.5	0
Fuel						
Natural gas (m^3/yr)	NA	NA	19,330	19,330	NA	0
Oil (l/yr)	38,000	25,000	24,000	87,000	NA[c]	0
Coal (t/yr)	NA	NA	NA	NA	NA[c]	0
Water (l/yr)	47,000,000	42,000,000	43,000,000	132,000,000	356,260,000	0

[a] Data reflect the higher of the requirements for ceramic and glass.
[b] Capacity minus current usage, a calculation based on data provided in Section 3.2.11.2.
[c] Not applicable due to coal no longer being used at Hanford.
Key: NA, not applicable.
Source: UC 1998a, 1998b, 1998c, 1998d.

4.26.2 INEEL

For INEEL, the maximum impacts on environmental resources would be experienced if Alternative 7A, 7B, or 8 were implemented. Under these alternatives, the pit conversion and MOX facilities would be located at INEEL. These alternatives would require the maximum ground disturbance at INEEL, thereby maximizing the potential impacts on related resources such as geology and soils, ecological, and cultural. These alternatives would also require the most water and place the maximum strain on infrastructure at the site. None of the other alternatives evaluated in this SPD EIS include facilities being built at INEEL.

4.26.2.1 Geology and Soils

4.26.2.1.1 Construction

Construction of the pit conversion facility in FPF and the MOX facility in a new building at INEEL would have negligible impacts on the geologic and soils resources. In the *Storage and Disposition Final PEIS*, hazards of the large-scale geologic conditions at INEEL were analyzed in detail. The analysis determined that these conditions pose an acceptable risk to the proposed long-term storage facilities. That decision is not revisited in this SPD EIS. More detailed descriptions of impacts of the potential geologic hazards at INEEL are included in the *Storage and Disposition Final PEIS* (DOE 1996a: 4-148–4-150).

The soils at INEEL are considered acceptable for standard construction techniques. Within INEEL, economically viable sand, gravel, and pumice resources have been identified. New construction could increase the use of sand and gravel; however, large volumes of these materials are present, and the impact should be negligible. No soils at INEEL are currently classified as prime farmland.

4.26.2.1.2 Operations

Operation of the pit conversion facility in FPF and the MOX facility in a new building at INEEL would have no impact on the geologic or soils resources.

4.26.2.2 Water Resources

4.26.2.2.1 Construction

There would be no withdrawals of surface water for the proposed construction of the pit conversion and MOX facilities at INEEL (UC 1998l, 1998m). Thus, there would be no impact on the water availability to any downstream users. All wastewater during construction would be treated in approved facilities designed to meet NPDES permit limitations and be discharged to evaporation and percolation ponds, or would be available for recycling. In either case, no impact on surface water quality would be expected from construction activities.

It is estimated that proposed construction activities would use a maximum of about 20 million l/yr (5.3 million gal/yr) of water. The maximum estimated groundwater usage for construction of these facilities, when added to current usage at INTEC, would represent about 29 percent of the INTEC groundwater capacity. This withdrawal volume would have no impact on groundwater availability to other users in the area. There would be no impacts on groundwater availability, and the withdrawals would be within DOE's groundwater allotment. All wastewater flows would be treated in evaporation and percolation ponds, or would be available for recycling. The *Storage and Disposition Final PEIS* concluded there would be no impacts on groundwater quality from these activities, and no new data have been developed to require that this conclusion be revised (DOE 1996a: 4-686).

The potential site is not an area historically prone to flooding, but it could be in the floodplain if the Mackay Dam failed. The *Storage and Disposition Final PEIS* concluded that this flood would exceed either the 100- or 500-year floods. This dam failure would produce the probable maximum flood. The PEIS concluded the facility would be designed to withstand such flooding (DOE 1996a:3-115, 4-686). Therefore, the facility should neither affect nor be affected by flooding. Established construction techniques would be used to control soil erosion during construction. No long-term impacts would be expected from soil erosion during construction of this facility.

Proven construction techniques would be used to minimize soil erosion impacts during construction. Due to the success of these techniques, there would be no long-term impact on water quality due to soil erosion from the construction of this facility.

4.26.2.2.2 Operations

Surface water would not be used for operation of the proposed pit conversion or MOX facilities at INEEL, and there would be no impact on the availability of surface water to downstream users (UC 1998l, 1998m). All process and sanitary wastewater would be discharged to evaporation and percolation ponds with no surface discharge, or would be treated in approved facilities designed to meet NPDES permit limitations (Abbott, Crockett, and Moor 1997:9). Therefore, no impact on surface water quality would be expected from these activities.

Current estimates of the water that would be needed during operation of the pit conversion and MOX facilities at INEEL are much lower than was assumed in the *Storage and Disposition Final PEIS*. The maximum estimated annual water usage for these facilities at INEEL is 92 million l (24.3 million gal) (UC 1998l, 1998m). This represents about 60 percent of the INTEC groundwater capacity when added to current usage.

This reduced usage estimate would not change the analysis or conclusions of the *Storage and Disposition Final PEIS*. Because it was determined that there was no impact on water availability at the higher rate, there would be no impact at this lower usage rate (DOE 1996a: 4-685).

As stated in the construction section above, there would be no direct discharge of wastewater to the groundwater aquifer, and no impact on groundwater quality would be expected from these activities. This finding is consistent with the conclusions of the *Storage and Disposition Final PEIS* (DOE 1996a: 4-685).

4.26.2.3 Ecological Resources

Ecological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. However, habitat disturbance would be minimal; the land area required for construction activities is small in relation to regionally available habitat, and construction would take place in previously disturbed or developed areas. Operational impacts would also be minimal because facility emissions to the environment would be processed in accordance with applicable permitting procedures. Therefore, impacts on nonsensitive and sensitive habitats, plant and animal species, and the overall biodiversity of the candidate site would be minimal.

4.26.2.3.1 Construction

Nonsensitive Habitat. Siting the pit conversion facility and MOX facilities at INEEL would disturb 13 ha (32 acres) of land inside the INTEC-protected area adjacent to FPF. Some of this land (4.7 ha [12 acres]) would be used temporarily during the 5-year construction and startup phases for the MOX facility (UC 1998m). Although an additional 2 ha (4.9 acres) of land would be required for construction of the pit conversion facility, this land was disturbed during construction of FPF (UC 1998l). Animal species that are adapted to disturbed industrial areas, such as small mammals (e.g., mice, rabbits, ground squirrels), birds (e.g., sparrows, finches), and reptiles (e.g., lizards) would be affected. Some of the less-mobile species within the construction zone could perish during land-clearing activities and from increased vehicular traffic. Furthermore, activities and noise associated with construction could cause larger mammals and birds to relocate to similar habitat in the area. Depending on the populations presently in those areas, the ecosystem dynamics could be altered, adding stress if food or shelter were limited. Prior to construction, the proposed site would be surveyed for nests of migratory birds in accordance with the Migratory Bird Treaty Act. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be drawn from groundwater sources (Abbott, Crockett, and Moor 1997:15; DOE 1996a: 4-693; UC 1998l, 1998m).

Sensitive Habitat. Construction would have no impact on wetlands or critical habitat because there are none on the proposed site. It is also unlikely that any threatened, endangered, or other special status species at INEEL would be affected because none have been sighted within the immediate environs of FPF (Abbott, Crockett, and Moor 1997:15; Werner 1997:WAG3 Report Summary). In the surrounding INTEC area, however, there could be peregrine falcon, bald eagle, ferruginous hawk, black tern, burrowing owl, white-faced ibis, loggerhead shrike, northern goshawk, trumpeter swan, pygmy rabbit, Townsend's western big-eared bat, long-eared and small-footed myotis, and northern sagebrush lizard. Preconstruction surveys and consultations with the U.S. Fish and Wildlife Service (USFWS) and the equivalent State agency would be conducted to ensure that impacts on sensitive species living in the vicinity of FPF are negligible, and that appropriate mitigation actions are implemented as needed.

4.26.2.3.2 Operations

Nonsensitive Habitat. Activities associated with operation of the surplus plutonium disposition facilities could impact wildlife in the area due to noise and human presence. As a result, animal species could leave the area and take up residence in similar habitat nearby, thus changing the ecosystem dynamics and adding stress to the habitat and its occupants. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters would be used (UC 1998l, 1998m). Aquatic resources should not be affected because groundwater would be used and liquid effluents would be sampled, treated, and disposed of in accordance with approved permits and procedures (UC 1998l, 1998m).

Sensitive Habitat. Operational impacts on wetlands or other sensitive habitats would be unlikely because airborne and aqueous effluents would be controlled and permitted. It is also unlikely that any federally listed, threatened, or endangered species would be affected, although Idaho State–classified special-status species could be affected by noise or human activity during operations, as discussed for construction.

4.26.2.4 Cultural and Paleontological Resources

Prehistoric, historic, Native American, and paleontological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. The land area required for construction activities is fairly small, however, and any such resource disturbance would be minimized by confinement of the construction to previously disturbed or developed areas. Impacts of operations would be negligible because facility operations and security would not restrict access to nearby prehistoric, historic, Native American, and paleontological resources. Continued compliance monitoring, before and after construction, would also help to limit or preclude impacts on these resources.

4.26.2.4.1 Construction

Siting the pit conversion and MOX facilities at INEEL would disturb about 13 ha (32 acres) of land inside the INTEC protected area adjacent to FPF. Some of this land (4.7 ha [12 acres]) would be used temporarily during the 5-year construction and startup phases for the MOX facility (UC 1998m). Although an additional 2 ha (4.9 acres) of land would be required for construction of the pit conversion facility, this land was previously disturbed during construction of FPF (UC 1998l).

Archaeological surveys have identified six prehistoric resources within the vicinity of the proposed construction area, but none are potentially eligible for nomination to the National Register. The surveys also identified two historic resources, a homestead and nearby trash dump, that may be eligible for nomination. Also, a historic building survey being conducted within INTEC is likely to identify structures potentially eligible for nomination to the National Register on the basis of relevance to the Cold War Era (Abbott, Crockett, and Moor 1997:16). Direct impacts of the proposed construction would be unlikely; however, consistent with the *INEL Management Plan for Cultural Resources*, surveys and monitoring would be conducted to ensure against impacts on National Register–eligible resources (Miller 1995).

Specific Native American resources have not been identified within the proposed construction area; however, resources important to the Shoshone and Bannock Tribes may be present in the vicinity. Direct consultations with the tribes would be conducted, consistent with a working agreement with DOE and the tribes, to ensure that there are no direct construction-related impacts (Abbott, Crockett, and Moor 1997:16). Paleontological resources are well documented within INEEL. No known resources have been reported within the proposed construction area; however, monitoring of construction excavations would be performed to ensure that no significant paleontological resources, if discovered, would be affected.

Indirect construction impacts on prehistoric, historic, or paleontological resources would be unlikely. There is, however, a potential for impacts on nearby Native American cultural resources. To avoid such impacts, consultations with the Shoshone and Bannock Tribes would be conducted prior to and during construction. Inadvertent discoveries of cultural resources will be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects).

4.26.2.4.2 Operations

The proposed surplus plutonium disposition facilities should have no direct impacts on prehistoric, historic, or paleontological resources. However, operations-related noise and traffic could directly affect nearby Native American cultural resources (if identified in preconstruction consultations). To avoid such impacts, consultations with the Shoshone and Bannock Tribes would be conducted prior to operations.

There should also be no indirect impacts of operations on prehistoric, historic, or paleontological resources. However, any Native American resources in the vicinity of the proposed facility locations could experience indirect impacts such as access restrictions. Consultations with the Shoshone and Bannock Tribes would be conducted to avoid impacts of this nature.

4.26.2.5 Land Use and Visual Resources

Land resources (land use and visual resources) could be affected by construction and operation of the proposed surplus plutonium disposition facilities. The land-use impact analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and land values, and other socioeconomic factors pertaining to land use. Land-use impacts would vary from site to site depending on existing facility land-use configurations, adjoining land uses, and other environmental and containment factors. The visual resource impact analysis emphasized changes in the existing landscape character that could result from the proposed action. The visual resource assessment was based on the VRM methodology.

4.26.2.5.1 Construction

Land area requirements at INEEL under Alternatives 7A, 7B, or 8 would include sufficient land for the modification of FPF to house the pit conversion facility and for construction of the MOX facility adjacent to FPF at INTEC (UC 1998l, 1998m). Table 4–220 provides an estimate of the total footprint area required, in terms of newly disturbed land, for construction and operation of the proposed surplus plutonium disposition facilities. The land required for the construction of facilities at INTEC for any of the INEEL alternatives would be about 13 ha (32 acres). This includes approximately 6.5 ha (16 acres) of new building footprints, new parking lots, and security areas that would remain in use throughout operations.

Table 4–220. Maximum New Facility and Construction Area Requirements at INEEL

Land Requirement	Pit Conversion (Existing)	MOX (New)
Construction area[a] (ha)	2	4.7
New operational area (ha)	0.5	6

[a] For uses such as construction laydown, construction worker parking, and waste storage.
Source: UC 1998l, 1998m.

The remaining 6.7 ha (17 acres) would be needed temporarily during construction for laydown, temporary storage, and parking. Construction areas would not be used after the facilities became operational. A number of these construction areas exist at INTEC. Land area requirements for Alternatives 7A, 7B, or 8 would not be major, and no permanent loss of land would result from construction and operation of the proposed surplus plutonium disposition facilities at INEEL.

4.26.2.5.2 Operations

The pit conversion facility activities would be in FPF, which is within the INTEC area (UC 1998l). FPF is an existing, structurally complete building that has not been used. Most of the support buildings required for operation of the pit conversion facility exist in INTEC. The MOX facility would be constructed within the existing INTEC area (UC 1998m). Operation of the pit conversion and MOX facilities would conform to existing and future land uses as described in the *INEEL Comprehensive Facilities and Land Use Plan* (DOE 1997f). Land within INTEC is currently disturbed and designated for waste-processing operations. Other INEEL land uses or special-status lands at INEEL would not be affected by facility operations. There would be no impact on Native American Treaty land-use rights from any of the proposed INEEL alternatives.

The appearance of the modified FPF and new facilities that may be required at INTEC would remain consistent with its industrialized landscape character and current VRM Class 4 designation. In height and size, the proposed facilities would be similar to existing buildings at INTEC (UC 1998l, 1998m). Construction and operation of the facilities would not effect a change in any natural features of visual interest in the area. The nearest sensitive viewpoint is Big Southern Butte National Natural Landmark, 20 km (12 mi) south of INTEC.

4.26.2.6 Infrastructure

4.26.2.6.1 Construction

Existing INEEL infrastructure would be capable of supporting the construction requirements for the proposed surplus plutonium disposition facilities included under Alternative 7A, 7B, or 8. Construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Only 2.3 km (1.4 mi) of road would be required for construction deliveries and access to new and temporary facilities (UC 1998l, 1998m); this would not have a major impact. The total requirement for fuel oil during construction might be higher than currently available storage, but the majority of fuel oil usage would be associated with construction vehicle usage; therefore, storage would not be limiting. Table 4–221 reflects estimates of additional annual infrastructure requirements for construction of the proposed surplus plutonium disposition facilities. Site resource availability and possible additional resource requirements are also presented.

4.26.2.6.2 Operations

Resources needed for operations under Alternative 7A, 7B, or 8 are well within INEEL capacity. The total fuel oil requirement for emergency generator testing during operations might be higher than current site storage, but shortfalls could be met through additional procurements by normal contractual means. Table 4–222 reflects estimates of additional annual resources required for operations of the proposed surplus plutonium disposition facilities. Available site resources and possible additional operational requirements are also presented.

4.26.3 Pantex

For Pantex, the maximum impacts on environmental resources would be experienced if Alternative 9A, 9B, or 10 were implemented. Under these alternatives, the pit conversion and MOX facilities would be located at Pantex. These alternatives would require the maximum ground disturbance at Pantex, thereby maximizing

Table 4–221. Maximum Annual Additional Site Infrastructure Requirements for Construction in INTEC at INEEL

Resource	Facility Requirement: Pit Conversion	MOX	Total	Availability[a]	Additional Requirement
Transportation					
Roads (km)	1.3	1.0	2.3	445	2.3
Railroads (km)	0	0	0	48	0
Electricity					
Energy consumption (MWh/yr)	1,700	750	2,450	202,800	0
Peak load (MW)	1.0	1.0	2.0	22.2	0
Fuel					
Natural gas (m^3/yr)	NA	NA	NA	NA	0
Oil (l/yr)	110,000	228,000	338,000	NA[b]	0
Coal (t/yr)	NA	NA	NA	NA[b]	0
Water (l/yr)	4,000,000	16,000,000	20,000,000	181,680,000	0

[a] Capacity minus current usage, a calculation based on data provided in Section 3.3.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: INTEC, Idaho Nuclear Technology and Engineering Center; NA, not applicable.
Source: UC 1998l, 1998m.

Table 4–222. Maximum Annual Additional Site Infrastructure Requirements for Operations in INTEC at INEEL

Resource	Facility Requirement: Pit Conversion	MOX	Total	Availability[a]	Additional Requirement
Transportation					
Roads (km)	0	0	0	445	0
Railroads (km)	0	0	0	48	0
Electricity					
Energy consumption (MWh/yr)	15,000	12,000	27,000	202,800	0
Peak load (MW)	3.9	2.1	6.0	22.2	0
Fuel					
Natural gas(m^3/yr)	NA	NA	NA	NA	0
Oil (l/yr)	38,000	NA	38,000	NA[b]	0
Coal (t/yr)	2,100	1,594	3,694	NA[b]	0
Water (l/yr)	49,000,000	43,000,000	92,000,000	181,680,000	0

[a] Capacity minus current usage, a calculation based on data provided in Section 3.3.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: INTEC, Idaho Nuclear Technology and Engineering Center; NA, not applicable.
Source: UC 1998l, 1998m.

the potential impacts on related resources such as geology and soils, ecological, and cultural. These alternatives would also require the most water and place the maximum strain on infrastructure at the site. All the other Pantex alternatives evaluated in this SPD EIS would require less ground disturbance, so none would result in greater impacts than those associated with Alternative 9A, 9B, or 10.

Next Section

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4.26.3.1 Geology and Soils

4.26.3.1.1 Construction

Construction of the pit conversion and the MOX facilities at Pantex would have no impact on the geologic and soils resources. In the *Storage and Disposition Final PEIS*, hazards of the large-scale geologic conditions at Pantex were analyzed in detail. The analysis determined that these conditions pose an acceptable risk to the proposed long-term storage facilities. That decision is not revisited in this SPD EIS. More detailed descriptions of impacts of the potential geologic hazards at Pantex are included in the *Storage and Disposition Final PEIS* (DOE 1996a: 4-204–4-206).

The soils at Pantex are considered acceptable for standard construction techniques. No economically viable geologic resources have been identified at Pantex. Pantex is underlain by soils of the Pullman-Randall association. The Pullman soil is classified as prime farmland. Pantex is exempt from the Farmland Protection Policy Act (FPPA) under Section 1540(c)(4) (7 U.S.C. Section 4201) because the acquisition of Pantex property occurred prior to the effective date of the act, June 22, 1982 (DOE 1996a:3-148).

4.26.3.1.2 Operations

Operation of the pit conversion and MOX facilities at Pantex would have no impact on the geologic and soils resources.

4.26.3.2 Water Resources

4.26.3.2.1 Construction

Surface water would not be used for the construction of the proposed pit conversion or MOX facilities at Pantex (UC 1998k, 1998n). Thus, there would be no impact on water availability for downstream users. The *Storage and Disposition Final PEIS* determined that wastewater would be discharged to the Zone 12 wastewater treatment plant, with discharge to the playa lakes, or be available for recycling, and that there would be no impact from these discharges (DOE 1996a: 4-397). No new data have been developed to require revision of these findings. As a result, no water quality impacts are expected.

The *Storage and Disposition Final PEIS* concluded that Pantex would neither affect nor be affected by flooding. For further information on this, consult the *Storage and Disposition Final PEIS* (DOE 1996a:3-498).

According to estimates, during construction the pit conversion and MOX facilities would use a maximum of about 28 million l/yr (7.4 million gal/yr) of water (UC 1998k, 1998n). When added to current usage on the site, this represents about 23 percent of the groundwater capacity. Pantex water use has decreased during the period from 1991 to 1995 by 231 million l (61 million gal) (M&H 1996:4-33, 9-8). The 28 million l/yr (7.4 million gal/yr) of water estimated to be used for construction of the pit conversion and MOX facilities would not increase water use above 1991 levels. The additional water use would be 0.1 percent of the 23.6 billion l (6.2 billion gal) of water pumped from the Carson County well fields by the city of Amarillo in 1995, and 0.03 percent of the 101 billion l (27 billion gal) of water applied for irrigation in Carson County in 1995. The amount of water required is relatively small in comparison with the available water resources, so there would be no impacts on groundwater capacity.

Although the expected drawdowns caused by withdrawing water required for this alternative are small, the overall decline in the groundwater level in the Ogallala aquifer near Amarillo is of concern. To mitigate some of the effects from pumping groundwater from the Ogallala aquifer, the city of Amarillo could supply treated wastewater from the Hollywood Road Wastewater Treatment Plant for nonpotable uses at Pantex.

The *Storage and Disposition Final PEIS* concluded that the facility would not have any impact on groundwater quality (DOE 1996a:4-686, 4-687). There are no new data available to indicate that this conclusion should be revisited. Therefore, no impact on groundwater quality would be expected.

4.26.3.2.2 Operations

There would be no impacts to the surface water resources from the proposed operation of the pit conversion and MOX fuel facilities at Pantex because surface water would not be used for the operation of these facilities (UC 1998k, 1998n). The impact on surface water would be similar to that expected from the construction activities described above. No impacts on water availability or quality would be expected.

Current estimates indicate the pit conversion and MOX facilities would require a maximum of about 91 million l (24 million gal) per year (UC 1998k, 1998n). Pantex water use has decreased during the period from 1991 to 1995 by 231 million l (61 million gal) (M&H 1996:4-33, 9-8). The 91 million l/yr (24 million gal/yr) of water estimated to be used by the pit conversion and MOX facilities would not increase water use above 1991 levels. The additional water use would be 0.4 percent of the 23.6 billion l (6.2 billion gal) of water pumped from the Carson County well fields by the city of Amarillo in 1995, and 0.09 percent of the 101 billion l (27 billion gal) of water applied for irrigation in Carson County in 1995. The amount of water required is relatively small in comparison with the available water resources, so there would be no impacts on groundwater capacity.

Although the expected drawdowns caused by withdrawing water required for this alternative are small, the overall decline in the groundwater level in the Ogallala aquifer near Amarillo is of concern. To mitigate some of the effects from pumping groundwater from the Ogallala aquifer, the city of Amarillo could supply treated wastewater from the Hollywood Road Wastewater Treatment Plant for nonpotable uses at Pantex.

The *Storage and Disposition Final PEIS* concluded that the facility would not have any impact on groundwater quality (DOE 1996a:4-686, 4-687). There are no new data available to indicate that this conclusion should be revisited. Therefore, no impact on groundwater quality would be expected.

4.26.3.3 Ecological Resources

Ecological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. However, habitat disturbance would be minimal; the land area required for construction activities is small in relation to regionally available habitat, and construction would take place in previously disturbed or developed areas. Operational impacts would also be minimal because facility emissions to the environment would be processed in accordance with applicable permitting procedures. Therefore, impacts on nonsensitive and sensitive habitats, plant and animal species, and the overall biodiversity of the candidate site would be minimal.

4.26.3.3.1 Construction

Nonsensitive Habitat. Siting the pit conversion and MOX facilities in new buildings in Zone 4 at Pantex would disturb about 16 ha (39 acres). Some of this land (4.7 ha [12 acres]) would be used only temporarily during the 5-year construction and startup phases for the MOX facility (UC 1998n). Previously disturbed areas in Zone 4 would be used for construction laydown for the pit conversion facility (2 ha [4.9 acres]) (UC 1998k). Zone 4 at Pantex contains sufficient land area to accommodate the new building footprints. Thus, there should be no direct impacts on nonsensitive terrestrial or aquatic habitats. Animal species inhabiting areas surrounding Zone 4 could be affected by the increased noise associated with construction activities, and the additional vehicular traffic could result in higher mortality for individual members of local animal populations. Prior to construction, the proposed sites would be surveyed for nests of migratory birds in accordance with the Migratory Bird Treaty Act. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be drawn from groundwater sources (UC 1998k, 1998n).

Sensitive Habitat. Although portions of Playas 1, 2, and 3 are within 1.6 km (1 mi) of the proposed pit conversion and MOX facilities, no wetlands should be directly affected by construction actions, which would be limited to developed areas of Zone 4 at Pantex. No critical habitat for any threatened or endangered species exists at Pantex; however, three special-status species (ferruginous hawk, western burrowing owl, and Texas horned lizard) might be found within the area surrounding Zone 4 (M&H 1997:22). Preconstruction surveys and consultations with USFWS and the equivalent State agency would be conducted to ensure that impacts on sensitive species living in the vicinity of Zone 4 are negligible, and that appropriate mitigation actions are implemented as needed.

4.26.3.3.2 Operations

Nonsensitive Habitat. Noise disturbance would probably be the most significant impact of routine operation of the proposed facilities on local wildlife populations. Disturbed individual members of local populations could migrate to adjacent areas of similar habitat. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters would be used (UC 1998k, 1998n). Impacts on aquatic habitats should be limited because all liquid, nonhazardous sanitary wastes would be sampled, treated, and disposed of in accordance with approved permits and procedures (UC 1998k, 1998n).

Sensitive Habitat. Operational impacts on wetlands or other sensitive habitats would be unlikely because airborne and aqueous effluents would be controlled and permitted. It is also unlikely that any federally listed threatened or endangered species would be affected, although Texas State–classified special status-species could be affected by noise or human activity during operations, as discussed for construction.

4.26.3.4 Cultural and Paleontological Resources

Prehistoric, historic, Native American, and paleontological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. The land area required for construction activities is fairly small, however, and any such resource disturbance would be minimized by confinement of much of the construction to previously disturbed or developed areas. Impacts of operations would be negligible because facility operations and security would restrict access to nearby prehistoric, historic, Native American, and paleontological resources. Continued compliance monitoring, before and after construction, would also help to limit or preclude impacts on these resources.

4.26.3.4.1 Construction

Siting the pit conversion and MOX facilities in new buildings in Zone 4 at Pantex would disturb about 16 ha (39 acres). Some of this area would be used only temporarily during the 5-year construction and startup phases for the MOX facility (4.7 ha [12 acres]) (UC 1998n). Previously disturbed areas in Zone 4 would be used for construction laydown for the pit conversion facility (2 ha [4.9 acres]) (UC 1998k). Zone 4 at Pantex contains enough land area to accommodate the new buildings.

Surveys for prehistoric and historic archaeological resources have covered about 50 percent of the Pantex land area. As a consequence, two sites have been determined eligible for nomination to the National Register by the Texas State Historic Preservation Officer and the Advisory Council on Historic Preservation. Neither is in the vicinity of the proposed construction area. Further, the Texas State Historic Preservation Officer and the Advisory Council have determined that additional surveys are not required at Pantex (M&H 1997:26-27). Thus, there should be no impact on archaeological resources associated with the proposed construction.

Historic building surveys and recordings have been completed for World War II Era facilities remaining at Pantex and similar surveys are under way for the Cold War Era. Under the terms of a programmatic agreement among DOE, the Texas State Historic Preservation Officer, and the Advisory Council, all potential impacts on modifications of Pantex structures having historic potential require internal review and mitigation by DOE. No direct impacts on historic structures would result from the proposed construction (DOE 1996b, M&H 1997:27).

No known Native American resources have been, or are likely to be, identified at Pantex. Consultations (see Chapter 5 for discussion) would be initiated with appropriate American Indian Tribal Government on publication of this SPD EIS to address any concerns associated with the actions evaluated therein. No Native American resources should be directly impacted by the proposed construction (M&H 1997:27). No paleontological resources have been identified in Zone 4; thus, there should also be no direct impacts on such resources.

Given the absence of significant cultural or paleontological resources in the construction area and its environs, there should be no indirect impacts associated with the proposed construction. Inadvertent discoveries of cultural resources will be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects).

4.26.3.4.2 Operations

Given to the absence of significant cultural or paleontological resources in the vicinity of the proposed surplus plutonium disposition facilities, there should be no direct or indirect impacts of plutonium disposition facility operations.

4.26.3.5 Land Use and Visual Resources

Land resources (land use and visual resources) could be affected by construction and operation of the proposed surplus plutonium disposition facilities. The land-use impact analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and land values, and other socioeconomic factors pertaining to land use. Land-use impacts would vary from site to site depending on existing facility land-use configurations, adjoining land uses, and other environmental and containment factors. The visual resource impact analysis emphasized changes in the existing landscape character that could result from the proposed action. The visual resource assessment was based on the VRM methodology.

4.26.3.5.1 Construction

Land area requirements at Pantex under Alternative 9A, 9B, or 10 would include sufficient land for the construction of the pit conversion and MOX facilities in Zone 4 (UC 1998k, 1998n). Table 4–223 provides an estimate of the total footprint area required, in terms of newly disturbed land, for construction and operation of the proposed surplus plutonium disposition facilities. The land required for the construction of facilities

Table 4–223. Maximum New Facility and Construction Area Requirements at Pantex

Land Requirement	Pit Conversion (New)	MOX (New)
Construction area[a] (ha)	2	4.7
New operational area (ha)	2.9	6

[a] For uses such as construction laydown, construction worker parking, and waste storage.
Source: UC 1998k, 1998n.

in Zone 4 for any of the Pantex alternatives would be about 16 ha (39 acres). This includes 8.9 ha (22 acres) of new building footprints, new parking lots, and security areas that would remain in use throughout operations.

The remaining 6.7 ha (17 acres) would be needed temporarily during construction for laydown, temporary storage, and parking. Construction areas would not be used after the facilities became operational. Land area requirements for Alternative 9A, 9B, or 10 would not be major, and no permanent loss of land would result from construction and operation of the surplus plutonium disposition facilities at Pantex.

4.26.3.5.2 Operations

The pit conversion and MOX facilities would be new buildings in Zone 4 at Pantex. Land within Zone 4 is currently disturbed and designated as industrial to support existing pit disassembly operations. Operation of the pit conversion and MOX facilities would conform to existing and future land uses as described in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996b:4-24, 4-25). About 0.4 km (0.2 mi) to the east of Zone 4 is the Playa 1 Management Unit. Neither this protected land management area nor any other special-status lands at Pantex would be affected by facility operations. There would also be no impact on Native American Treaty land-use rights from any of the Pantex alternatives.

The appearance of the new facilities within Zone 4 would remain consistent with the zone's industrialized landscape character and VRM Class 5 designation. In height and size, the proposed facilities would be similar to buildings in other industrialized areas of the site (UC 1998k, 1998n). Construction and operation of the facilities would not effect a significant change in any natural features of visual interest in the area. The nearest sensitive viewpoint is the intersection of U.S. Route 60 and FM Road 2373, 2.4 km (1.5 mi) away.

4.26.3.6 Infrastructure

4.26.3.6.1 Construction

Existing Pantex infrastructure would be capable of supporting the construction requirements for the proposed surplus plutonium disposition facilities under Alternative 9A, 9B, or 10. Construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Only 4.1 km (2.6 mi) of road would be required for construction deliveries and access to new and temporary facilities; this would not have a major impact. The total requirement for fuel oil during construction might be higher than current available storage, but the majority of fuel oil usage would be connected to construction vehicle usage; therefore, storage would not be limiting. Table 4–224 reflects estimates of additional annual infrastructure requirements for construction of the proposed surplus plutonium disposition facilities. Site resource availability and possible additional resource requirements are also presented.

Table 4–224. Maximum Annual Additional Site Infrastructure Requirements for Construction in Zone 4 at Pantex

Resource	Facility Requirement: Pit Conversion	Facility Requirement: MOX	Facility Requirement: Total	Availability[a]	Additional Requirement
Transportation					
Roads (km)	3.1	1.0	4.1	76	4.1
Railroads (km)	0	0	0	27	0
Electricity					
Energy consumption (MWh/yr)	1,700	750	2,450	338,634	0
Peak load (MW)	1.0	1.0	2.0	110.4	0
Fuel					
Natural gas (m^3/yr)	NA	NA	NA	235,181,309	0
Oil (l/yr)	330,000	228,000	558,000	NA[b]	0
Coal (t/yr)	NA	NA	NA	NA[b]	0
Water (l/yr)	12,000,000	16,000,000	28,000,000	2,933,000,000	0

[a] Capacity minus current usage, a calculation based on data provided in Section 3.4.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: UC 1998k, 1998n.

4.26.3.6.2 Operations

Resources needed for operations under Alternative 9A, 9B, or 10 are well within Pantex capacity. The total fuel oil requirement for emergency generator testing during operations might be higher than current site storage, but shortfalls could be met through additional procurements by normal contractual means. Table 4–225 reflects estimates of additional annual resources required for operation of the proposed surplus plutonium disposition facilities. Available site resources and possible additional operational requirements are also presented.

4.26.4 SRS

For SRS, the maximum impacts on environmental resources would be experienced if Alternative 3 were implemented. Under Alternative 3A, all the proposed surplus plutonium disposition facilities would be located in newly constructed buildings on the site. This alternative would require the maximum ground disturbance, thereby maximizing the potential impacts on related resources such as geology and soils, ecological, and cultural. Under Alternative 3B, the immobilization facility would be located in Building 221–F. This alternative would require the maximum water use. All the other SRS alternatives evaluated in this SPD EIS would require less new ground to be broken and less utility usage, so none would result in greater impacts than those associated with Alternative 3.

4.26.4.1 Geology and Soils

4.26.4.1.1 Construction

Construction of all the facilities in new buildings at SRS would have a negligible impact on the geologic and soils resources. In the *Storage and Disposition Final PEIS*, hazards of the large-scale geologic conditions at

Table 4–225. Maximum Annual Additional Site Infrastructure Requirements for Operations in Zone 4 at Pantex

Resource	Facility Requirement			Availability[a]	Additional Requirement
	Pit Conversion	MOX	Total		
Transportation					
Roads (km)	0	0	0	76	0
Railroads (km)	0	0	0	27	0
Electricity					
Energy consumption (MWh/yr)	16,000	12,000	28,000	338,634	0
Peak load (MW)	4.0	2.1	6.1	110.4	0
Fuel					
Natural gas (m^3/yr)	1,300,000	920,000	2,220,000	235,181,309	0
Oil (l/yr)	38,000	24,000	62,000	NA[b]	0
Coal (t/yr)	NA	NA	NA	NA[b]	0
Water (l/yr)	48,000,000	43,000,000	91,000,000	2,933,000,000	0

[a] Capacity minus current usage, a calculation based on data provided in Section 3.4.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: UC 1998k, 1998n.

SRS were analyzed in detail. The analysis determined that these conditions pose an acceptable risk to the proposed long-term storage facilities. That decision is not revisited in this SPD EIS. More detailed descriptions of impacts of the potential geologic hazards at SRS are included in the *Storage and Disposition Final PEIS* (DOE 1996a: 4-309–4-311).

The soils at SRS are considered acceptable for standard construction techniques. No economically viable geologic resources have been identified at SRS. No soils at SRS are currently classified as prime farmlands.

4.26.4.1.2 Operations

Operation of all the facilities in new buildings at SRS would have no impact on the geologic and soils resources.

4.26.4.2 Water Resources

4.26.4.2.1 Construction

Surface water would not be used in the construction of proposed surplus plutonium disposition facilities at SRS (UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j). Thus, there would be no impact on the surface water availability to downstream users.

All wastewater would be treated in the sitewide treatment system, which has sufficient hydraulic and organic capacity to treat the flows expected from these activities. No impacts on surface water quality would be expected from the discharge of these flows to the treatment system and to the receiving stream (Sessions 1997).

The maximum estimated annual average water usage for constructing all the proposed surplus plutonium disposition facilities at SRS would be 98 million l (25.6 million gal) (UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j). Current water usage in F-Area is 374 million l/yr (98.8 million gal/yr). When added to current usage, the total construction requirement represents 30 percent of the F-Area groundwater capacity. No impact on water availability would be anticipated.

Wastewater would not be directly discharged to the groundwater aquifer (Sessions 1997:11); it would be treated in the Central Sanitary Wastewater Treatment Facility and subsequently discharged to surface water. Thus, no adverse impacts on groundwater quality are anticipated.

4.26.4.2.2 Operations

Surface water would not be used in the operation of these proposed surplus plutonium disposition facilities at SRS (UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j). No impact on surface water availability to downstream users would be expected. The Central Sanitary Wastewater Treatment Facility has sufficient capacity to treat the wastewater flows from these activities. Because the plant is only loaded at about 30 percent of its design capacity, it would be able to treat these flows adequately to meet NPDES permit limitations. Thus, no impacts on surface water quality would be expected (Sessions 1997).

The maximum annual average water usage for operating these facilities has been estimated at 138 million l (36.5 million gal) (UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j). When added to current water usage, the total requirement represents about 32 percent of the F-Area groundwater capacity. The water treatment system has an approved capacity to service this volume of water. Therefore, no impacts on water availability would be expected. There would be no direct discharge of waste to the groundwater aquifer. Therefore, no impacts on groundwater would be expected.

4.26.4.3 Ecological Resources

Ecological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. However, habitat disturbance would be minimal; land area required for construction activities is small in relation to regionally available habitat, and construction would take place largely in previously disturbed or developed areas. Operational impacts would also be minimal because facility emissions to the environment would be processed in accordance with applicable permitting procedures. Therefore, impacts on nonsensitive and sensitive habitats, plant and animal species, and the overall biodiversity of the candidate site would be minimal.

4.26.4.3.1 Construction

Nonsensitive Habitat. Siting the three proposed surplus plutonium disposition facilities in new buildings at SRS would disturb a total of about 31 ha (77 acres) of land adjacent to APSF, which is currently being constructed in F-Area (UC 1998e, 1998f, 1998g, 1998h). Some of this land (12 ha [30 acres]) would be used temporarily during the 3-year construction phase for the immobilization facility, and some (4.7 ha [12 acres]) during the 5-year construction and startup phases for the MOX facility (UC 1998f, 1998g, 1998h). Previously disturbed areas in F-Area would be used for construction laydown for the pit conversion facility (2 ha [4.9 acres]) (UC 1998e). Thus, there should be no direct impacts on nonsensitive terrestrial or aquatic habitats. Animal species inhabiting areas surrounding F-Area could be disturbed by the increased noise associated with construction activities, and the additional vehicular traffic could result in higher mortality for individual members of local animal populations. Prior to construction, the proposed sites would be surveyed for nests of migratory birds in accordance with the Migratory Bird Treaty Act. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be drawn from groundwater sources (UC 1998e, 1998f, 1998g, 1998h).

Sensitive Habitat. Wetlands associated with floodplains, streams, and impoundments should not be directly impacted by construction activities. No critical habitat for any threatened or endangered species exists on SRS. However, the bald eagle, red-cockaded woodpecker, wood stork, American alligator, smooth purple coneflower, and Oconee azalea might occur near F-Area (DOE 1995c:3-37, DOE 1996a:3-245). Preconstruction surveys and consultations with USFWS and the equivalent State agency would be conducted to ensure that impacts on sensitive species living in the vicinity of F-Area are negligible, and that appropriate mitigation actions are implemented as needed.

4.26.4.3.2 Operations

Nonsensitive Habitat. Noise disturbance would probably be the most significant impact of routine operation of the three facilities on local wildlife populations. Disturbed individual members of local populations could migrate to adjacent areas of similar habitat. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters will be used (UC 1998e, 1998f, 1998g, 1998h). Impacts on aquatic habitats should be limited because all liquid, nonhazardous sanitary wastes would be sampled, treated, and disposed of in accordance with approved permits and procedures (UC 1998e, 1998f, 1998g, 1998h).

Sensitive Habitat. Operational impacts on wetlands or other sensitive habitats would be unlikely because airborne and aqueous effluents would be controlled and permitted. It is also unlikely that any federally listed threatened or endangered species would be affected, although South Carolina State–classified special status-species could be affected by noise or human activity during operations, as discussed for construction.

4.26.4.4 Cultural and Paleontological Resources

Prehistoric, historic, Native American, and paleontological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. The land area required for construction activities is fairly small, however, and any such resource disturbance would be minimized as much of the construction would take place in previously disturbed or developed areas. Impacts of operations would be negligible because facility operations and security would restrict access to nearby prehistoric, historic, Native American, and paleontological resources. Continued compliance monitoring, before and after construction, would also help to limit or preclude impacts on these resources.

4.26.4.4.1 Construction

Siting all facilities in new buildings at SRS would disturb a total of about 31 ha (77 acres) of land adjacent to APSF, which is currently being constructed in F-Area (UC 1998e, 1998f, 1998g, 1998h). Some of this land (12 ha [30 acres]) would be used temporarily during the 3-year construction phase for the immobilization facility, and some (4.7 ha [12 acres]) during the 5-year construction and startup phases for the MOX facility (UC 1998f, 1998g, 1998h). Previously disturbed areas in F-Area would be used for construction laydown for the pit conversion facility (2 ha [4.9 acres]) (UC 1998e).

Not all areas within the proposed construction area have been completely surveyed for cultural resources, and this area has a high potential to yield subsurface deposits (SRARP 1997:1, 5). Based on previous archaeological investigations, four archaeological sites have been recorded in or near the proposed construction areas (SRARP 1997). One of these sites (38AK546), located along the edge of the proposed construction impact area, has been recommended to the South Carolina State Historic Preservation Officer as eligible for nomination to the National Register (SRARP 1997:3–5; Cabak, Sassaman, and Gillam 1996). Potential direct impacts on 38AK546 and other archaeological sites that may exist in unsurveyed areas of the construction area could be mitigated through either avoidance or data recovery following additional survey and testing.

Mitigation would require South Carolina State Historic Preservation Officer's concurrence on National Register–eligibility determinations and plans for mitigation of potential adverse effect (SRARP 1997:5). All compliance activities would be conducted in accordance with the *Programmatic Memorandum of Agreement for the Savannah River Site* (SRARP 1989:179–188).

There should be no direct impacts on historic resources associated with the Cold War Era. A historical review of SRS was initiated in 1996 and will continue for several years. An assessment of two buildings (Buildings 217–F and 701–5F) located within the proposed construction area indicates neither structure meets the age nor architectural uniqueness criteria for eligibility to the National Register (Reed 1997). No Native American cultural sites or paleontological sites are known to exist within the proposed construction area. However, consultations (see Chapter 5 for discussion) would be initiated with appropriate American Indian Tribal Governments on publication of this SPD EIS to address any concerns associated with the actions evaluated therein.

No indirect impacts on prehistoric, historic, Native American, or paleontological resources would occur under this alternative. Inadvertent discoveries of cultural resources will be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects).

4.26.4.4.2 Operations

There should be no direct impacts on prehistoric, historic, Native American, or paleontological resources associated with operation of the proposed surplus plutonium disposition facilities. Once the facilities were operational, no direct land disturbance or other action with impact potential would be conducted beyond the facility's perimeter fence.

There also should be no indirect impacts on prehistoric, historic, Native American, or paleontological resources associated with operation of the proposed surplus plutonium disposition facilities. Once the facilities were operational, access to, and the integrity of, resources beyond the direct impact area would not be affected.

4.26.4.5 Land Use and Visual Resources

Land resources (land use and visual resources) could be affected by construction and operation of the proposed surplus plutonium disposition facilities. The land-use impact analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and land values, and other socioeconomic factors pertaining to land use. Land-use impacts would vary from site to site depending on existing facility land-use configurations, adjoining land uses, and other environmental and containment factors. The visual resource impact analysis emphasized changes in the existing landscape character that could result from the proposed action. The visual resource assessment was based on the VRM methodology.

4.26.4.5.1 Construction

Land area requirements at SRS would include sufficient land for the construction of new facilities and the modification of APSF in F-Area to support the pit conversion, immobilization, and MOX facilities and the use of DWPF in S-Area (UC 1998e, 1998f, 1998g, 1998h). Table 4–226 provides an estimate for the total footprint area required, in terms of newly disturbed land, for construction and operation of the proposed surplus plutonium disposition facilities.

The land required for the construction of facilities in F-Area for Alternative 3A would be about 31 ha (77 acres). This includes 12 ha (30 acres) of new building footprints, new parking lots, and security areas that

Table 4–226. Maximum New Facility and Construction Area Requirements at SRS

Land Requirement	Pit Conversion (New)	Immobilization (New)	MOX (New)
Construction area[a] (ha)	2	12.4	4.7
New operational area (ha)	2.1	3.4	6

[a] For uses such as construction laydown, construction worker parking, and waste storage.
Source: UC 1998e, 1998f, 1998g, 1998h.

would remain in use throughout operations. The new facilities would occupy less than 0.02 percent of the 58,681 ha (145,000 acres) of available land designated for waste management facilities at SRS (DOE 1997g:4-20).

The remaining 19 ha (47 acres) would be needed temporarily during construction for laydown, temporary storage, and parking. Construction areas would not be used after the facilities became operational. A number of these construction areas exist within F-Area but are currently inactive. F-Area has ample space available for construction (UC 1998h). Land area requirements for Alternative 3A would not be major, and no permanent loss of land use would result from construction and operation of the proposed surplus plutonium disposition facilities at SRS.

4.26.4.5.2 Operations

All of the proposed surplus plutonium disposition facilities would be in new buildings adjacent to APSF in F-Area at SRS. Land within F-Area is currently disturbed and designated as industrial. Operation of the pit conversion, immobilization, and MOX facilities in F-Area would conform to existing heavy industrial land use and future land uses as described in the *Draft Site Development Plan* (DOE 1996f:7–9). Other SRS land uses or special-status lands would not be affected by facility operations. There would also be no impact on Native American Treaty land-use rights from Alternative 3A. Use of DWPF in S-Area would also be consistent with existing and future land uses as described in the *Draft Site Development Plan* (DOE 1996f:7–9).

The appearance of new facilities in and adjacent to F-Area would remain consistent with this area's industrialized landscape character and current VRM Class 5 designation. In height and size, the proposed facilities would be similar to existing buildings in F-Area. Facilities are generally not visible off the site because views are limited by rolling terrain and heavy vegetation. Construction and operation of the surplus plutonium disposition facilities would not effect a major change in any natural features of visual interest in the area. The nearest sensitive viewpoints are those on State Route 125 and SRS Road 1, 7 km (4.3 mi) and 8.5 km (5.3 km) away, respectively.

4.26.4.6 Infrastructure

4.26.4.6.1 Construction

Existing SRS infrastructure would be capable of supporting the construction requirements for the proposed surplus plutonium disposition facilities under Alternative 3B.[1] Construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Only 2.8 km (1.7 mi) of road would be required for construction deliveries and access to new and temporary facilities

[1] SRS infrastructure requirements for the construction of the proposed surplus plutonium disposition facilities under Alternative 3B are greater than those for Alternative 3A. Alternative 3B data is used for both construction and operations since the infrastructure requirements for operations are consistent in both alternatives.

(UC 1998e, 1998h); this would not have a major impact. Total construction requirements for fuel oil might be higher than currently available storage, but the majority of fuel oil usage would be connected to construction vehicle usage; therefore, storage would not be limiting. Table 4–227 reflects estimates of the additional annual infrastructure requirements for construction of the proposed surplus plutonium disposition facilities. Site resource availability and possible additional resource requirements are also presented.

Table 4–227. Maximum Annual Additional Site Infrastructure Requirements for Construction in F-Area at SRS

	Facility Requirement					Additional
Resource	**Pit Conversion**	**Immobilization**	**MOX**	**Total**	**Availability[a]**	**Requirement**
Transportation						
Roads (km)	1.8	0	1.0	2.8	230	2.8
Railroads (km)	0	0	0	0	103	0
Electricity						
Energy consumption (MWh/yr)	1,700	11,000	875	13,575	482,700	0
Peak load (MW)	1.0	1.7	1.0	3.7	49.5	0
Fuel						
Natural gas (m^3/yr)	NA	NA	NA	NA	NA	0
Oil (l/yr)	310,000	75,000	228,000	613,000	NA[b]	0
Coal (t/yr)	NA	445	NA	445	NA[b]	0
Water (l/yr)	10,000,000	72,000,000	16,000,000	98,000,000	1,216,000,000	0

[a] Capacity minus current usage, a calculation based on data provided in Section 3.5.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: UC 1998e, 1998f, 1998g, 1998h.

4.26.4.6.2 Operations

Resources needed for operations under Alternative 3B[2] are well within SRS capacity. The total fuel oil requirement for emergency generator testing during operations might be higher than current site storage, but shortfalls could be met through additional procurements by normal contractual means. Table 4–228 reflects estimates of additional annual resources required for operation of the proposed surplus plutonium disposition facilities. Available site resources and possible additional operational requirements are also presented.

[2] SRS infrastructure requirements for the construction of the proposed surplus plutonium disposition facilities under Alternative 3B are greater than those for Alternative 3A. Alternative 3B data is used for both construction and operations since the infrastructure requirements for operations are consistent in both alternatives.

Table 4–228. Maximum Annual Additional Site Infrastructure Requirements for Operations in F-Area at SRS

	Facility Requirement					
Resource	**Pit Conversion**	**Immobilization[a]**	**MOX**	**Total**	**Availability[b]**	**Additional Requirement**
Transportation						
Roads (km)	0	0	0	0	230	0
Railroads (km)	0	0	0	0	103	0
Electricity						
Energy consumption (MWh/yr)	13,000	11,500	12,000	36,500	482,700	0
Peak load (MW)	4.0	2.6	2.1	8.7	49.5	0
Fuel						
Natural gas (m^3/yr)	NA	NA	NA	NA	NA	0
Oil (l/yr)	38,000	25,000	24,000	87,000	NA[c]	0
Coal (t/yr)	1,800	445	686	2,931	NA[c]	0
Water (l/yr)	48,000,000	47,000,000	43,000,000	138,000,000	1,216,000,000	0

[a] Data reflect the higher of the requirements for ceramic and glass.
[b] Capacity minus current usage, a calculation based on data provided in Section 3.5.11.2.
[c] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: UC 1998e, 1998f, 1998g, 1998h.

Next Section

4.27 LEAD ASSEMBLY ALTERNATIVES

Five sites have been proposed for domestic fabrication of lead assemblies. Those sites are LLNL, LANL, and three of the four candidate sites for the proposed surplus plutonium disposition activities: Hanford, INEEL (the ANL–W facilities are being considered), and SRS. Pantex was not included as a candidate site for lead assembly fabrication because it does not currently have any plutonium processing facilities. After irradiation in a domestic, commercial LWR, the lead assemblies would be examined at a postirradiation examination facility. Locations include ANL–W, Oak Ridge National Laboratory (ORNL), or commercial examination facilities.

4.27.1 ANL–W

4.27.1.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at ANL–W would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at ANL–W and would result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating these existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at ANL–W and INEEL. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly facility would be smaller than the levels shown in Table 4–131, and the concentrations at the site boundary would continue to meet ambient air quality standards. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less than 0.001 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAP limit.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic associated with operating these facilities would be a small fraction of the existing traffic associated with activities at ANL–W and should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment would be similar to noise from existing ventilation equipment.

4.27.1.2 Waste Management

Table 4–229 compares the waste generated during modification of facilities for lead assembly fabrication at ANL–W with the existing treatment, storage, and disposal capacity for the various waste types. LLW would be generated during modification of contaminated areas of FMF and ZPPR, although no TRU, mixed, or hazardous waste is expected to be generated. Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at INEEL or at other DOE sites or commercial facilities. For this SPD EIS, it is assumed that waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–229. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at ANL–W

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
LLW	18	<1	<1	<1
Nonhazardous				
Liquid	37	NA	NA	1
Solid	11	NA	NA	<1

[a] See definitions in Appendix F.8.

[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.

Key: ANL–W, Argonne National Laboratory–West; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated and stored on the site); TRU, transuranic.

LLW would be packaged, certified, and accumulated at the modification site before transfer for treatment and disposal in existing ANL–W and INEEL facilities. A total of 36 m^3 (47 yd^3) of LLW would be generated over the modification period. LLW generation during modification of facilities for lead assembly fabrication is estimated to be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) treatment capacity of WERF, less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity of RWMC, and less than 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of RWMC. Using the 6,264-m^3/ha (3,316-yd^3/acre) disposal land usage factor for RWMC published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 36-m^3 (47 yd^3) of waste would require less than 0.1 ha (0.25 acre) of disposal space. Therefore, impacts of the management of this additional LLW at ANL–W and INEEL should not be major.

Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication would be packaged in conformance with standard industrial practice and would be disposed of in the onsite Central Facilities Area landfill complex, or shipped to offsite facilities for recycling. Nonhazardous solid waste generation during modification of facilities for lead assembly fabrication is estimated to be less than 1 percent of the 48,000-m^3 (62,800-yd^3) capacity of the Central Facilities Area landfill complex. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at ANL–W and INEEL.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be managed at the ANL–W sewage treatment facility. Nonhazardous liquid waste generation during modification of these facilities is estimated to be 1 percent of the 6,057-m^3/yr (7,923-yd^3/yr) capacity of the ANL–W sewage treatment facility. Therefore, management of these wastes at ANL–W should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–230 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from lead assembly fabrication at ANL–W. No HLW would be generated by lead assembly fabrication.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at INEEL or at other DOE sites or commerical facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities

Table 4–230. Potential Waste Management Impacts of Operation of Lead Assembly Facility at ANL–W

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of [b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	1	<1	<1 of WIPP
LLW	200	<1	1	1
Mixed LLW	1	<1	<1	NA
Hazardous	<1	<1	<1	NA
Nonhazardous				
Liquid	1,600	NA	NA	26[d]
Solid	1,300	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation on an annual basis. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities would not generate remotely handled TRU waste.
[d] Percent of the capacity of the ANL–W sewage treatment facility.
Key: ANL–W, Argonne National Laboratory–West; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at INEEL are described in the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final EIS* (DOE 1995a).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the facilities for lead assembly fabrication. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned Waste Characterization Facility at INEEL.

TRU waste generated by lead assembly fabrication at ANL–W is estimated to be 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all the TRU waste were to be stored at INEEL, this would be less than 1 percent of the 177,300 m^3 (231,900 yd^3) storage capacity available at RWMC. Impacts of the management of additional quantities of TRU waste at ANL–W and INEEL should not be major.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facility before transfer for treatment, storage, and disposal in existing ANL–W or INEEL facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated during the 3-year operation period. LLW generated during lead assembly fabrication is estimated to be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) treatment capacity of WERF, 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity of RWMC, and 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of RWMC. Using the 6,264-m^3/ha (3,316-yd^3/acre) disposal land usage factor for RWMC published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3)

of waste would require 0.11 ha (0.27 acre) of disposal space at RWMC. Therefore, impacts of the management of this additional LLW at ANL–W and INEEL should not be major.

Mixed LLW would be stabilized, packaged, and stored for treatment and disposal in a manner consistent with the site treatment plan. At INEEL, mixed LLW is currently treated on the site with some waste shipped to Envirocare of Utah for disposal. INEEL is planning a new facility for onsite disposal of mixed LLW. Mixed LLW generated by lead assembly fabrication is estimated to be less than 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project and less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity of RWMC. Therefore, the management of this additional waste at ANL–W and INEEL should not have a major impact on the mixed LLW management system.

Any hazardous waste generated during lead assembly fabrication at ANL–W would be packaged for storage and treatment at a combination of onsite and offsite facilities, with disposal at offsite commercial facilities. Assuming that all hazardous waste is managed at INEEL, hazardous waste generated by lead assembly fabrication is estimated to be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) capacity of WERF and less than 1 percent of the 1,600-m^3 (2,090-yd^3) capacity of the hazardous waste storage buildings. Therefore, the management of these additional hazardous wastes at ANL–W and INEEL should not have a major impact on the hazardous waste management system.

If all the TRU waste and mixed LLW generated by lead assembly fabrication at ANL–W is processed in the planned Advanced Mixed Waste Treatment Project, this additional waste would be 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) capacity of the facility. If all TRU waste, LLW, and mixed LLW generated by lead assembly fabrication is stored at RWMC, this additional waste would be 1 percent of the 112,400-m^3 (147,000-yd^3) capacity of the facility. If all LLW and hazardous waste generated by lead assembly fabrication is treated at WERF, this additional waste would be less than 1 percent of the 49,610-m^3 (64,890-yd^3) capacity of the facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent off the site for disposal in the Bonneville County Landfill. This additional waste load should not have a major impact on the nonhazardous solid waste management systems at ANL–W and INEEL.

Nonhazardous wastewater generated by lead assembly fabrication would be treated, if necessary, before being discharged to the ANL–W sewage treatment facility. Nonhazardous liquid waste generated by lead assembly fabrication is estimated to be 26 percent of the 6,057-m^3/yr (7,923-yd^3/yr) capacity of the ANL–W sewage treatment facility. Therefore, management of nonhazardous liquid waste at ANL–W should not have a major impact on the wastewater treatment system.

4.27.1.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification and operation of the facilities for the proposed lead assembly program. Proposed activities would use existing facilities, therefore, all required utility connections are in existence. See Table 3–50 for current infrastructure characteristics at ANL–W. To support the lead assembly fabrication, annual electricity requirements at ANL–W are estimated to increase by 720 MWh. Current annual electrical usage at ANL–W is 4,200 MWh, with a site capacity of 7,000 MWh. Additional annual fuel requirements are estimated to be 49,200 l (13,000 gal) of diesel fuel for heating and 4,600 l (1,215 gal) of diesel oil for emergency generators. Fuel is procured on the site on an as-needed basis. Annual total water usage for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). No surface water requirements are expected for the facility. Current annual water usage at

ANL–W is 1.5 million l (396,000 gal), while the current capacity is 15 million l (4 million gal). Even though the amount of water needed at the site would effectively double, it would still be less than 25 percent of the water available. Thus, there would not be any major impacts on infrastructure should the decision be made to conduct the proposed lead test assembly program at ANL–W (O'Connor et al. 1998a).

4.27.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at ANL–W. Moreover, doses to construction workers should not exceed the normally low levels attributable to routine occupancy. Nonetheless, construction workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

Table 4–231 reflects the potential radiological impacts of normal operations on three individual receptor groups at ANL–W: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–231. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at ANL–W

Population within 80 km for year 2005	
Dose (person-rem/yr)	0.011
Percent of natural background[a]	1.2×10^{-5}
Associated latent fatal cancers	5.5×10^{-6}
Maximally exposed individual	
Annual dose (mrem/yr)	9.4×10^{-4}
Percent of natural background[a]	2.6×10^{-4}
Associated latent fatal cancer risk	4.7×10^{-10}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	4.4×10^{-5}
Associated latent fatal cancer risk	2.2×10^{-11}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 90,600 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2005 (251,500).

Key: ANL–W, Argonne National Laboratory–West.

Source: Appendix J.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 0.011 person-rem. The corresponding number of LCFs in the population around ANL–W from annual operation of the facility would be 5.5×10^{-6}. The total dose to the maximally exposed member of the public from annual operation would be 9.4×10^{-4} mrem; this corresponds to an LCF risk of 4.7×10^{-10}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–232; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF.

Table 4–232. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at ANL–W

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Key: ANL–W, Argonne National Laboratory–West.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998a.

Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Limited hazardous chemical releases would be expected as a result of modification or operation activities. However, concentrations would be within the regulated exposure limits.

4.27.1.5 Facility Accidents

Given the estimated 1,517 person-days of construction labor and standard industrial accident rates, about 0.63 cases of nonfatal occupational injury or illness and 8.8×10^{-4} fatality would be expected. DOE-required industrial safety programs would be in place to reduce the risks.

The potential consequences of postulated bounding facility accidents from lead assembly fabrication activities at ANL–W are presented in Table 4–233. The most severe consequences of a design basis accident would be associated with a nuclear criticality. Radiological consequences of the criticality for the MEI would include a dose of 4.9×10^{-3} rem, corresponding to an LCF probability of 2.5×10^{-6}. Among the general population off the site, an estimated 1.6×10^{-4} LCF could occur as a result of a criticality. The frequency of this accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year. This accident would also be expected to be more severe than any accident associated with postirradiation examination activities that could be conducted at ANL–W (see Section 4.27.6.3).

Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest during the nuclear criticality. The consequences of such an accident would include an LCF probability of 3.1×10^{-5}.

Given total facility collapse as a result of the beyond-design-basis earthquake, the radiological effects from the proposed activities would be 3.9×10^{-1} LCF in the population residing within 80 km (50 mi) of ANL–W. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Table 4–233. Accident Impacts of Lead Assembly Fabrication at ANL–W

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker [b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary [b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km [c]
Criticality	Extremely unlikely	7.7×10^{-2}	3.1×10^{-5}	4.9×10^{-3}	2.5×10^{-6}	3.4×10^{-1}	1.6×10^{-4}
Design basis earthquake	Unlikely	1.7×10^{-4}	6.8×10^{-8}	7.7×10^{-6}	3.9×10^{-9}	2.7×10^{-3}	1.4×10^{-6}
Design basis fire	Unlikely	7.4×10^{-5}	2.9×10^{-8}	3.3×10^{-6}	1.7×10^{-9}	1.2×10^{-3}	5.9×10^{-7}
Design basis explosion	Extremely unlikely	1.2×10^{-3}	4.8×10^{-7}	5.4×10^{-5}	2.7×10^{-8}	1.9×10^{-2}	9.6×10^{-6}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	7.4×10^{1}	3.0×10^{-2}	2.8	1.4×10^{-3}	7.9×10^{2}	3.9×10^{-1}
Beyond-evaluation-basis fire	Beyond extremely unlikely	1.7×10^{-1}	6.6×10^{-5}	6.2×10^{-3}	3.1×10^{-6}	1.8	8.7×10^{-4}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: ANL–W, Argonne National Laboratory–West.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

4.27.1.6 Transportation

Plutonium dioxide would be shipped from LANL to lead assembly fabrication facilities at ANL–W. These facilities would also receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to a reactor site. Approximately 30 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 80,000 km (50,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.5 person-rem; the dose to the public, 10.3 person-rem. Accordingly, incident-free transportation of radioactive material would result in 5.9×10^{-4} LCF among transportation workers and 5.2×10^{-3} LCF in the total affected population over the duration of the transportation activities. (LCFs associated with radiological releases were estimated by multiplying the occupational (worker) dose by 4.0×10^{-4} cancer per person-rem of exposure, and the public accident and accident-free dose by 5.0×10^{-4} cancer per person-rem of exposure [ICRP 1991].) The estimated number of nonradiological fatalities from vehicular emissions would be 2.3×10^{-4}.

Impacts of Accidents During Ground Transportation. Estimates of the total ground transportation accident risks follow: a radiological dose to the population of 6.3 person-rem, resulting in a total population risk of 3.2×10^{-3} LCF; and traffic accidents resulting in 9.2×10^{-4} traffic fatality.

4.27.1.7 Other Resource Areas

Other resource areas include geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected to any of these resource areas.

4.27.1.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, the lead assembly fabrication activities at ANL–W would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of ANL–W would be 5.5×10^{-6}; thus, no additional LCFs would be expected (see Table 4–231). Transportation related to these activities would not be expected to result in any LCFs either (see Section 4.27.1.6). The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 8.4×10^{-3} due to radiological impacts, by 2.3×10^{-4} due to emissions, and by 9.2×10^{-4} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.1.6). Risks posed by the implementation of the ANL–W alternative for lead assembly fabrication would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at ANL–W would have no significant impacts on minority or low-income populations.

4.27.2 Hanford

4.27.2.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at Hanford would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary. However, occasional exceedances of the PM_{10} and total suspended particulate standards would likely continue from natural sources.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at Hanford and would result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating these existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at Hanford. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly facility would be smaller than the levels shown in Table 4–97, and the concentrations at the site boundary would continue to meet ambient air quality standards. However, occasional exceedances of the PM_{10} and total suspended particulate standards would likely continue from natural sources. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less than 0.001 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAP limit.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic noise associated with operating these facilities would be a small fraction of the existing traffic associated with activities at Hanford and should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment would be similar to noise from existing ventilation equipment.

4.27.2.2 Waste Management

Table 4–234 compares the waste generated during modification of facilities for lead assembly fabrication at Hanford with the existing treatment, storage, and disposal capacity for the various waste types. No TRU waste, LLW, mixed LLW, or hazardous waste would be generated during modification. This SPD EIS also assumes that nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–234. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]: Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Nonhazardous				
Liquid	15	<1	NA	<1
Solid	50	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.

Key: NA, not applicable (i.e., it is assumed that the majority of the nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at Hanford.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be discharged to the sewer system in the 400 Area. Nonhazardous liquid waste generation during modification of these facilities is estimated to be less than 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and less than 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility.

Therefore, management of these wastes at Hanford should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–235 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from lead assembly fabrication activities at Hanford. No HLW would be generated during lead assembly fabrication.

Table 4–235. Potential Waste Management Impacts of Operation of Lead Assembly Facility at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	2	1	<1 of WIPP
LLW	200	NA	NA	<1
Mixed LLW	1	<1	<1	<1
Hazardous	<1	NA	NA	NA
Nonhazardous				
Liquid	1,600	1[d]	NA	1[e]
Solid	1,300	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation annually. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities would not generate remotely handled TRU waste.
[d] Percent of the capacity of 400 Area sanitary sewer.
[e] Percent of the capacity of WPPSS Sewage Treatment Facility.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant; WPPSS, Washington Public Power Supply System.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at Hanford or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts on treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS*, which is being prepared by the DOE Richland Operations Office (DOE 1997c).

TRU wastes would be packaged and certified to WIPP waste acceptance criteria at the lead assembly fabrication facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generated by lead assembly fabrication is estimated to be 2 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all of the TRU waste had to be stored on the site, this would be 1 percent of the 17,000-m^3 (2,220-yd^3) storage capacity available at Hanford. Therefore, impacts of the management of additional quantities of TRU waste at Hanford should not be major.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facility before transfer for disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generated by lead assembly fabrication is estimated to be less than 1 percent of the 1,740,000-m^3 (2,280,000-yd^3) capacity of the LLW Burial Grounds and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.2 ha (0.49 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW would be packaged and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Mixed LLW generated by lead assembly fabrication is estimated to be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

If all TRU waste and mixed LLW generated by lead assembly fabrication were processed in the Waste Receiving and Processing Facility, this additional waste would be 2 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the facility, and therefore should not have a major impact on this facility.

The small quantity of hazardous waste generated during operations would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operation period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent offsite for recycling. The remaining solid sanitary waste would be sent for disposal in the Richland Sanitary Landfill. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

To be conservative, it was assumed that all nonhazardous wastewater generated by lead assembly fabrication at Hanford would be managed in the 400 Area. Nonhazardous wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer system, which connects to the WPPSS Sewage Treatment Facility. Nonhazardous liquid waste generated by lead assembly fabrication is estimated to be 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer and 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, management of additional nonhazardous liquid waste at Hanford should not have a major impact on the wastewater treatment system.

4.27.2.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification and operation of the facilities for the proposed lead assembly program. Proposed activities would use the existing space at the Fuel

Assembly Area, appended to FMEF, in Hanford's 400 Area; therefore, all utility connections are in existence. See Table 3–6 for additional information on the infrastructure characteristics at FMEF. To support lead assembly fabrication, annual electricity requirements are calculated to increase by 1,230 MWh; this includes 514 MWh for heating. Current annual electrical usage at FMEF is 7,300 MWh, with a capacity of 61,000 MWh. An estimated 4,600 l (1,215 gal) of diesel oil for emergency generators is also required. Fuel is procured on the site on an as-needed basis. Annual total water usage for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). Current water usage is 41.7 million l (11 million gal), while capacity is 400 million l (105 million gal). There would not be any major impacts on infrastructure should the decision be made to conduct the proposed lead assembly program at the Fuel Assembly Area at FMEF (Mecca 1997; O'Connor et al. 1998b:24).

4.27.2.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at Hanford. Moreover, doses to construction workers should not exceed the normally low levels attributable to routine occupancy (Antonio 1998). Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

Table 4–236 reflects the potential radiological impacts of normal operations on three individual receptor groups at Hanford: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–236. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at Hanford

Population within 80 km for year 2005	
Dose (person-rem/yr)	0.025
Percent of natural background[a]	2.3×10^{-5}
Associated latent fatal cancers	1.2×10^{-5}
Maximally exposed individual	
Annual dose (mrem/yr)	3.4×10^{-4}
Percent of natural background[a]	1.1×10^{-4}
Associated latent fatal cancer risk	1.7×10^{-10}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	7.0×10^{-5}
Associated latent fatal cancer risk	3.5×10^{-11}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 107,400 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2005 (358,100).
Source: Appendix J.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 0.025 person-rem. The corresponding number of LCFs in the population around Hanford from annual operation of the facility would be 1.2×10^{-5}. The total dose to the maximally exposed member of the public from annual operation would be 3.4×10^{-4} mrem; this corresponds to an LCF risk of 1.7×10^{-10}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–237; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–237. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at Hanford

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998b.

Hazardous Chemical Impacts. Limited hazardous chemical releases would be expected as a result of modification or operation activities. However, concentrations would be within the regulated exposure limits.

4.27.2.5 Facility Accidents

No major modifications would be required for any of the facilities proposed for lead assembly fabrication. The potential for accidents during construction would thus be minimal.

The potential consequences of postulated bounding facility accidents from lead assembly fabrication activities at Hanford is presented in Table 4–238. The source terms are identical to those for lead assembly activities at ANL–W; the different consequences are attributable to differences in stack height, meteorology, site boundary distance, and population.

The most severe consequences of a design basis accident would be associated with a nuclear criticality. Bounding radiological consequences for the MEI would result in a dose of 3.4×10^{-3} rem, corresponding to an LCF probability of 1.7×10^{-6}. Consequences of the criticality for the general population in the environs of Hanford would include an estimated 2.7×10^{-3} LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the criticality accident. The consequences of such an accident would include an LCF probability of 1.3×10^{-5}.

The radiological effects from total collapse of FMEF for lead assembly fabrication in the beyond-design-basis earthquake would be approximately 2.8 LCFs in the population residing within 80 km (50 mi) of Hanford. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of

Table 4–238. Accident Impacts of Lead Assembly Fabrication at Hanford

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Design basis earthquake	Unlikely	3.5×10^{-5}	1.4×10^{-8}	5.2×10^{-6}	2.6×10^{-9}	1.7×10^{-2}	8.5×10^{-6}
Design basis fire	Unlikely	1.5×10^{-5}	6.0×10^{-9}	2.3×10^{-6}	1.1×10^{-9}	7.4×10^{-3}	3.7×10^{-6}
Design basis explosion	Extremely unlikely	2.4×10^{-4}	9.8×10^{-8}	3.7×10^{-5}	1.8×10^{-8}	1.2×10^{-1}	5.9×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	7.1×10^{1}	2.8×10^{-2}	2.7	1.3×10^{-3}	6.5×10^{3}	2.8
Beyond-design- basis fire	Beyond extremely unlikely	1.6×10^{-1}	6.3×10^{-5}	5.9×10^{-3}	3.0×10^{-6}	1.4×10^{1}	6.2×10^{-3}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

4.27.2.6 Transportation

Plutonium dioxide would be shipped from LANL to lead assembly fabrication facilities at Hanford. These facilities would also receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to a reactor site. Approximately 30 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 89,000 km (55,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.5 person-rem; the dose to the public, 10.3 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.9×10^{-4} LCF among transportation workers and 5.2×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 2.5×10^{-4}.

Impacts of Accidents During Ground Transportation. Estimates of the total ground transportation accident follow: a radiological dose to the population of 6.5 person-rem, resulting in a total population risk of 3.2×10^{-3} LCF; and traffic accidents resulting in 1.0×10^{-3} traffic fatality.

4.27.2.7 Other Resource Areas

Other resource areas include geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected to any of these resource areas.

4.27.2.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, the lead assembly fabrication activities at Hanford would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of Hanford would be 1.2×10^{-5}; thus, no additional LCFs would be expected (see Table 4–236). Transportation related to these activities would not be expected to result in any LCFs either. The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 8.4×10^{-3} due to radiological impacts, by 2.5×10^{-4} due to emissions, and by 1.0×10^{-3} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.2.6). Risks posed by the implementation of the Hanford alternative for lead assembly fabrication would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at Hanford would have no significant impacts on minority or low-income populations.

4.27.3 LLNL

4.27.3.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at LLNL would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at LLNL and would result in little or no increase in traffic noise levels along roads to the site.

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Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating these existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at LLNL. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly facility would be small. Estimated maximum concentrations of criteria air pollutants at the site boundary from testing of the emergency generators are less than 0.2 percent of the applicable standards. The estimated maximum 8-hr concentration of hydrocarbons at the site boundary from process sources is less than 0.007 percent of the threshold limit value for ethylene glycol and will not be of concern. The concentrations at the site boundary would continue to meet ambient air quality standards except possibly for ozone. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less that 0.1 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAP limit.

Section 176(c) of the 1990 Clean Air Act amendments requires that all Federal actions conform with the applicable State implementation plan. EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. Although the area in which LLNL is located is not currently designated as nonattainment for any air pollutants (EPA 1997d; EPA 1998), EPA has recently proposed to redesignate the San Francisco Bay Area as nonattainment for ozone (EPA 1997e). Therefore, proposed actions at this site may need to be evaluated for applicability of the conformity regulations. Total direct and indirect emissions from the No Action Alternative or the lead assembly fabrication alternative result in little or no change in emissions from LLNL. Therefore, the requirement for a conformity determination is not applicable to the No Action Alternative or the lead assembly fabrication alternative and no further analysis of conformity at LLNL is required related to alternatives considered in this SPD EIS.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic associated with operating these facilities would be a small fraction of the existing traffic associated with activities at LLNL and should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment should be similar to noise from existing ventilation equipment.

4.27.3.2 Waste Management

Table 4–239 compares the waste generated during modification of facilities for lead assembly fabrication at LLNL with the existing treatment, storage, and disposal capacity for the various waste types. No TRU waste, LLW, mixed LLW, or hazardous waste would be generated during modification. This SPD EIS also assumes that nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at LLNL.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be discharged to the LLNL sanitary sewer system. Nonhazardous liquid waste generation during modification of these facilities is estimated to be less than 1 percent of the 2,763,271-m^3/yr (3,614,358-yd^3/yr) capacity of the LLNL sanitary sewer. Therefore, management of these wastes at LLNL should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–239. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at LLNL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Nonhazardous				
Liquid	17	<1	NA	NA
Solid	12	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.
Key: LLNL, Lawrence Livermore National Laboratory; NA, not applicable (i.e., it is assumed that the majority of the nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Table 4–240 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from the conduct of lead assembly fabrication activities at LLNL. No HLW would be generated during lead assembly fabrication.

Table 4–240. Potential Waste Management Impacts of the Conduct of Lead Assembly Fabrication Activities at LLNL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	NA	4	<1 of WIPP
LLW	200	26	13	<1 of NTS
Mixed LLW	1	<1	<1	NA
Hazardous	<1	<1	<1	NA
Nonhazardous				
Liquid	1,600	<1	NA	NA
Solid	1,300	NA	NA	NA

[a] See waste type definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation annually. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
Key: LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; NTS, Nevada Test Site; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at LLNL or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed that TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment and storage of radioactive, hazardous, and mixed wastes at LLNL are described in the *Final EIS for Continued Operation of LLNL and SNL-Livermore* (DOE 1992:vol. I).

TRU wastes would be packaged and certified to WIPP waste acceptance criteria at the lead assembly fabrication facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at other as yet unidentified LLNL facilities.

A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all of the TRU waste were stored on the site, this would be 51 percent of the 257 m^3 (336 yd^3) of contact-handled TRU waste currently in storage at LLNL and 4 percent of the 3,335 m^3 (4,362 yrd^3) of onsite storage capacity. Assuming that the waste were stored in 208-l (55-gal) drums that can be stacked two high and adding a 50 percent factor for aisle space, a storage area of about 189 m^2 (226 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at LLNL should not be major.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facility before transfer for treatment and storage in existing onsite facilities. LLW generated during lead assembly fabrication is estimated to be 26 percent of the 771-m^3/yr (1,008-yd^3/yr) capacity of the LLW size reduction facility. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. This would be 13 percent of the 5,255 m^3 (6,874 yd^3) of onsite storage capacity, and would not require LLNL to build additional storage capacity, because this waste would be shipped to a disposal facility on a routine basis. If additional storage space were required, and assuming that the waste were stored in 208-l (55-gal) drums that can be stacked two high and adding a 50 percent factor for aisle space, a storage area of about 1,000 m^2 (1,196 yd^2) would be required. Impacts of the storage of additional quantities of LLW on 0.1 ha (0.25 acre) of land at LLNL should not be major.

LLW would be disposed of at NTS or a similar facility off the site. The additional LLW from lead assembly fabrication at LLNL would be 4 percent of the 20,000 m^3 (26,000 yd^3) of LLW disposed of at NTS in 1995 and less than 1 percent of the 500,000-m^3 (650,000-yd^3) disposal capacity at NTS. Using the 6,085-m^3/ha (3,221-yd^3/acre) disposal land usage factor for NTS published in the *Final Storage and Disposition Final PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.12 ha (0.30 acre) of disposal space at NTS or a similar facility. Therefore, impacts of the management of this additional LLW at the disposal site should not be major. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996c).

The small quantity of mixed LLW would be packaged and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for LLNL. Mixed LLW disposal would occur off the site. Mixed LLW generation for these activities is estimated to be less than 1 percent of the 1,000-m^3/yr (1,310-yd^3/yr) capacity of the Building 513 and 514 waste treatment facilities. Over the operating period of the lead assembly fabrication activities, the 4 m^3 (5.2 yd^3) of mixed LLW generated would be less than 1 percent of the 2,825 m^3 (3,695 yd^3) of onsite storage capacity. Therefore, the management of this additional waste at LLNL should not have a major impact on the mixed LLW management system.

The small quantity of hazardous waste generated during operations (<1 m^3/yr [<1.3 yd^3/yr]) would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. Hazardous waste generated by lead assembly fabrication activities is estimated to be less than 1 percent of the 1,000 m^3/yr (1,310 yd^3/yr) capacity of the Building 513 and 514 waste treatment facilities, and less than 1 percent of the 2,825 m^3 (3,695 yd^3) of hazardous waste storage capacity. Because the additional waste load is very small, the waste generated during the operation period should not have a major impact on the LLNL hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent off the site for disposal in the Vasco Road Landfill. This additional waste load should not have a major impact on the nonhazardous solid waste management system at LLNL.

Nonhazardous wastewater would be treated, if necessary, before being discharged to the sanitary sewer system. After monitoring to ensure that the wastewater meets discharge limits, sanitary wastewaters from lead assembly fabrication, along with other sanitary wastewaters from LLNL and Sandia National Laboratories, Livermore (SNL-Livermore), would be routed to the City of Livermore Water Reclamation Plant. Nonhazardous liquid waste generated by these activities is estimated to be less than 1 percent of the existing annual site waste generation and less than 1 percent of the 2,763,271-m^3/yr (3,614,358-yd^3/yr) capacity of the LLNL sanitary sewer, and therefore should not have a major impact on the LLNL and City of Livermore sanitary wastewater treatment systems.

4.27.3.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification to and operations of the facilities for the proposed lead test assembly program. Proposed activities will use existing facilities on the Livermore Site at LLNL; therefore, all required utility connections are in existence. See Table 3–52 for current infrastructure characteristics at the Livermore Site. To support lead assembly fabrication, annual electricity requirements are estimated to increase by 720 MWh. Current annual electrical usage at the Livermore Site is 296,000 MWh. Natural gas requirements for heating are 55,200 m^3/yr (72,200 yd^3/yr). Current natural gas usage for the Livermore Site is 13 million m^3/yr (17 million yd^3/yr) . An estimated 4,600 l (1,215 gal) of diesel oil for emergency generators is also required. Annual liquid fuel usage at the Livermore Site is 1.3 million l (343,000 gal). Annual total water usage for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). Current annual water usage is 873 million l (231 million gal). There would not be any major impacts on infrastructure should the decision be made to conduct the proposed lead test assembly program at the Livermore Site at LLNL (DOE 1996a:4-333-337; O'Connor et al. 1998c:24).

4.27.3.4 *Human Health Risk*

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at LLNL. Moreover, doses to construction workers should not exceed the normally low levels attributable to routine occupancy. Nonetheless, construction workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

Table 4–241 reflects the potential radiological impacts of normal operations on three individual receptor groups at LLNL: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 1.1 person-rem. The corresponding number of LCFs in the population around LLNL from annual operation of the facility would be 5.5×10^{-4}. The total dose to the maximally exposed member of the public from annual

Table 4–241. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at LLNL

Population within 80 km for year 2005	
Dose (person-rem/yr)	1.1
Percent of natural background[a]	4.7×10^{-5}
Associated latent fatal cancers	5.5×10^{-4}
Maximally exposed individual	
Annual dose (mrem/yr)	0.064
Percent of natural background[a]	0.021
Associated latent fatal cancer risk	3.2×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	1.4×10^{-4}
Associated latent fatal cancer risk	7.1×10^{-11}

[a] The annual natural background radiation level at LLNL is 300 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 2,323,000 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of LLNL in 2005 (7,742,000).
Key: LLNL, Lawrence Livermore National Laboratory.
Source: Appendix J.

operation would be 0.064 mrem; this corresponds to an LCF risk of 3.2×10^{-8}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–242; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–242. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at LLNL

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Key: LLNL, Lawrence Livermore National Laboratory.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998c.

Hazardous Chemical Impacts. Limited hazardous chemical releases would be expected as a result of modification or operation activities. However, concentrations would be within the regulated exposure limits.

4.27.3.5 Facility Accidents

Given the estimated 2,060 person-days of construction labor and standard industrial accident rates, about 0.85 cases of nonfatal occupational injury or illness and 1.2×10^{-3} fatality would be expected. DOE-required industrial safety programs would be in place to reduce the risks.

The potential consequences of postulated bounding facility accidents from lead assembly fabrication activities at LLNL are presented in Table 4–243. The source terms are identical to those for lead assembly activities at ANL–W; the different consequences are attributable to differences in stack height, meteorology, site boundary distance, and population.

Table 4–243. Accident Impacts of Lead Assembly Fabrication at LLNL

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	5.3×10^{-1}	2.1×10^{-4}	5.3×10^{-1}	2.7×10^{-4}	6.4×10^{1}	3.1×10^{-2}
Design basis earthquake	Unlikely	1.3×10^{-3}	5.3×10^{-7}	1.7×10^{-3}	8.5×10^{-7}	2.8×10^{-1}	1.5×10^{-4}
Design basis fire	Unlikely	5.7×10^{-4}	2.3×10^{-7}	7.4×10^{-4}	3.7×10^{-7}	1.2×10^{-1}	6.3×10^{-5}
Design basis explosion	Extremely unlikely	9.3×10^{-3}	3.7×10^{-6}	1.2×10^{-2}	6.0×10^{-6}	1.9	1.0×10^{-3}
Beyond-design-basis fire	Beyond extremely unlikely	1.1	4.3×10^{-4}	1.1	5.3×10^{-4}	1.7×10^{2}	9.3×10^{-2}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: LLNL, Lawrence Livermore National Laboratory.

Note: A beyond-design-basis earthquake scenario was not evaluated for Building 332 at LLNL because extensive analyses of the seismic hazard at the site and the response of the building to those hazards indicate that the scenario is beyond the range of "reasonably foreseeable." Current estimates are that the frequency of collapse is about 1×10^{-7} per year or less (Murray 1998).

The most severe consequences of a design basis accident would be associated with a nuclear criticality. Bounding radiological consequences for the MEI would result in a dose of 0.53 rem, corresponding to an LCF probability of 2.7×10^{-4}. Consequences of the criticality for the population in the environs of LLNL would include an estimated 3.1×10^{-2} LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the criticality accident. The consequences of such an accident would include an LCF probability of 2.1×10^{-4}.

Extensive analyses have been performed on the seismic hazard at the LLNL site and the response of the Plutonium Facility, Building 332, to those hazards. The geology and seismology studies have characterized the nature and magnitude of the seismic threat to LLNL and indicate there is no physiographic basis for postulating earthquake magnitudes or ground accelerations greater than Richter magnitude 6.9g or 1.1g, respectively. Building 332, Increment III, has been designed and/or evaluated against earthquakes and ground accelerations of these magnitudes and found to be adequate. Significantly greater magnitude events and ground acceleration levels would be required before any potential collapse of Increment III would be expected. Based on the current LLNL hazard curve and various estimates of the fragility curves for collapse of Increment III, the frequency of collapse is on the order of 1×10^{-7} per year or less (Murray 1998). Thus, the frequency is considered sufficiently low that evaluation of consequences due to a beyond-design-basis earthquake is unnecessary.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident

4.27.3.6 Transportation

Plutonium dioxide would be shipped from LANL to lead assembly fabrication facilities at LLNL. These facilities would also receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to a reactor site. Approximately 30 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 73,000 km (45,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.5 person-rem; the dose to the public, 10.3 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.9×10^{-4} LCF among transportation workers and 5.2×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 3.0×10^{-4}.

Impacts of Accidents During Ground Transportation. Estimates of the total ground transportation accident risks are as follows: a radiological dose to the population of 6.8 person-rem, resulting in a total population risk of 3.4×10^{-3} LCF; and traffic accidents resulting in 9.1×10^{-4} traffic fatality.

4.27.3.7 Other Resource Areas

Other resource areas include geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected to any of these resource areas.

4.27.3.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, the lead assembly fabrication activities at LLNL would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of LLNL would be 5.5×10^{-4}; thus, no additional LCFs would be expected (see Table 4–241). Transportation related to these activities would not be expected to result in any LCFs either. The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 8.6×10^{-3} due to radiological impacts, by 3.0×10^{-4} due to emissions, and by 9.1×10^{-4} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.3.6). Risks posed by the implementation of the LLNL alternative for lead assembly fabrication would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at LLNL would have no significant impacts on minority or low-income populations.

4.27.4 LANL

4.27.4.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at LANL would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at LANL and would result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating these existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at LANL. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly facility would be small. Estimated maximum concentrations of criteria air pollutants at the site boundary from testing of the emergency generators are less than 1 percent of the applicable standards. The estimated maximum 8-hr concentration of hydrocarbons at the site boundary from process sources is less than 0.02 percent of the threshold limit value for ethylene glycol and will not be of concern. The concentrations at the site boundary would continue to meet ambient air quality standards. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less than 0.01 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAP limit.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic associated with operating these facilities would be a small fraction of the existing traffic associated with activities at LANL and should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment would be similar to noise from existing ventilation equipment.

4.27.4.2 Waste Management

Table 4–244 compares the waste generated during modification of facilities for lead assembly fabrication at LANL with the existing treatment, storage, and disposal capacity for the various waste types. TRU waste and LLW would be generated during modification of contaminated areas of the glovebox line in Building PF–4, although no mixed waste or hazardous wastes would be generated.

Table 4–244. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at LANL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU	3	<1	<1	<1 of WIPP
LLW	3	NA	1	<1
Nonhazardous, liquid	10	<1	NA	<1

[a] See definitions in Appendix F.8.
[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.

Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated or stored on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at LLNL or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

TRU wastes would be packaged and certified to WIPP waste acceptance criteria at the modification site. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at other as yet unidentified LANL facilities.

TRU waste generated during modification of Building PF–4 is estimated to be less than 1 percent of the 1,080-m^3/yr (1,413-yd^3/yr) TRU waste volume reduction capacity. A total of 5 m^3 (6.5 yd^3) of TRU waste would be generated over the modification period. If all of the TRU waste were to be stored on the site, this would be less than 1 percent of the 24,355-m^3 (31,856-yd^3) storage capacity available at LANL. Therefore, impacts of the management of additional quantities of TRU waste at LANL should not be major. In addition, the TRU waste generated during modification of Building PF–4 would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW generated during modification of Building PF–4 would be packaged, certified, and accumulated at the facility before transfer for treatment, storage, and disposal in existing onsite facilities. A total of 5 m^3 (6.5 yd^3) of LLW would be generated over the modification period. LLW generated by modification of facilities for lead assembly fabrication is estimated to be 1 percent of the 663-m^3 (867-yd^3) LLW storage capacity and less than 1 percent of the 252,500-m^3 (330,270-yd^3) capacity of the Technical Area–54 (TA–54) LLW disposal area. Using the 12,562-m^3/ha (6,649-yd^3/acre) disposal land usage factor for LANL published in the *Stockpile*

Stewardship and Management PEIS (DOE 1996g:H-9), 5 m^3 (6.5 yd^3) of waste would require less than 0.1 ha (0.25 acre) of disposal space at LANL. Therefore, impacts of the management of this additional LLW at LANL should not be major.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be discharged to the LANL sanitary wastewater treatment plant. Nonhazardous liquid waste generation during modification of these facilities is estimated to be less than 1 percent of the 1,060,063-m^3/yr (1,386,562-yd^3/yr) capacity of the sanitary wastewater treatment plant and less than 1 percent of the 567,750-m^3/yr (742,617-d^3/yr) capacity of the sanitary drain fields. Therefore, management of these wastes at LANL should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–245 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from lead assembly fabrication activities at LANL. No HLW would be generated during lead assembly fabrication.

Table 4–245. Potential Waste Management Impacts of Operation of Lead Assembly Facility at LANL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	4	1	<1 of WIPP
LLW	200	NA	106	<1
Mixed LLW	1	NA	1	NA
Hazardous	<1	NA	<1	NA
Nonhazardous				
Liquid	1,600	<1[d]	NA	<1[e]
Solid	1,300	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation annually. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of the capacity of sanitary wastewater treatment plant.
[e] Percent of the capacity of sanitary tile fields.
Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at LANL or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, it is assumed that TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste form surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of waste at LANL will be evaluated in the *Draft LANL Site-Wide EIS*, which is being prepared by the DOE Albuquerque Operations Office (DOE 1995d).

TRU wastes would be packaged and certified to WIPP waste acceptance criteria at the lead assembly fabrication facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at other as yet unidentified LANL facilities.

TRU waste generated by lead assembly fabrication is estimated to be 4 percent of the 1,080-m^3/yr (1,413 yd^3/yr) TRU waste volume reduction capacity. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all of the TRU waste were to be stored on the site, this would be 1 percent of the 24,355-m^3 (31,856-yd^3) storage capacity available at LANL. Therefore, impacts of the management of additional quantities of TRU waste at LANL should not be major.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facility before transfer for disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generated by lead assembly fabrication is estimated to be 106 percent of the 663-m^3 (867-yd^3) LLW storage capacity and less than 1 percent of the 252,000-m^3 (329,600-yd^3) capacity of the TA–54 LLW disposal area. Because the waste would be sent for disposal on a regular basis, storage should not be a problem. Using the 12,562-m^3/ha (6,649-yd^3/acre) disposal land usage factor for LANL published in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS) (DOE 1996g:H-9), 700 m^3 (916 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at LANL. Thus, impacts of the management of this additional LLW at LANL should not be major.

The small quantity of mixed LLW would be packaged and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for LANL. Mixed LLW generation at the lead assembly fabrication facility is estimated to be 1 percent of the 583-m^3 (763-yd^3) mixed LLW storage capacity. Therefore, the management of this additional waste at LANL should not have a major impact on the mixed LLW management system.

The small quantity of hazardous waste generated during operations would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. Hazardous waste generated by lead assembly fabrication facilities is estimated to be less than 1 percent of the 1,864 m^3 (2,438 yd^3) of hazardous waste storage capacity. The additional waste load generated during the operation period should not have a major impact on the LANL hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for disposal in the Los Alamos County Landfill. This additional waste load should not have a major impact on the nonhazardous solid waste management system at LANL.

Nonhazardous wastewater would be treated, if necessary, before being discharged to the sanitary sewer system. Nonhazardous liquid waste generated by lead assembly fabrication is estimated to be less than 1 percent of the 1,060,063-m^3/yr (1,386,562-yd^3/yr) capacity of the sanitary wastewater treatment plant and less than 1 percent of the 567,750-m^3/yr (742,617-yd^3/yr) capacity of the sanitary drain fields. Therefore, management of additional nonhazardous liquid waste at LANL should not have a major impact on the wastewater treatment system.

4.27.4.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification and operation of the facilities for the proposed lead assembly program. Proposed activities would use existing facilities, therefore, utility connections are in existence. See Table 3–58 for additional information on the infrastructure characteristics at LANL. To support lead assembly fabrication, annual electricity requirements are calculated to increase by 720 MWh. Current annual electrical usage at LANL is 381,000 MWh, with a site capacity of 500,000 MWh. Additional annual natural gas requirements for heating are 55,200 m^3/yr (72,200 yd^3/yr). Current natural gas usage at LANL is 43.4 million m^3/yr (56.8 million yd^3/yr), with a site capacity of 103.4 million m^3/yr (135.2 million yd^3/yr). An estimated 4,600 l (1,215 gal) of diesel oil for emergency generators is also required. Fuel is procured on the site on an as-needed basis. Annual total groundwater usage for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). Current annual water usage is 5.5 million l (1.5 million gal), while the current capacity is 6.8 million l (1.8 million gal). DOE also owns a contract for 1.5 million l/yr (396,000 gal/yr) of San Juan-Chama water (DOE 1996a:3-317). If the lead assembly facilities were located at LANL, these water rights may need to be exercised. There would not be any other major impacts to infrastructure should the decision be made to conduct the proposed lead test assembly program at LANL (DOE 1997h:3-53, 3-60; O'Connor et al. 1998d).

4.27.4.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at LANL. As shown in Table 4–246, additional doses (above the normally low levels attributable to routine occupancy) to construction workers are expected from modification activities. Construction worker exposures would be limited to ensure that doses are maintained ALARA and would be monitored (badged) as appropriate.

Table 4–246. Potential Radiological Impacts on Construction Workers of Lead Assembly Facility at LANL

Number of badged workers	15
Annual total dose (person-rem/yr)	5.7
Associated latent fatal cancers[a]	2.3×10^{-3}
Annual average worker dose (mrem/yr)	383
Associated latent fatal cancer risk	1.5×10^{-4}

[a] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.

Key: LANL, Los Alamos National Laboratory.

Note: If the worker is a LANL radiation worker, the whole body dose limit is 5,000 mrem/yr (DOE 1995e), with a DOE administrative control level of 2,000 mrem/yr. If the worker is a contractor (i.e., LANL site "visitor"), the whole body dose limit is 100 mrem/yr (DOE 1993) because the worker would be considered a member of the public. In either case, an effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: ICRP 1991; NAS 1990; O'Connor et al. 1998d.

Table 4–247 reflects the potential radiological impacts of normal operations on three individual receptor groups at LANL: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–247. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at LANL

Population within 80 km for year 2005	
Dose (person-rem/yr)	0.025
Percent of natural background[a]	2.4×10^{-5}
Associated latent fatal cancers	1.2×10^{-5}
Maximally exposed individual	
Annual dose (mrem/yr)	9.0×10^{-3}
Percent of natural background[a]	2.6×10^{-3}
Associated latent fatal cancer risk	4.5×10^{-9}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	8.5×10^{-5}
Associated latent fatal cancer risk	4.3×10^{-11}

[a] The annual natural background radiation level at LANL is 349 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 102,200 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of LANL in 2005 (292,700).
Key: LANL, Los Alamos National Laboratory.
Source: Appendix J.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 0.025 person-rem. The corresponding number of LCFs in the population around LANL from annual operation of the facility would be 1.2×10^{-5}. The total dose to the maximally exposed member of the public from annual operation would be 9.0×10^{-3} mrem; this corresponds to an LCF risk of 4.5×10^{-9}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–248; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF.

Table 4–248. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at LANL

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Key: LANL, Los Alamos National Laboratory.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved with operations will be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program will ensure that doses will be reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998d.

Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Limited hazardous chemical releases would be expected as a result of modification or operation activities. However, concentrations would be within the regulated exposure limits.

4.27.4.5 Facility Accidents

The only change in employment resources that would be required for lead assembly fabrication at LANL would be increased labor hours to modify the existing glovebox line and related equipment. Given the estimated 594 person-days of construction labor and standard industrial accident rates, about 0.25 cases of nonfatal occupational injury or illness and 3.5×10^{-4} fatality would be expected.

The potential consequences of postulated bounding facility accidents from lead assembly operations at LANL are presented in Table 4–249. The source terms are identical to those for lead assembly operations at ANL–W; the different consequences are attributable to differences in stack height, meteorology, site boundary distance, and population.

Table 4–249. Accident Impacts of Lead Assembly Fabrication at LANL

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	6.5×10^{-2}	2.6×10^{-5}	2.8×10^{-2}	1.4×10^{-5}	6.6	3.2×10^{-3}
Design basis earthquake	Unlikely	1.1×10^{-4}	4.3×10^{-8}	4.1×10^{-5}	2.1×10^{-8}	1.4×10^{-2}	6.8×10^{-6}
Design basis fire	Unlikely	4.7×10^{-5}	1.9×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	5.9×10^{-3}	2.9×10^{-6}
Design basis explosion	Extremely unlikely	7.6×10^{-4}	3.0×10^{-7}	2.9×10^{-4}	1.5×10^{-7}	9.5×10^{-2}	4.8×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.1×10^{1}	2.1×10^{-2}	1.4×10^{1}	7.1×10^{-3}	4.2×10^{3}	2.1
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-1}	4.6×10^{-5}	3.1×10^{-2}	1.6×10^{-5}	9.2	4.6×10^{-3}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: LANL, Los Alamos National Laboratory.

The most severe consequences of a design basis accident would be associated with a nuclear criticality. Bounding radiological consequences for the MEI would result in a dose of 2.8×10^{-2} rem, corresponding to an LCF probability of 1.4×10^{-5}. Consequences of the criticality for the general population in the environs of LANL would include an estimated 3.2×10^{-3} LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the criticality accident. The consequences of such an accident would include an LCF probability of 2.6×10^{-5}.

The radiological effects from total collapse of the lead assembly fabrication facility at LANL in the beyond-design-basis earthquake would be approximately 2.1 LCFs in the population residing within 80 km (50 mi) of LANL. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

4.27.4.6 Transportation

Plutonium dioxide would already be at LANL so no shipping would be required for this material. These facilities would receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to a reactor site. Approximately 20 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 55,000 km (34,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.5 person-rem; the dose to the public, 10.3 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.9×10^{-4} LCF among transportation workers and 5.1×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 1.5×10^{-4}.

Impacts of Accidents During Ground Transportation. Estimates of the total ground transportation accident risks follow: a radiological dose to the population of 6.2 person-rem, resulting in a total population risk of 3.1×10^{-3} LCF; and traffic accidents resulting in 6.7×10^{-4} traffic fatality.

4.27.4.7 Other Resource Areas

Other resource areas include geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected to any of these resource areas.

4.27.4.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, the lead assembly fabrication activities at LANL would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of LANL would be 1.2×10^{-5}; thus, no additional LCFs would be expected (see Table 4–247). Transportation related to these activities would not be expected to result in any LCFs either. The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 8.3×10^{-3} due to radiological impacts, by 1.5×10^{-4} due to emissions, and by 6.7×10^{-4} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.4.6). Risks posed by the implementation of the LANL alternative for lead assembly fabrication would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at LANL would have no significant impacts on minority or low-income populations.

4.27.5 SRS

4.27.5.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at SRS would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at SRS and should result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating these existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at SRS. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly fabrication facility would be smaller than the levels shown in Table 4–79, and the concentrations at the site boundary would continue to meet ambient air quality standards. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less than 0.0001 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAP limit.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic associated with operating these facilities would be a small fraction of the existing traffic associated with activities at SRS and should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment should be similar to noise from existing ventilation equipment.

Next Section

4.27.5.2 Waste Management

Table 4–250 compares the waste generated during modification of facilities for lead assembly fabrication at SRS with the existing treatment, storage, and disposal capacity for the various waste types. No TRU waste, LLW, or mixed LLW would be generated during modification. For this SPD EIS, it is assumed that hazardous and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–250. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	1	NA	NA	NA
Nonhazardous				
Liquid	2,350	2[c]	NA	<1[d]
Solid	19	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.
[c] Percent of the capacity of H-Area sanitary sewer.
[d] Percent of the capacity of Central Sanitary Wastewater Treatment Facility.
Key: NA, not applicable (i.e., it is assumed that the majority of the hazardous and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Hazardous waste generated during modification of facilities for lead assembly fabrication would be typical of those generated during construction of an industrial facility. Any hazardous waste generated during modification would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the modification period should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the SRS nonhazardous solid waste management system.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be managed at the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generation during modification of these facilities is estimated to be 2 percent of the 136,274-m^3/yr (178,246-yd^3/yr) capacity of the H-Area sanitary sewer and less than 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–251 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from lead assembly fabrication at SRS. No HLW would be generated during lead assembly fabrication.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at SRS or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and

Table 4–251. Potential Waste Management Impacts of Operation of Lead Assembly Facility at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	2	<1	<1 of WIPP
LLW	200	1	NA	2
Mixed LLW	1	<1	<1	NA
Hazardous	<1	<1	<1	NA
Nonhazardous				
Liquid	1,600	1[d]	NA	<1[e]
Solid	1,300	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation annually. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of the capacity of H-Area sanitary sewer.
[e] Percent of the capacity of Central Sanitary Wastewater Treatment Facility.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997b:17). Therefore, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged and certified to WIPP waste acceptance criteria at the lead assembly fabrication facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generated by lead assembly fabrication is estimated to be 2 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all of the TRU waste were stored on the site, this would be less than 1 percent of the 34,400 m^3 (45,000 yd^3) of storage capacity available at the TRU Waste Storage Pads. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facilities before transfer for treatment and disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generated by lead assembly fabrication is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility (CIF) and 2 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687-m^3/ha (4,598-yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generated by lead assembly fabrication is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of CIF, and less than 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste would be packaged at the generating facility for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generated by lead assembly fabrication is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of CIF, and less than 1 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous waste generated by lead assembly fabrication activities is treated in CIF, this additional waste would be only 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of CIF.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent to a non-DOE disposal facility. This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous wastewater would be managed in H-Area. Nonhazardous wastewater would be treated, if necessary, before being discharged to the H-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by lead assembly fabrication is estimated to be 1 percent of the 136,274-m^3/yr (178,246-yd^3/yr) capacity of the H-Area sanitary sewer and less than 1 percent of the 1.03-million-m^3/yr (1.35-million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the wastewater treatment system.

4.27.5.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification and operation of the facilities for the proposed lead assembly program in Building 221–H. Proposed activities would use existing facilities, therefore, utility connections are in existence. See Table 3–64 for additional information on the infrastructure characteristics of Building 221–H. To support lead assembly fabrication, annual electricity requirements are estimated to increase by 720 MWh. Current annual electrical usage at Building 221–H is 120,000 MWh, with a current annual capacity is 500,000 MWh. An additional annual coal requirement for heating is estimated at 60 t (66 tons). An estimated 4,600 l (1,215 gal) of diesel oil for emergency generators is also required. Fuel is procured on the site on an as-needed basis. Annual total groundwater usage for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). Current annual water usage is 380 million l (100 million gal), while the current capacity is 1.5 billion l (396 million gal). There would not be any major impacts to infrastructure should the decision be made to conduct the proposed lead assembly program in Building 221–H (O'Connor et al. 1998e).

4.27.5.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at SRS. Moreover, doses to construction workers should not exceed normally low levels attributable to routine occupancy. Nonetheless, construction workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

Table 4–252 reflects potential radiological impacts of normal operations on three individual receptor groups at SRS: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–252. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at SRS

Population within 80 km for year 2005	
Dose (person-rem/yr)	6.6×10^{-3}
Percent of natural background[a]	3.0×10^{-6}
Associated latent fatal cancers	3.3×10^{-6}
Maximally exposed individual	
Annual dose (mrem/yr)	5.5×10^{-5}
Percent of natural background[a]	1.9×10^{-5}
Associated latent fatal cancer risk	2.8×10^{-11}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	8.8×10^{-6}
Associated latent fatal cancer risk	4.4×10^{-12}

[a] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 222,400 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2005 (754,000).
Source: Appendix J.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 6.6×10^{-3} person-rem. The corresponding number of LCFs in the population around SRS from annual operation of the facility would be 3.3×10^{-6}. The total dose to the maximally exposed member of the public from annual operation would be 5.5×10^{-5} mrem; this corresponds to an LCF risk of 2.8×10^{-11}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–253; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Limited hazardous chemical releases would be expected as a result of modification or operation activities. However, concentrations would be within the regulated exposure limits.

Table 4–253. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at SRS

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998e.

4.27.5.5 Facility Accidents

The SRS lead assembly fabrication option would involve a total of 59,000 person-days of construction labor. Thus, given standard industrial accident rates, 24.3 cases of nonfatal occupational injury or illness and 0.034 fatality would be expected.

The potential consequences of postulated bounding facility accidents from lead assembly operations at SRS are presented in Table 4–254. The source terms are identical to those for lead assembly operations at ANL–W; the different consequences are attributable to differences in stack height, meteorology, site boundary distance, and population.

The most severe consequences of a design basis accident would be associated with a nuclear criticality. Bounding radiological consequences for the MEI would result in a dose of 9.3×10^{-4} rem, corresponding to an LCF probability of 4.6×10^{-7}. Consequences of the criticality for the general population in the environs of SRS would include an estimated 6.5×10^{-4} LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

Consistent with the analysis presented in the *Storage and Disposition Final PEIS*, the noninvolved worker is assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the criticality accident. The consequences of such an accident would include an LCF probability of 4.0×10^{-6}.

The radiological effects from total collapse of the lead assembly fabrication facility at SRS in the beyond-design-basis earthquake would be approximately 1.1 LCF in the population residing within 80 km (50 mi) of SRS. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the

Table 4–254. Accident Impacts of Lead Assembly Fabrication at SRS

Accident	Frequency (per year)	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)[a]	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)[a]	Latent Cancer Fatalities Within 80 km[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.0×10^{-6}	9.3×10^{-4}	4.6×10^{-7}	1.3	6.5×10^{-4}
Design basis earthquake	Unlikely	7.8×10^{-6}	3.1×10^{-9}	1.3×10^{-6}	6.7×10^{-10}	5.6×10^{-3}	2.7×10^{-6}
Design basis fire	Unlikely	3.4×10^{-6}	1.3×10^{-9}	5.8×10^{-7}	2.9×10^{-10}	2.4×10^{-3}	1.2×10^{-6}
Design basis explosion	Extremely unlikely	5.5×10^{-5}	2.2×10^{-8}	9.5×10^{-6}	4.7×10^{-9}	3.9×10^{-2}	1.9×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	2.6×10^{1}	1.0×10^{-2}	8.8×10^{-1}	4.4×10^{-4}	2.2×10^{3}	1.1
Beyond-design-basis fire	Beyond extremely unlikely	5.8×10^{-2}	2.3×10^{-5}	2.0×10^{-3}	9.8×10^{-7}	4.9	2.4×10^{-3}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

4.27.5.6 Transportation

Plutonium dioxide would be shipped from LANL to lead assembly fabrication facilities at SRS. These facilities would also receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to a reactor site. Approximately 20 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 84,000 km (52,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.5 person-rem; the dose to the public, 10.2 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.9×10^{-4} LCF among transportation workers and 5.1×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 3.4×10^{-4}.

Impacts of Accidents During Ground Transportation. Estimates of the total ground transportation accident risks follow: a radiological dose to the population of 6.7 person-rem, resulting in a total population risk of 3.4×10^{-3} LCF; and traffic accidents resulting in 7.3×10^{-4} traffic fatality.

4.27.5.7 Other Resource Areas

Other resource areas include geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected to any of these resource areas.

4.27.5.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, the lead assembly fabrication activities at SRS would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of SRS would be 3.3×10^{-6}; thus, no additional LCFs would be expected (see Table 4–252). Transportation related to these activities would not be expected to result in any LCFs either. The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 8.5×10^{-3} due to radiological impacts, by 3.4×10^{-4} due to emissions, and by 7.3×10^{-4} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.5.6). Risks posed by the implementation of the SRS alternative for lead assembly fabrication would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at SRS would have no significant impacts on minority or low-income populations.

4.27.6 Postirradiation Examination

After the lead assemblies have been irradiated, they would be shipped to a postirradiation facility where they would be disassembled and examined. DOE facilities being considered for this work include ANL–W and ORNL. These two sites are currently the only sites that possess the capability to conduct postirradiation examination activities without major modifications to facility and processing capabilities. The only facility modification that might be needed to perform the work is to increase the size of the hot cell to receive a full-size fuel assembly.

4.27.6.1 Transportation

In order to support these activities, the spent MOX fuel assemblies would be shipped from the reactor site to the postirradiation examination facilities. Because it not known where the reactor would be located, it has been assumed that the fuel would be shipped 4,000 km (2,486 mi) to a postirradiation examination facility. Approximately eight shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be 32,000 km (20,000 mi). The transportation impacts for postirradiation examination have been included in the impacts presented in Sections 4.27.1 to 4.27.5.

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities related to postirradiation examination has been estimated at 1.5 person-rem; the dose the public, 10.2 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.8×10^{-4} LCF among transportation workers and 5.1×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 8.3×10^{-5}.

Impacts of Accidents During Ground Transportation. The total ground transportation accident risks for shipping spent fuel assemblies to the postirradiation examination facility is estimated to be 0.0027 LCF from radiation and 2.5×10^{-4} traffic fatality.

4.27.6.2 ANL–W

Radiological Impacts. No radiological risk would be incurred by members of the public from the minor modification of the hot cell at the postirradiation examination facility at ANL–W. Moreover, doses to associated workers should not exceed the normally low levels attributable to routine occupancy. Nonetheless, workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

There would be no radiological releases associated with the normal operation of the postirradiation examination facility at ANL–W; thus, there would be no radiological impacts incurred by the public from this facility.

Doses to involved workers from normal operations are given in Table 4–255; these workers are defined as those directly associated with postirradiation examination facility activities. Under the proposed action, the annual average dose to postirradiation examination facility workers is estimated to be 177 mrem. The annual dose received by the total involved workforce for this facility would be 1.8 person-rem, which corresponds to 7.1×10^{-4} LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–255. Potential Radiological Impacts on Involved Workers of Operation of Postirradiation Examination Facility at ANL–W

Number of badged workers	10[a]
Total dose (person-rem/yr)	1.8
Associated latent fatal cancers	7.1×10^{-4}
Average worker dose (mrem/yr)	177
Associated latent fatal cancer risk	7.1×10^{-5}

[a] The maximum estimated dose to one of these workers is 347 mrem/yr.
Key: ANL–W, Argonne National Laboratory–West.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998a.

Hazardous Chemical Impacts. Limited hazardous chemical releases would be expected as a result of modification or examination activities. However, concentrations would be within the regulated exposure limits.

Facility Accidents. The accident risks to the public, worker, and environment from postirradiation examination of spent light water reactor (LWR) fuel rods have been analyzed at a number of existing DOE and commercial facilities (PNL 1996). Spent fuel rods or assemblies are shipped from the reactor site to a postirradiation examination facility in heavy shielded casks. Fuel rods are typically removed from the fuel assemblies or bundles in deep, water-filled fuel storage basins and transferred via heavy, shielded casks. The rods are transferred from the casks to heavily shielded hot cells designed to protect the operators from the intense gamma and neutron radiation. Accidents occurring in the hot cells due to fuel examination, including spills, fires, and handling accidents, would not result in unfiltered releases or serious worker exposures due to the multiple HEPA filters on the cell exhaust and the heavy construction and shielding of the cell. The most severe accident conceivable with these types of operations would be nuclear criticality. The amount of spent fuel necessary for an accident to be physically possible, however, would be at least one to two orders of magnitude greater than would normally be available during postirradiation examination. Such an accident could result in high, though probably not fatal, radiological exposures to hot cell workers. Noninvolved workers and members of the public would also be exposed to doses in the range of fractions of a millirem to a hundred millirem, depending on distance from the facility. For example, a criticality of 1×10^{19} fissions would result in increased probabilities of fatal cancer to the noninvolved worker and MEI of 3.1×10^{-5} and 2.5×10^{-6}, respectively. No LCFs would be expected in the general population as a result of the accident.

4.27.6.3 ORNL

Radiological Impacts. No radiological risk would be incurred by members of the public from the minor modification of the hot cell at the postirradiation examination facility at the Oak Ridge National Laboratory (ORNL). Moreover, doses to associated workers should not exceed the normally low levels attributable to routine occupancy. Nonetheless, workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

There would be no radiological releases associated with the normal operation of the postirradiation examination facility at ORNL; there would be no radiological impacts incurred by the public from this facility.

Doses to involved workers from normal operations are given in Table 4–256; these workers are defined as those directly associated with postirradiation examination facility activities. Under the proposed action, the annual average dose to postirradiation examination facility workers is estimated to be 177 mrem. The annual dose received by the total involved workforce for this facility would be 1.8 person-rem, which corresponds to 7.1×10^{-4} LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–256. Potential Radiological Impacts on Involved Workers of Operation of Postirradiation Examination Facility at ORNL

Number of badged workers	10[a]
Total dose (person-rem/yr)	1.8
Associated latent fatal cancers	7.1×10^{-4}
Average worker dose (mrem/yr)	177
Associated latent fatal cancer risk	7.1×10^{-5}

[a] The maximum estimated dose to one of these workers is 347 mrem/yr.

Key: ORNL, Oak Ridge National Laboratory.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995e). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: O'Connor et al. 1998f.

Hazardous Chemical Impacts. Limited hazardous chemical releases would be expected as a result of modification or examination activities. However, concentrations would be within the regulated exposure limits.

Facility Accidents. The impacts of accidents associated with postirradiation examination activities at ORNL are substantially equivalent to those associated with the same activities at ANL–W as discussed in Section 4.27.6.2.

Next Section

4.28 SUMMARY OF *STORAGE AND DISPOSITION PEIS* GENERIC REACTOR ANALYSIS

Section 4.3.5.2 of the *Storage and Disposition Final PEIS* provides an analysis of the Existing Light Water Reactor Alternative proposed in that document. This alternative is consistent with the MOX fuel fabrication alternatives proposed in this SPD EIS. Assemblies containing MOX fuel rods would replace some of the low-enriched uranium fuel assemblies in one or more existing domestic, commercial power reactors. The *Storage and Disposition Final PEIS* evaluated this alternative as the operation of a minimum of three reactors that could be located at the same or different sites, and presented the impacts in the context of a generic range of conditions that could exist at potential locations. Those impacts are summarized here, as they are used to present a complete picture of potential impacts of implementing the MOX fuel fabricating alternatives proposed in this SPD EIS.

The *Storage and Disposition Final PEIS* indicates that the only changes to an existing reactor site might be a small addition to the fuel receiving and storage buildings to properly handle MOX fuel. However, if this were required, it would be only a minor change to the plant profile and would be anticipated to use land area previously disturbed. Therefore, any new construction would be inconsequential. As a result, land use; visual, cultural, and paleontological resources; geology and soils; and site infrastructure would not be affected by any new construction or other activities related to MOX fuel use. Neither would there be any effect on air quality and noise, ecological and water resources, or socioeconomics.

Use of MOX fuel would not generate high-level or TRU waste, nor would it be expected to increase the amount or change the content of the waste generated. Although the radionuclide distribution in the waste would be somewhat different, the *Storage and Disposition Final PEIS* indicates that system modifications would not be expected to be required to comply with regulatory requirements. It also indicates that while there would be no additional waste generated as a result of using MOX fuel, more spent fuel would be generated as a result of the proposed disposition of surplus plutonium as MOX fuel. This was attributed to the assumed practice of removing the MOX fuel assemblies from the reactor as soon as the fuel had been irradiated enough to meet the Spent Fuel Standard, rather than leaving it in the reactor for the maximum length of time. The *Storage and Disposition Final PEIS* indicated that even so, there would be sufficient space at the reactor sites (in either spent fuel pools or dry storage) to store the additional spent fuel until it could be sent to a geologic repository pursuant to the Nuclear Waste Policy Act (NWPA).

During normal operation, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. However, the radiological doses and resulting fatal cancer risks to both the average and maximally exposed member of the public, and also to the population, would not be significantly different than operations with a uranium core. The *Storage and Disposition Final PEIS* predicts that the annual population dose would be less than 2.0 person-rem. Nonradiological chemical emissions, and consequently, hazardous chemical impacts, which were essentially zero, would not change as a result of using MOX fuel.

Doses to onsite workers from normal operations with a uranium core would range from 280 to 540 mrem/yr. Using MOX fuel could increase worker dose by 1.3 to 2.7 mrem/yr, to a range of 281 to 543 mrem/yr. Dose to the total site workforce could increase by 1.6 to 4.8 person-rem/yr, from a range of 327 to 1,190 person-rem/yr to 331 to 1,193 person-rem/yr.

The *Storage and Disposition Final PEIS* also evaluated the potential impacts from a set of postulated highly unlikely accidents with potentially severe consequences at a domestic, commercial power reactor using both uranium-only and MOX cores. In this evaluation, the *Storage and Disposition Final PEIS* cited a report by the National Academy of Sciences (NAS), *Management and Disposition of Excess Weapons Plutonium Reactor-Related Options* (NAS 1995). This NAS report indicates that the potential influences on safety of the use of MOX fuel in LWRs[3] were extensively studied in the United States in the 1970s in the *Final Generic Environmental Impact Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors*, NUREG-0002 (NRC 1976). Regarding effects of MOX fuel on accident probabilities, the NAS report states, ". . . no important overall adverse impact of MOX use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than low enriched uranium (LEU) fuel" (NAS 1995:352). Regarding the effects of MOX fuel on accident consequences, the report states, ". . . it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by no more than 10 to 20 percent. The influence on the consequences of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all" (NAS 1995:355).

In the *Storage and Disposition Final PEIS*, the incremental effects of using MOX fuel in a commercial reactor in place of LEU fuel were derived from a quantitative analysis of several highly unlikely severe accident scenarios for MOX and LEU fuel. The analysis considers severe accidents where sufficient damage could occur to cause the release of plutonium or uranium. The consequences of these accident releases were found to be in the range of plus 8 to minus 7 percent,[4] compared with LEU fuel, depending on the accident release scenario. This analysis was based on existing commercial LWR probabilistic risk assessments of severe accidents, and the release scenarios were modeled assuming large population distributions near the LWRs and meteorological conditions for dispersal that lead to large doses, which are not necessarily reflective of specific or actual site conditions.

As discussed in Section 2.1.3, DOE is pursuing a contract for MOX fuel fabrication and irradiation services. As part of its Request for Proposals (RFP) for these services, DOE has requested that each offeror provide, as part of its proposal, environmental information specific to its proposed MOX facility design and the domestic, commercial reactors it proposes for irradiation of the MOX fuel. The SPD Final EIS will include environmental impact and accident analyses related to the specific reactors identified in response to the RFP.

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[3] Light water reactor is the type of reactor used in the United States for power production. The domestic, commercial nuclear reactors referred to in this SPD EIS are LWRs.

[4] Accidents severe enough to cause a release of plutonium involve combinations of events that are highly unlikely. Estimates and analyses presented in the *Storage and Disposition Final PEIS* indicate a range of postulated LCFs of 1.3×10^2 to 7.3×10^3 (in the population within 80 km [50 mi] of the release point) with attendant risks of LCFs over 11 years of reactor operation of 0.012 and 0.010, respectively (and risks of LCFs over 17 years of reactor operation of 0.018 and 0.016, respectively). One of the accidents analyzed had a higher risk of LCFs, 0.098 over 11 years (0.15 over 17 years), but the number of postulated LCFs (5.9×10^3) falls within the stated range of LCFs.

4.29 COMPARISON OF IMMOBILIZATION TECHNOLOGY IMPACTS

In order to provide a basis for evaluating alternative immobilization forms and technologies, the environmental impacts associated with operating the ceramic and glass can-in-canister immobilization facilities evaluated in this SPD EIS were compared with the corresponding environmental impacts associated with operating the homogenous ceramic immobilization and vitrification facilities evaluated in the *Storage and Disposition Final PEIS* (DOE 1996a).

Tables 4–257 through 4–265 present the comparable impacts for key environmental resources (e.g., air quality, waste management, human health risk, and resource requirements) at Hanford and SRS for the homogenous ceramic immobilization and vitrification facilities and the can-in-canister immobilization facilities. The impacts associated with facility accidents, intersite transportation and environmental justice are also discussed.

The comparison of impacts is based on immobilizing the full 50 t (55 tons) of surplus plutonium. The *Storage and Disposition Final PEIS* impact analyses are based on operating facilities that would convert the plutonium to an oxide in one new facility and immobilize it in a homogenous ceramic or glass form in another new facility. Impacts for a plutonium conversion facility are evaluated and itemized separately from the impacts for a ceramic immobilization or vitrification facility. In contrast, this SPD EIS considers the use of both new and existing facilities and is based on evaluating a collocated plutonium conversion and immobilization capability. To compare impacts, it was therefore necessary to combine the separate *Storage and Disposition Final PEIS* impact values, as appropriate, to establish a suitable standard of comparison.

4.29.1 Air Quality

Tables 4–257 and 4–258 present the potential emissions of federally regulated criteria pollutants for both the homogenous ceramic immobilization/vitrification facilities and the can-in-canister immobilization facilities. With the exception of sulfur dioxide in the ceramic can-in-canister process, all criteria pollutant emissions associated with either can-in-canister technology would be much lower. In terms of differences between the can-in-canister immobilized forms, pollutant levels attributed to the ceramic process would be slightly higher than those for the glass process, although both would be much lower than the regulatory limits.

Table 4–257. Estimated Concentrations of Air Pollutants ($\mu g/m^3$) of Immobilization Facilities During Operation at Hanford

		PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]	
Criteria Pollutant	Averaging Period	Ceramic Immobilization[a]	Vitrification[b]	Ceramic	Glass
Carbon monoxide	8 hours	40	12	0.28	0.11
	1 hour	320	96	1.6	0.73
Nitrogen dioxide	Annual	3.8	0.44	0.02	0.02
Ozone[d]	1 hour	NA	NA	NA	NA
PM_{10}	Annual	<0.01	<0.01	0	0
	24 hours	0.04	0.03	0.01	0.01
Sulfur dioxide	3 hours	0.03	0.77	0.08	0.08

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix G.
[d] Ozone is not directly emitted or monitored by the sites.
Key: NA, not applicable; PEIS, *Storage and Disposition Final PEIS*.
Source: DOE 1996a:4-436, 4-568, 4-614.

Table 4–258. Estimated Concentrations of Air Pollutants ($\mu g/m^3$) of Immobilization Facilities During Operation at SRS

Criteria Pollutant	Averaging Period	PEIS Homogenous Facilities: Ceramic Immobilization[a]	PEIS Homogenous Facilities: Vitrification[b]	Can-in-Canister Immobilization Facilities[c] New: Ceramic	New: Glass	Building 221–F: Ceramic	Building 221–F: Glass
Carbon monoxide	8 hours	344	103	0.14	0.06	0.15	0.07
	1 hour	1,620	485	0.58	0.26	0.59	0.27
Nitrogen dioxide	Annual	16	1.9	0.01	0.01	0.01	0.01
Ozone[d]	1 hour	NA	NA	NA	NA	NA	NA
PM_{10}	Annual	0.02	0.01	0	0	0	0
	24 hours	0.38	0.28	0.01	0.01	0.01	0.01
Sulfur dioxide	3 hours	0.24	5.7	0.61	0.61	0.62	0.62

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix G.
[d] Ozone is not directly emitted or monitored by the sites.
Key: NA, not applicable; PEIS, *Storage and Disposition Final PEIS*.
Source: DOE 1996a:4-436, 4-568, 4-614.

4.29.2 Waste Management

As shown in Table 4–259, potential volumes of each waste type resulting from operation of the ceramic or glass can-in-canister technology would be considerably less than the waste volumes expected from either homogenous ceramic immobilization or vitrification technology evaluated in the *Storage and Disposition Final PEIS*. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in TRU waste volumes of 126 m^3/yr (165 yd^3/yr), compared with the 647 m^3/yr (846 yd^3/yr) of TRU waste estimated in the *Storage and Disposition Final PEIS* from operation of the homogenous ceramic immobilization facility. Factors contributing to the reduced waste levels associated with the can-in-canister facility would include the use of dry-feed preparation techniques, coordination with existing HLW vitrification operations, and the need for a smaller operating workforce. Waste volumes would not be expected to differ appreciably between the ceramic and glass can-in-canister processes.

4.29.3 Human Health Risk

Radiological Impacts. Tables 4–260 and 4–261 present the potential radiological exposure and cancer risk to the public from normal operation of the immobilization facilities. The potential risks to the public associated with either can-in-canister technology would be about the same as the homogenous technologies at Hanford, but lower at SRS. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in population doses of 1.6×10^{-2} or 4.9×10^{-3} person-rem/yr, respectively, compared with the population doses of 8.4×10^{-3} (at Hanford) or 6.6×10^{-2} (at SRS) person-rem/yr resulting from operation of the homogenous ceramic immobilization facility evaluated in the *Storage and Disposition Final PEIS*. These variations may be attributable to the incorporation of updated source terms, meteorology, population distribution, and other modeling variables in the analysis of the can-in-canister technologies. A comparison between the ceramic and glass can-in-canister technologies indicates operation of the ceramic process would result in slightly higher potential offsite impacts, regardless of whether it is located at Hanford or SRS. For example, the dose associated with operation of the can-in-canister facility at Hanford would result in a population dose of 1.6×10^{-2} person-rem/yr using the ceramic process and

Table 4–259. Estimated Waste Volumes (m^3/yr) of Immobilization Facilities During Operation at Hanford and SRS

	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]					
			Hanford		SRS (New)		SRS (221–F)	
Waste Type	Ceramic Immobilization[a]	Vitrification[b]	Ceramic	Glass	Ceramic	Glass	Ceramic	Glass
TRU	647	573	126	126	126	126	126	126
LLW	1,820	1,820	80	80	80	80	80	80
Mixed LLW	191	191	1	1	1	1	1	1
Hazardous	70	51	30	30	30	30	30	30
Nonhazardous[d]								
Liquid	219,056	318,056	25,000	25,000	28,000	28,000	30,000	30,000
Solid	2,995	2,995	230	230	230	230	230	230

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix H.
[d] Includes sanitary and other nonhazardous waste.
Key: LLW, low-level waste; PEIS, *Storage and Disposition Final PEIS*; TRU, transuranic.
Source: DOE 1996a:4-471, 4-472, 4-603, 4-654, 4-655.

Table 4–260. Potential Radiological Impacts on the Public of Operations for Immobilization Facilities at Hanford

	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]	
Impact	Ceramic Immobilization[a]	Vitrification[b]	Ceramic	Glass
Maximally exposed individual (mrem/yr)	1.8×10^{-4}	1.9×10^{-4}	2.2×10^{-4}	2.0×10^{-4}
10-year latent fatal cancer risk	9.0×10^{-10}	9.7×10^{-10}	1.1×10^{-9}	1.0×10^{-9}
Population dose (person-rem/yr)	8.4×10^{-3}	9.2×10^{-3}	1.6×10^{-2}	1.5×10^{-2}
10-year latent fatal cancers	4.2×10^{-5}	4.6×10^{-5}	8.0×10^{-5}	7.5×10^{-5}
Average exposed individual (mrem/yr)	1.4×10^{-5}	1.5×10^{-5}	4.1×10^{-5}	3.9×10^{-5}
10-year latent fatal cancer risk	6.8×10^{-11}	7.4×10^{-11}	2.1×10^{-10}	2.0×10^{-10}

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix J.
Key: PEIS, *Storage and Disposition Final PEIS*.
Source: DOE 1996a:4-459, 4-460, 4-590, 4-591, 4-636, 4-637.

1.5×10^{-2} person-rem/yr using the glass process; the same facility at SRS would result in a population dose of 4.9×10^{-3} person-rem/yr using the ceramic process, and a dose of 4.5×10^{-3} person-rem/yr using the glass process.

Table 4–262 presents the potential radiological exposure and cancer risk to involved workers at the homogenous ceramic immobilization/vitrification facilities evaluated in the *Storage and Disposition Final PEIS* and the can-in-canister immobilization facilities. The estimated average worker dose and associated cancer risk for the can-in-canister technologies are slightly higher than estimated in the *Storage and Disposition Final PEIS* for the homogenous technologies. In all cases, however, the average worker dose would be within the DOE design objective of 1,000 mrem/yr (DOE 1995e). Although the estimated average dose to an individual involved worker is higher for the can-in-canister approaches than for the homogenous approaches (e.g., 750 mrem/yr versus 512 mrem/yr), the total dose to all involved workers would be lower

Table 4–261. Potential Radiological Impacts on the Public of Operations for Immobilization Facilities at SRS

Impact	PEIS Homogenous Facilities: Ceramic Immobilization[a]	PEIS Homogenous Facilities: Vitrification[b]	Can-in-Canister Immobilization Facilities[c] New: Ceramic	New: Glass	Building 221–F: Ceramic	Building 221–F: Glass
Maximally exposed individual (mrem/yr)	1.0×10^{-3}	1.1×10^{-3}	5.0×10^{-5}	4.6×10^{-5}	5.0×10^{-5}	4.6×10^{-5}
10-year latent fatal cancer risk	5.0×10^{-9}	5.4×10^{-9}	2.5×10^{-10}	2.3×10^{-10}	2.5×10^{-10}	2.3×10^{-10}
Population dose (person-rem/yr)	6.6×10^{-2}	7.1×10^{-2}	4.9×10^{-3}	4.5×10^{-3}	4.9×10^{-3}	4.5×10^{-3}
10-year latent fatal cancers	3.3×10^{-4}	3.6×10^{-4}	2.5×10^{-5}	2.3×10^{-5}	2.5×10^{-5}	2.3×10^{-5}
Average exposed individual (mrem/yr)	7.4×10^{-5}	8.0×10^{-5}	6.3×10^{-6}	5.7×10^{-6}	6.3×10^{-6}	5.7×10^{-6}
10-year latent fatal cancer risk	3.7×10^{-10}	4.0×10^{-10}	3.2×10^{-11}	2.9×10^{-11}	3.2×10^{-11}	2.9×10^{-11}

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix J.
Key: PEIS, *Storage and Disposition Final PEIS.*
Source: DOE 1996a:4-459, 4-460, 4-590, 4-591, 4-636, 4-637.

Table 4–262. Potential Radiological Impacts on Involved Workers of Operations for Immobilization Facilities at Hanford and SRS

Impact	PEIS Homogenous Facilities: Ceramic Immobilization[a]	PEIS Homogenous Facilities: Vitrification[b]	Can-in-Canister Immobilization Facilities[c] Hanford: Ceramic	Hanford: Glass	SRS (New): Ceramic	SRS (New): Glass	SRS (221–F): Ceramic	SRS (221–F): Glass
Average worker dose (mrem/yr)	512	433	750	750	750	750	750	750
10-year latent fatal cancer risk	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Total dose (person-rem/yr)	253	243	218	218	193	193	218	218
10-year latent fatal cancers	0.99	0.97	0.87	0.87	0.77	0.77	0.87	0.87

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix J.
Key: PEIS, *Storage and Disposition Final PEIS.*
Source: DOE 1996a:4-461, 4-593, 4-638, 4-639.

from either can-in-canister technology (ranging from 193 to 218 person-rem/yr) than from either homogenous technology (ranging from 243 to 253 person-rem/yr) because fewer workers would be required. Potential radiological impacts on involved workers are not expected to differ appreciably between the ceramic and glass can-in-canister processes.

Hazardous Chemical Impacts. Tables 4–263 and 4–264 present the potential hazardous chemical impacts resulting from operation of the homogenous ceramic immobilization/vitrification facilities and can-in-canister immobilization facilities. Although some potential hazardous chemical impacts were determined for the homogenous technologies evaluated in the *Storage and Disposition Final PEIS*, none are expected for either the ceramic or glass can-in-canister technology because no hazardous chemical emissions would occur from operations.

Table 4–263. Potential Hazardous Chemical Impacts on Public and Workers of Operations for Immobilization Facilities at Hanford

Impact	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]	
	Ceramic Immobilization[a]	Vitrification[b]	Ceramic	Glass
Maximally exposed individual (public)				
Hazard index	2.63×10^{-3}	6.99×10^{-4}	0	0
Cancer risk	3.2×10^{-8}	3.2×10^{-8}	0	0
Worker onsite				
Hazard index	1.62×10^{-1}	3.96×10^{-2}	0	0
Cancer risk	1.4×10^{-5}	1.4×10^{-5}	0	0

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] No hazardous or carcinogenic chemicals are expected to be released from operation of the can-in-canister immobilization facilities.
Key: PEIS, *Storage and Disposition Final PEIS.*
Source: DOE 1996a:4-463, 4-594, 4-640.

Table 4–264. Potential Hazardous Chemical Impacts on Public and Workers of Operations for Immobilization Facilities at SRS

Impact	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c] New		Can-in-Canister Immobilization Facilities[c] Building 221–F	
	Ceramic Immobilization[a]	Vitrification[b]	Ceramic	Glass	Ceramic	Glass
Maximally exposed individual (public)						
Hazard index	7.2×10^{-4}	1.9×10^{-4}	0	0	0	0
Cancer risk	8.7×10^{-9}	8.7×10^{-9}	0	0	0	0
Worker onsite						
Hazard index	1.4×10^{-1}	3.5×10^{-2}	0	0	0	0
Cancer risk	1.3×10^{-5}	1.3×10^{-5}	0	0	0	0

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] No hazardous or carcinogenic chemicals are expected to be released from operation of the can-in-canister immobilization facilities.
Key: PEIS, *Storage and Disposition Final PEIS.*
Source: DOE 1996a:4-463, 4-594, 4-640.

4.29.4 Facility Accidents

Because of substantial differences between the *Storage and Disposition Final PEIS* and the SPD EIS in terms of the specific accident scenarios and supporting assumptions used in the determination of facility accident impacts, no basis for appropriately comparing between homogenous technology and can-in-canister technology accidents is available. However, comparison between the ceramic and glass can-in-canister processes indicates slightly higher impacts would be associated with the ceramic process. For example, a design basis earthquake at Hanford would result in 9.6×10^{-5} LCF in the general population using the ceramic process, and 8.4×10^{-5} LCF using the glass process. Similarly, a design basis earthquake in a new facility at SRS would result in 3.6×10^{-5} LCF in the general population using a ceramic process, and 3.1×10^{-5} LCF using a glass process.

4.29.5 Resource Requirements

As shown in Table 4–265, operation of the can-in-canister immobilization technologies would require substantially lower amounts of electricity, fuel, land area, and water than would the ceramic immobilization and vitrification technologies evaluated in the *Storage and Disposition Final PEIS*. Fewer workers would be required to operate the can-in-canister technologies, which in turn would result in lower socioeconomic impacts. Resource requirements would differ between the ceramic and glass can-in-canister processes in two areas: water requirements would be greater to support the ceramic process at Hanford (i.e., the ceramic process would require 44 million l/yr (12 million gal/yr), compared with 41 million l/yr (11 million gal/yr) for the glass process) and electricity requirements would be greater to support the ceramic process at either site (i.e., the ceramic process would require 16,000 or 14,000 MWh/yr at Hanford or SRS, respectively, compared with the 15,000 or 13,000 MWh/yr, respectively, required for the glass process).

Table 4–265. Estimated Resource Requirements for Operations at Hanford and SRS

	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities					
			Hanford		SRS (New)		SRS (221–F)	
Resource	**Ceramic Immobilization[a]**	**Vitrification[b]**	**Ceramic**	**Glass**	**Ceramic**	**Glass**	**Ceramic**	**Glass**
Electricity (MWh/yr)	46,000	33,000	16,000	15,000	14,000	13,000	14,000	13,000
Peak load (MW)	8	8	3.8	3.6	2.9	2.7	2.9	2.7
Fuel								
Oil (l/yr)	229,750	418,250	29,000	29,000	29,000	29,000	29,000	29,000
Natural gas (m^3/yr)	436,100	3,936,100	0	0	0	0	0	0
Coal (t/yr)	0	0	0	0	450	450	450	450
Land use								
Construction area (ha)	16	20	2.1	2.1	12	12	11	11
New operation area (ha)	40	40	0	0	3.4	3.4	2.1	2.1
Water (million l/yr)	330	330	44	41	49	49	52	52
Total workers	1,743	1,651	304	304	271	271	312	312

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
Key: PEIS, *Storage and Disposition Final PEIS.*
Source: DOE 1996a:4-427, 4-432, 4-561, 4-566, 4-605, 4-610; UC 1998b, 1998c, 1998f, 1998g, 1998i, 1998j.

4.29.6 Intersite Transportation

The *Storage and Disposition Final PEIS* analysis assumes that canisters of plutonium immobilized with radionuclides would be transported to a Federal geologic repository via rail. Several canisters would be included in each shipment, and up to 64 shipments would be required from the homogenous ceramic immobilization/vitrification facility to the repository. Total potential fatalities were calculated based on both radiological and nonradiological risks to the public and workers for both routine and accident conditions. Intersite transportation associated with a homogenous ceramic immobilization/vitrification facility at Hanford were estimated to result in 0.96 and 0.98 total potential fatalities, respectively. Intersite transportation associated with those same facilities located at SRS were estimated to result in 1.40 and 1.43 total potential fatalities, respectively.

This SPD EIS analysis is consistent with the methodology used in the WM PEIS, which assumes that the immobilized canisters would be shipped by truck from the immobilization site to the repository. It also conservatively assumes that only one canister would be transported per truck shipment. The ceramic or glass can-in-canister facilities would require the production of an additional 210 or 340 canisters, respectively, over that expected for the DOE HLW vitrification program. Intersite transportation would result in 0.12 total potential fatalities in association with a glass can-in-canister facility at Hanford, and 0.21 total potential fatalities in association with a glass can-in-canister facility at SRS. Because the ceramic process would produce fewer canisters, it would correspondingly result in somewhat lower transportation impacts.

4.29.7 Environmental Justice

Evaluations of both the homogenous ceramic immobilization/vitrification technologies and can-in-canister technologies included routine facility operations and transportation as well as accidents. Generally, no LCFs would be expected to occur for normal operations or in the event of a design basis accident. For alternatives that include immobilization at Building 221–F, a design basis earthquake would be expected to result in 0.43 to 0.53 LCF among the general population. Depending on the weather conditions prevailing at the time of the earthquake, the expected impact could occur among any member of the general population residing within 80 km (50 mi) of the accident site. However, the probability of occurrence of a design basis earthquake is unlikely. Therefore, implementation of homogenous ceramic immobilization/vitrification technologies or can-in-canister technologies would pose no significant risk to the general population, nor would implementation of these technologies result in a significant risk of disproportionately high and adverse impacts on minority or low-income groups within the general population.

Next Section

4.30 INCREMENTAL IMPACTS OF REAPPORTIONING MATERIALS IN THE HYBRID APPROACH

Under the hybrid alternatives (Alternatives 2 through 10), it is possible that a small amount of the 33 t (36 tons) of surplus plutonium considered for disposition as MOX fuel would not meet fuel specifications, and thus would have to be added to the 17 t (19 tons) of surplus plutonium apportioned for immobilization. Because the immobilization and MOX facilities would be designed and constructed to process as much as 35 t (38 tons) and 50 t (55 tons), respectively, reapportionment of a small amount of material would not affect construction activities or schedules. However, such a shift in the material throughputs of each facility could slightly change their respective operating parameters. Thus, an analysis was conducted to evaluate the influence (per metric ton) of this shift on the environmental impacts presented for the hybrid alternatives in this SPD EIS—specifically, any operational incremental reduction of impacts attributable to the MOX facility and, conversely, the incremental increase in impacts attributable to the immobilization facility. In addition, a qualitative discussion of the incremental impacts of extending or shortening the operating period of the surplus plutonium disposition facilities is provided in Section 4.30.9.

4.30.1 Air Quality

The reapportionment of surplus plutonium from MOX fuel fabrication to immobilization would result in slight modifications in process emissions at each facility, as shown in Table 4–266. For the MOX facility, each metric ton of plutonium reallocated to the immobilization facility would result in a reduction in ethylene glycol emissions. As a result, the concentrations of this pollutant would decrease, but only by 29 one-millionths of the State standard at Hanford or 27 one-millionths of the State standard at SRS. For the immobilization facility, each additional metric ton of plutonium processed would result in increased carbon monoxide emissions. The concentrations of this pollutant would increase by only 10 one-millionths of the standard at Hanford and 5 one-millionths of the standard at SRS. No other process emissions would be associated with either facility. The pollutants associated with heating and cooling the facilities would not be affected because both facilities would continue to operate albeit at slightly higher or lower levels. See Appendix G for more details on the effects of these operations on air quality.

Table 4–266. Potential Incremental Changes in Emissions (kg/t) From Facility Operations

Pollutant	Incremental Reduction in MOX Facility Impacts[a]	Incremental Increase in Immobilization Facility Impacts[a]	Total Incremental Change
Carbon monoxide	NA	2,091	2,091
Ethylene glycol	303	NA	(303)

[a] Values are for the ceramic form of can-in-canister immobilization in FMEF at Hanford and a new facility at SRS.
Key: FMEF, Fuels and Materials Examination Facility; NA, not applicable.
Note: Values are per metric ton of surplus plutonium reapportioned from MOX fuel fabrication to immobilization.
Source: Appendix G.

4.30.2 Waste Management

Table 4–267 presents the incremental changes in annual operating waste volumes that would result from each metric ton of surplus plutonium reapportioned from MOX fuel fabrication to immobilization. This would result in slight annual reductions in the generation of TRU, LLW, mixed LLW, and hazardous wastes at the MOX facility. Although there would be associated slight increases in the generation of TRU and LLW at the immobilization facility, the incremental change from reapportioning each metric ton of plutonium would be a small net reduction in waste generation. However, such modifications in process throughput would not affect

Table 4–267. Potential Incremental Changes in Waste Generated (m^3/t) From Facility Operations

Waste Type[a]	Incremental Reduction in MOX Facility Impacts	Incremental Increase in Immobilization Facility Impacts	Total Incremental Change
TRU	13.9	9.4	(4.5)
LLW	10.3	6.1	(4.2)
Mixed LLW	0.61	0	(0.61)
Hazardous	<0.30	0	(<0.30)
Nonhazardous	NA[b]	NA[b]	NA[b]

[a] See definitions in Appendix F.8

[b] Generation of nonhazardous wastes (e.g., sanitary sewer, trash) are not considered a function of facility throughput.

Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.

Note: Values are per metric ton of surplus plutonium reapportioned from MOX fuel fabrication to immobilization.

Source: Appendix H.

either facility's generation of nonhazardous wastes, which is primarily a function of nonprocess activities such as facility air conditioning and sanitary systems.

4.30.3 Socioeconomics

Slight adjustments in the surplus plutonium material throughputs apportioned to either the MOX facility or immobilization facility would not be expected to affect the number of personnel needed to operate the facilities. Therefore, no change in socioeconomic impacts would be expected.

4.30.4 Human Health Risk

Table 4–268 presents the potential incremental radiological impacts on the public of reapportioning plutonium from the MOX facility to the immobilization facility. Because estimated radiological impacts would vary somewhat between sites and between the use of new or existing facilities, the analysis of a new MOX facility and a new immobilization facility at SRS is presented as a representative example of potential incremental changes to human health risk. In this example, the data clearly reflect the sensitivity of potential impacts to changes in material throughput. Each reapportioned metric ton of surplus plutonium would result in slight reductions in the doses and LCFs associated with normal operation of the MOX facility, and in contrasting increases in the doses and LCFs associated with normal operation of the immobilization facility. However, the total incremental change would equate to a net reduction in radiological impacts on the public.

4.30.5 Facility Accidents

Adjusting the amount of plutonium to be immobilized could influence accident impacts in two ways. One, increased throughput would increase the number of times a process would need to be repeated, therefore potentially increasing the chance of an accident occurring. Two, in some accident scenarios an increased amount of material at risk could increase the consequences. However, since the 50-t (55-ton) case was used to bound the accident analyses, the accident impacts reported under the individual immobilization alternatives would bound any incremental changes discussed here. See Appendix K for a more detailed description of assumptions and specific accident scenarios.

Table 4–268. Potential Incremental Changes in Radiological Impacts on the Public From Normal Operations[a]

Impact	Incremental Reduction in MOX Facility Impacts	Incremental Increase in Immobilization Facility Impacts[b]	Total Incremental Change
Population within 80 km for year 2010			
Dose (person-rem)	8.8×10^{-3}	7.9×10^{-4}	(8.0×10^{-3})
10-year latent fatal cancers	4.5×10^{-6}	3.9×10^{-7}	(4.2×10^{-6})
Maximally exposed individual			
Annual dose (mrem)	9.4×10^{-5}	7.9×10^{-6}	(8.6×10^{-5})
10-year latent fatal cancer risk	4.8×10^{-11}	3.9×10^{-12}	(4.5×10^{-11})
Average exposed individual within 80 km[c]			
Annual dose (mrem)	1.1×10^{-5}	1.0×10^{-6}	(1.0×10^{-5})
10-year latent fatal cancer risk	5.8×10^{-12}	5.2×10^{-13}	(5.2×10^{-12})

[a] SRS is presented as a representative site for purposes of analysis.
[b] Values are for the ceramic form of can-in-canister immobilization in a new facility.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2010 (785,400).
Note: Values are per metric ton of surplus plutonium reapportioned from MOX fuel fabrication to immobilization.
Source: Appendix J.

4.30.6 Transportation

The reapportionment of surplus plutonium from MOX fuel fabrication to immobilization would result in a slight decrease in the number of trips needed to transport uranium dioxide and MOX fuel rods from the MOX facility to a domestic commercial reactor. Conversely, it would increase the number of trips needed to transport additional canisters of immobilized plutonium from the HLW vitrification facility to the geologic repository. The incremental impacts of these changes would vary by site and SPD EIS collocation alternative because of the different travel routes and distances involved. Under any scenario, the radiological impacts from normal transportation of immobilized plutonium would not exceed those associated with Alternatives 12C or 12D. These alternatives entail the greatest distances for the transport of canisters given the disposition of all surplus plutonium through immobilization.

As more plutonium is sent to immobilization, the risks associated with radiological transportation accidents would generally become lower because there are fewer transportation requirements associated with immobilization. Any reduction in the amount of plutonium being sent to the MOX facility means there would be less depleted uranium required by the facility and less MOX fuel rods that would be shipped to a reactor for irradiation. Similarly, nonradiological transportation accident risks would also generally decrease as more plutonium is sent to immobilization, with the exception being under alternatives where the MOX facility would be collocated with the pit conversion facility at Pantex (Alternatives 9A, 9B, and 10). In these alternatives, the location of the majority of the surplus pits at Pantex, when collocated with the MOX facility, greatly reduces the distance that would need to be traveled under the hybrid alternatives. However, it needs to be recognized that the risks associated with transporting these materials to and from either disposition facility under any of the alternatives would be low.

4.30.7 Environmental Justice

Analysis in connection with this SPD EIS indicates that minority or low-income populations residing in the vicinity of the candidate sites would experience no significant impacts from either the MOX or immobilization facility under any of the disposition alternatives. Therefore, no significant impacts would be expected to result from the reapportionment of plutonium throughputs during routine operations. Facility accidents would similarly not be expected to pose a significant risk (when probability is considered) to the general population, nor would they be expected to result in a significant risk of disproportionately high and adverse impacts to minority or low-income groups within the general population.

4.30.8 Other Resource Areas

Several resource areas (i.e., geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and infrastructure) were determined to have minimal or no impacts from the disposition alternatives being considered, as discussed in Section 4.26. The reapportionment of plutonium throughputs from the MOX facility to the immobilization facility would not change the impacts on these resource areas.

4.30.9 Incremental Impacts of Extending or Shortening the Operating Period of Surplus Plutonium Disposition Facilities

Each of the disposition facilities is proposed to operate for only about 10 years. However, the operating life of the facilities may vary somewhat, depending on facility startup experiences and negotiations with other countries (e.g., Russia) regarding the pace of disposition. The operating period of the MOX facility could also be affected by the responses to the procurement, since the RFP allows offerors to recommend the length of operation needed to meet DOE's program goals. Slightly more or less material could be processed in any given year, potentially extending or shortening the operating period of any of the disposition facilities.

Some impacts occur only during surplus plutonium materials processing. For these resources, total impacts would not change even if the processing schedule was extended or shortened. This includes impacts to air quality for hazardous air pollutants, hazardous and radioactive waste management, human health risk, facility accidents during material processing, transportation impacts from material transport, and environmental justice. For example, if the operating period was extended by 1 year, the total dose and LCFs for the worker and the public would be expected to remain unchanged, even though the annual dose would be expected to decrease.

For other resources, impacts occur whenever the facility is operational regardless of whether material processing is occurring. These types of impacts are associated with activities, such as building heating, sanitary water use, and nonhazardous solid waste generation that would take place independent of the materials processing schedule. These include impacts to air quality for criteria air pollutants, nonhazardous waste management, socioeconomics, facility accidents not associated with material processing, transportation impacts from employee trips, and infrastructure. For example, air quality impacts from criteria pollutant emissions associated with building heating would continue as long as the facility is occupied. Likewise, impacts from nonhazardous waste management and impacts to infrastructure would occur as long as personnel continue to use potable water and generate nonhazardous waste. The impacts on these resource areas from extending or shortening the operating period are presented in Chapter 4 since this chapter largely presents impacts for these resources on an annual basis. Extending operations by 1 year would mean that impacts would continue at the level described in Chapter 4 for 1 year longer. Shortening operations by 1 year would mean that impacts would cease 1 year earlier.

4.31 DEACTIVATION AND STABILIZATION

DOE has anticipated the need for eventual deactivation of the proposed surplus plutonium disposition facilities. Process functions would be compartmentalized to allow isolation so that effective deactivation could be achieved. Protective coatings would be applied to concrete surfaces in the process areas to reduce the amount of contamination adsorbed into the concrete. Stainless steel cell and area liners would be provided to facilitate stabilization in selected areas where accumulation of radioactive contamination could increase personnel radiation exposure. Ventilation of operating and processing areas would minimize surface contamination from airborne contaminants. Process equipment would be designed to minimize areas where radioactive materials could accumulate. Operations would be conducted to minimize the spread of radioactive contamination.

When the missions have been completed and the facilities are no longer needed, deactivation and stabilization would be performed to reduce the risk of radiological exposure; reduce the need for and costs associated with long-term maintenance; and prepare the buildings for productive future use. At the end of the useful life of the facilities, DOE would evaluate options for decontamination and decommissioning (D&D). At that time, DOE would perform engineering evaluations, environmental studies, and further NEPA review to assess the consequences of different potential courses of action.

DOE anticipates that alternatives for disposition of the facilities would include:

- D&D and demolition of the structures and release of the site for unrestricted use
- D&D and demolition of the structures and restricted use of the site
- Partial D&D and retention of the structures for unrestricted use
- Partial D&D and retention of the structures for modified or restricted use

For the purposes of this SPD EIS, it is assumed that the equipment within the building would be deactivated and the facilities stabilized to a condition suitable for reuse. It is also assumed that this level of activity would take no more than 3 years to complete.

All feed materials, including any remaining plutonium metal, plutonium oxide, uranium oxide and chemicals, and process wastes, would be removed from the facilities to leave them in a low-cost condition for surveillance and maintenance. Usable items of equipment, instruments, and machine parts would be removed for reuse in other DOE facilities. After completion of the initial deactivation effort, the facilities would be monitored to ensure that contamination present in the facilities is contained and worker and public safety maintained. Deactivation and stabilization activities would be implemented in accordance with dismantlement work packages. Finally, a formal closeout would be conducted. Closeout activities would include inspection of support systems, such as heating, ventilation, and air conditioning (HVAC) and water systems, to ensure that they are in condition for reuse.

Next Section

4.32 CUMULATIVE IMPACTS

The projected incremental impacts of the operation of the proposed surplus plutonium disposition facilities were added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These other site activities include baseline impacts presented in Chapter 3. A methodology for this cumulative impact assessment is presented in Appendix F.

Impacts of the following are considered in the cumulative impacts assessment:

- Current activities at or in the vicinity of candidate sites
- Operation of the proposed surplus plutonium disposition facilities
- Other onsite and offsite activities that are reasonably foreseeable and documented

Other activities that may be implemented in the foreseeable future at one or more of the surplus plutonium disposition candidate sites and included in the cumulative impact assessment are discussed in the following documents:

- *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (ROD issued)

- *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (ROD issued)

- *Interim Management of Nuclear Materials at the Savannah River Site Final Environmental Impact Statement* (ROD issued)

- *Waste Isolation Pilot Plant Final Environmental Impact Statement* (ROD issued)

- *Tritium Supply and Recycling Final Programmatic Environmental Impact Statement* (ROD issued)

- *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Final issued; ROD issued for TRU waste)

- *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (ROD issued)

- *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (ROD issued)

- *Tank Waste Remediation System Final Environmental Impact Statement* (ROD issued)

- *Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement* (Final issued)

- *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (ROD issued)

- *Final Environmental Impact Statement for Stockpile Stewardship and Management* (ROD issued)

- *Draft Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (Draft issued)

- *Accelerator for Production of Tritium at Savannah River Site Environmental Impact Statement* (Draft issued)

- *Construction & Operation of a Tritium Extraction Facility at the Savannah River Site* (Draft issued)

- *Hanford Remedial Action and Comprehensive Land Use Plan Environmental Impact Statement* (Draft issued)

In addition to the actions listed in the above documents, DOE is also proposing a number of activities at some of the four candidate sites. For example, DOE recently proposed facilities for the treatment of mixed waste and HLW at INEEL (62 Federal Register 62025 and 62 Federal Register 49209). Such proposed facilities have the potential to affect cumulative impacts at INEEL by effects on air, soil, and water quality, by commitment of resources and use of land, and by effects on the public and workers from exposure to radiological and hazardous materials during normal operation and reasonably foreseeable accidents. Due to the preliminary nature of the proposed actions, no data are yet available, and therefore are not included in the cumulative impacts analysis. The SPD Final EIS will incorporate any additional data from those actions, as information becomes available.

The related programs included in the cumulative impact assessment and the four candidate sites potentially affected are identified in Table 4–269.

Tables included in the following sections combine No Action activities with reasonably foreseeable activities at each site under the heading "Other Site Activities." The impacts associated with the operation of the proposed surplus plutonium disposition facilities[5] are shown as "SPD EIS Maximum Impacts."

In addition to reasonably foreseeable site activities, non-Federal activities within the region of the candidate sites were considered in the cumulative impact analysis for selected resources. Because of the distances between the candidate sites and other existing and planned facilities, there is little opportunity for interactions of plant emissions in terms of impacts to air quality, water quality, or waste management. However, whenever possible, large source contributors have been evaluated for those impacts to human health risk and socioeconomics.

4.32.1 Hanford

For Hanford, the bounding alternative for this SPD EIS would be Alternative 2. Alternative 2 calls for the siting of all three proposed disposition facilities in the 400 Area with the pit conversion and immobilization facilities in FMEF and a new MOX facility located nearby.

4.32.1.1 Resource Requirements

Cumulative impacts on resource requirements at Hanford are presented in Table 4–270. Hanford would remain within its site capacity for its major resources, i.e., water, land, and power. If Alternative 2 were implemented, the proposed surplus plutonium disposition facilities would require 10 percent of the annual

[5] A bounding alternative was analyzed for each site. The bounding alternative is the alternative that involves the greatest amount of plutonium disposition construction and operation activity at the candidate site. For example, the bounding alternative for Hanford is Alternative 2—all facilities located at Hanford.

Table 4–269. Other Past, Present, and Reasonably Foreseeable Actions Included in the Cumulative Impact Assessment

Activities	Hanford	INEEL	Pantex	SRS
Storage and Disposition of Weapons-Usable Fissile Materials	X	X	X	X
Disposition of Surplus Highly Enriched Uranium				X
Interim Management of Nuclear Materials at SRS				X
SRS Waste Management				X
Tritium Supply and Recycling				X
Waste Management	X	X	X	X
Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management	X	X		X
Foreign Research Reactor Spent Nuclear Fuel		X		X
Tank Waste Remediation System	X			
Shutdown of the River Water System at SRS				X
Radioactive Releases From Nuclear Power Plant Sites, Vogtle and WNP	X			X
Hanford Remedial Actions and Comprehensive Land Use Plan	X			
Management of Plutonium Residues and Scrub Alloy at Rocky Flats				X
Hanford Reach of the Columbia River Comprehensive River Conservation Study	X			
Stockpile Stewardship and Management			X	X
Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components			X	
Accelerator Production of Tritium at SRS				X
Construction and Operation of a Tritium Extraction Facility at SRS				X

Key: NEPA, National Environmental Policy Act.

Table 4–270. Maximum Cumulative Resource Use and Impacts at Hanford—2007

Resource	Other Site Activities	Alternative 2 Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	14,840	1,014	15,854	NA
Electrical consumption (MWh/yr)	620,000	68,000	688,000	2,484,336
Water usage (million l/yr)	3,160	149	3,309	8,263
Developed land (ha)	9,279	15	9,294	143,200

Key: NA, not applicable.
Source: DOE 1995a, 1996e, 1997g.

electricity used on the site and 4.0 percent of the water; cumulatively, about 27 percent of the electricity, and 40 percent of the water would be required. The land used by these facilities would represent less than 1 percent of the developed land on the site; cumulatively, less than 6 percent of the land would be used. Impacts on resource requirements were evaluated for the year 2007 (the peak year) because that would be the first full year in which all three surplus plutonium disposition facilities operate simultaneously.

Nuclear facilities within an 80-km (50-mi) radius of Hanford include the WPPSS's WNP–2 nuclear reactor. Radiological impacts from the operation of the WNP–2 are minimal, but DOE has factored them into the analysis.

4.32.1.2 Air Quality

Cumulative impacts on air quality at Hanford are presented in Table 4–271. Hanford is currently in compliance with all Federal, State, and local regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contributions to overall site concentration are extremely small.

Table 4–271. Maximum Cumulative Air Pollutant Concentrations at Hanford and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] ($\mu g/m^3$)	Alternative 2 Increment ($\mu g/m^3$)	Estimated Cumulative Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.53	34.6	0.35
	1 hour	40,000	3.29	51.6	0.13
Nitrogen dioxide	Annual	100	0.046	0.296	0.3
PM_{10}	Annual	50	0.0025	0.0204	0.041
	24 hours	150	0.0278	0.798	0.53
Sulfur dioxide	Annual	50	0.00222	1.63	3.1
	24 hours	260	0.0247	8.94	3.4
	3 hours	1,300	0.168	29.8	2.3
	1 hour	700	0.504	33.4	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.0025	0.0204	0.034
	24 hours	150	0.0278	0.798	0.53
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	420	0.0406	0.0406	0.01

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

4.32.1.3 Waste Management

Cumulative impacts on waste management at Hanford are presented in Table 4–272. Although a few cumulative waste volumes would be expected to exceed current storage capacities if the wastes were held in storage and not disposed, this is not likely. Current schedules for shipment of TRU waste to WIPP indicate that TRU waste generated by the surplus plutonium disposition facilities would need to be stored onsite until 2016 (DOE 1997b:17). However, since Hanford is expected to begin shipping its existing inventory of TRU waste to WIPP in 1999 (DOE 1997b:17), TRU waste generated by surplus plutonium disposition facilities could be stored in the space vacated by the waste shipped to WIPP. Likewise, it is unlikely that additional LLW storage capacity would be needed since this waste is routinely sent to onsite disposal. Additional mixed LLW storage and disposal capacity could be required, but would likely be augmented by offsite commercial capacity.

Table 4–272. Cumulative Impacts of Waste Management Activities at Hanford Over 15-Year Period From 2002–2016 (m^3)

Waste Type	Other Site Activities	Alternative 2 Maximum Impacts[a]	Cumulative Total	Site Capacity[b] Treatment	Storage	Disposal
TRU	37,700	1,722	39,422	1,125,975	16,800	168,500[c]
LLW	129,000	2,240	131,240	2,047,050	23,988	1,970,000
Mixed LLW	37,500	44	37,544	2,376,975	24,466	14,200
Hazardous	13,000	414	13,414	NA	NA	NA
Nonhazardous						
Liquid	2,000,000	943,130	2,943,130	5,325,000	NA	5,325,000
Solid	645,000	30,094	675,094	NA	NA	NA

[a] Includes waste generated during lead assembly fabrication and postirradiation examination.
[b] Total 15-year capacity derived from Table 3–8.
[c] Current disposal capacity at WIPP.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

4.32.1.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at Hanford are presented in Table 4–273. The number of LCFs in the general population from Hanford operations would be expected to increase from 0.05 to 0.10 if the proposed surplus plutonium disposition facilities were located there as described in Alternative 2. No additional LCFs would be expected as a result of these activities. Doses to the MEI are based on source location; summing the MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 0.46 mrem which corresponds to an LCF risk from 15 years of site operations of 3.5×10^{-6}. The MEI for Alternative 2 would receive an additional 0.019 mrem per year, for a cumulative annual dose from all activities of 0.48 mrem and a corresponding risk of an LCF of 3.6×10^{-6}. The regulatory dose limits for individual members of the public are given in DOE Order 5400.5 (DOE 1993). As discussed in that order, the NESHAP dose limit from airborne emissions is 10 mrem/yr, as required by the Clean Air Act; the dose limit from drinking water is 4 mrem/yr, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 mrem/yr. Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of LCFs due to radiation from normal site operations of 2.2, from about 10 to 12.2, if all of the proposed surplus plutonium dispositions activities were sited at Hanford.

Table 4–273. Maximum Cumulative Radiation Exposures and Impacts at Hanford

Impact	Population Dose Within 80 km[a] Dose (person-rem)	Population Dose Within 80 km[a] Number of Fatal Cancers	Total Site Workforce Dose (person-rem)	Total Site Workforce Number of Fatal Cancers
Other site activities	120	0.06	25,000	10
Alternative 2	70	0.04	5,610	2.2
Cumulative	190	0.10	30,610	12.2

[a] Values are based on the total expected duration of all proposed disposition activities (includes construction, operation, and lead assembly).
Source: DOE 1995a, 1996e, 1997g.

4.32.1.5 Transportation

Transportation requirements associated with Alternative 2 at Hanford would include shipments to and from all three of the proposed surplus plutonium disposition facilities. It is estimated that the number of total shipments to and from Hanford would be 414,000 truck shipments during the same timeframe the surplus plutonium disposition facilities would be built and operated. Alternative 2 would add approximately 2,300 truck shipments to this estimate for a total of 416,300. The annual dose to the MEI from these shipments would be expected to increase from 1.68 mrem/yr to about 1.78 mrem/yr (DOE 1997g). This dose corresponds to an LCF risk from 15 years of transportation of 1.3×10^{-5}, which does not significantly increase the risk to the public.

4.32.2 INEEL

For INEEL, the bounding alternative for this SPD EIS would be Alternative 7A. Alternative 7A calls for the siting of the pit conversion facility in FPF and a new MOX facility to be located nearby.

4.32.2.1 Resource Requirements

Cumulative impacts on resource requirements at INEEL are presented in Table 4–274. INEEL would remain within its site capacity for all major resources. If Alternative 7A were implemented, the proposed surplus plutonium disposition facilities would require 8.4 percent of the annual electricity used on the site and about 1.5 percent of the water; cumulatively, about 81 percent of the electricity and 14 percent of the water would be required. The land used by these facilities would represent less than 1 percent of the developed land on the site; cumulatively, about 41 percent of the land would be used. Impacts on resource requirements were evaluated for the year 2007 because that would be the first full year in which both surplus plutonium disposition facilities operate simultaneously.

Table 4–274. Maximum Cumulative Resource Use and Impacts at INEEL—2007

Resource	Other Site Activities	Alternative 7A Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	7,250	750	8,000	NA
Electrical consumption (MWh/yr)	295,556	27,000	322,556	394,200
Water usage (million l/yr)	5,937	92	6,029	43,000
Developed land (ha)	9,328	13	9,341	230,000

Key: NA, not applicable.
Source: DOE 1995a, 1996h, 1997g.

4.32.2.2 Air Quality

Cumulative impacts on air quality at INEEL are presented in Table 4–275. INEEL is currently in compliance with all Federal, State, and local regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contributions to overall site concentrations are extremely small.

4.32.2.3 Waste Management

Cumulative impacts on waste management at INEEL are presented in Table 4–276. It is unlikely that there would be major impacts to the waste management infrastructure at INEEL since sufficient capacity should exist to manage the wastes that could be generated by planned activities. In the case of storage capacity for

Table 4–275. Maximum Cumulative Air Pollutant Concentrations at INEEL and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	Alternative 7A Concentration ($\mu g/m^3$)	Estimated Cumulative Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.703	303	3.0
	1 hour	40,000	2.82	1220	3.1
Nitrogen dioxide	Annual	100	0.141	11.1	11
PM_{10}	Annual	50	0.00798	3.01	6.0
	24 hours	150	0.0854	39.1	26
Sulfur dioxide	Annual	80	0.305	6.31	7.9
	24 hours	365	3.05	140	38
	3 hours	1,300	16.4	607	47
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	6,350	0.0197	0.0197	0.0031

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Table 4–276. Cumulative Impacts of Waste Management Activities at INEEL Over 15-Year Period From 2002–2016 (m^3)

	Other Site Activities	Alternative 7A Maximum Impacts[a]	Cumulative Total	Site Capacity[b] Treatment	Site Capacity[b] Storage	Site Capacity[b] Disposal
TRU	1,125	783	1,908	722,723	158,772	168,500[c]
LLW	119,355	1,816	121,171	1,368,818	112,500	565,500
Mixed LLW	10,035	35	10,070	1,754,453	114,499	NA
Hazardous	15,450	112	15,562	744,150	NA	NA
Nonhazardous						
Liquid	30,000,000	713,894	30,713,894	48,000,000	NA	48,000,000
Solid	930,270	27,431	957,701	NA	NA	NA

[a] Includes waste generated during lead assembly fabrication and postirradiation examination.
[b] Total 15-year capacity derived from Table 3–20.
[c] Current disposal capacity at WIPP.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

LLW, if the wastes were held in storage and not disposed of, the total would exceed current storage capacity. However, this waste is routinely disposed of on the site so there should not be any problem.

4.32.2.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at INEEL are presented in Table 4–277. The number of LCFs in the general population from INEEL site operations would be expected to increase from 0.06 to 0.07 if the proposed surplus plutonium disposition facilities were located there as described in Alternative 7A. Thus, no additional LCFs would be expected as a result of these activities. Doses to the MEI are based on source location; summing the MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 0.72 mrem, which

Table 4–277. Maximum Cumulative Radiation Exposures and Impacts at INEEL

	Population Dose Within 80 km		Total Site Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Other site activities	127	0.064	8,985	3.6
Alternative 7A[a]	22	0.011	3,503	1.4
Cumulative	149	0.075	12,488	5

[a] Values are based on the total expected duration of all proposed disposition activities (includes construction, operation, and lead assembly).

Source: DOE 1995a, 1996h, 1997g.

corresponds to an LCF risk from 15 years of site operations of 5.4×10^{-6}. The MEI for Alternative 7A would receive an additional 0.016 mrem per year, for a cumulative annual dose from all activities of 0.74 mrem and a corresponding risk of an LCF of 5.5×10^{-6}. The regulatory dose limits for individual members of the public are given in DOE Order 5400.5 (DOE 1993). As discussed in that order, the dose limit from airborne emissions is 10 mrem/yr, as required by the Clean Air Act; the NESHAP dose limit from drinking water is 4 mrem/yr, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 mrem/yr. Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations of 1.4, from about 3.6 to 5, if the pit conversion and MOX facilities were sited at INEEL.

4.32.2.5 Transportation

Transportation requirements associated with Alternative 7A at INEEL would include shipments to and from the proposed pit conversion and MOX facilities. The number of total shipments to and from INEEL is estimated to be 35,746 truck shipments during the approximately 15-year timeframe the surplus plutonium disposition facilities would be built and operated. Alternative 7A would add approximately 2,500 truck shipments to this estimate for a total of 38,246. The annual dose to the MEI from these shipments would be expected to increase from 1.05 mrem per year to about 1.1 mrem per year (DOE 1997g). This dose corresponds to an LCF risk from 15 years of transportation of 8.3×10^{-6}, which does not significantly increase the risk to the public.

4.32.3 Pantex

For Pantex, the bounding alternative for this SPD EIS would be Alternative 9A. Alternative 9A calls for the siting of the new pit conversion and MOX facilities in Zone 4.

4.32.3.1 Resource Requirements

Cumulative impacts on resource requirements at Pantex are presented in Table 4–278. Pantex would remain within its site capacity for all major resources. The Ogallala aquifer would not be impacted. If Alternative 9A were implemented, the proposed surplus plutonium disposition facilities would require 13.2 percent of the annual electricity used on the site and about 6.8 percent of the water; cumulatively, this would require about 35 percent of the water and 50 percent of the electrical capacity. The land used by these facilities would represent one percent of the developed land on the site; cumulatively, about 23 percent of the land will be developed. Impacts on resource requirements were evaluated for the year 2007 because that would be the first full year in which both surplus plutonium disposition facilities operate simultaneously.

Table 4–278. Maximum Cumulative Resource Use and Impacts at Pantex—2007

Resource	Other Site Activities	Alternative 9A Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	1,750	750	2,500	NA
Electrical consumption (MWh/yr)	184,296	28,000	212,296	420,500
Water usage (million l/yr)	1,247	91	1,338	3,785
Developed land (ha)	1,489	16	1,505	6,475

Key: NA, not applicable.
Source: DOE 1995a, 1996a, 1996b.

4.32.3.2 Air Quality

Cumulative impacts on air quality at Pantex are presented in Table 4–279. Pantex is currently in compliance with all Federal, State, and local regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contributions to overall site concentrations are extremely small.

Table 4–279. Maximum Cumulative Air Pollutant Concentrations at Pantex and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	Alternative 9A Concentration ($\mu g/m^3$)	Estimated Cumulative Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.687	620	6.2
	1 hour	40,000	3.79	3000	7.5
Nitrogen dioxide	Annual	100	0.0725	2.02	2
PM_{10}	Annual	50	0.00514	8.8	18
	24 hours	150	0.056	89.5	60
Sulfur dioxide	Annual	50	0.00264	0.00264	0.0033
	24 hours	365	0.0314	0.0314	0.0066
	3 hours	1,300	0.137	0.137	0.011
	30 minutes	1,048	0.55	0.55	0.053
Other regulated pollutants					
Total suspended particulates	3 hours	200	0.237	0.237[b]	0.12
	1 hour	400	0.783	0.783[b]	0.12
Hazardous and other toxic compounds					
Ethylene glycol	24 hours	26	0.217	0.217	0.83
	1 hour	260	5.3	5.3	2

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates are not listed for existing sources in the source document. Only the contribution from sources associated with the alternative are presented.

4.32.3.3 Waste Management

Cumulative impacts on waste management at Pantex are presented in Table 4–280. It is likely that some additional TRU waste storage capacity would be needed at Pantex. Because there is not any TRU waste currently stored at Pantex, space for storage would be provided within the new surplus plutonium disposition

Table 4–280. Cumulative Impacts of Waste Management Activities at Pantex Over 15-Year Period From 2002–2016 (m^3)

Waste Type	Other Site Activities	Alternative 9A Maximum Impacts	Cumulative Total	Site Capacity[a] Treatment	Storage	Disposal
TRU	0	640	640	NA	NA	168,500[b]
LLW	7,952	940	8,892	17,745	1,389	500,000[c]
Mixed LLW	420	30	450	16,335	1,047	NA
Hazardous	10,897	213	11,110	21,795	NA	NA
Nonhazardous						
Liquid	7,096,875	554,900	7,651,775	14,204,010	NA	14,204,010
Solid	19,740	22,320	42,060	NA	NA	NA

[a] Total 15-year capacity derived from Table 3–32.
[b] Current disposal capacity at WIPP.
[c] Current disposal capacity at NTS.
Key: LLW, low-level waste; NTS, Nevada Test Site; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

facility. It is unlikely that additional LLW storage capacity would be needed at Pantex because this waste is routinely sent to offsite disposal.

4.32.3.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at Pantex are presented in Table 4–281. The number of LCFs in the general population from Pantex site operations would be expected to increase from 5.5×10^{-5} to 0.003 if the proposed surplus plutonium disposition facilities were located there, as described in Alternative 9A. Thus, no additional LCFs would be expected as a result of these activities. Doses to the MEI are based on source location; summing the MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 2.2×10^{-3} mrem which corresponds to an LCF risk from 15 years of site operations of 1.7×10^{-8}. The MEI for Alternative 9A would receive an additional 0.068 mrem per year, for a cumulative annual dose from all activities of 0.070 mrem and a corresponding risk of an LCF would be 5.3×10^{-7}. The regulatory dose limits for individual members of the public are given in DOE Order 5400.5 (DOE 1993). As discussed in that order, the NESHAP dose limit from airborne emissions is 10 mrem/yr, as required by the Clean Air Act; the dose limit from drinking water is 4 mrem/yr, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 mrem/yr. Thus, the dose to the MEI would be expected to remain well within the regulatory limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations of 1.5, from about 0.2 to 1.7, if the pit conversion and MOX facilities were sited at Pantex.

4.32.3.5 Transportation

Transportation requirements associated with Alternative 9A at Pantex would include shipments to and from the proposed pit conversion and MOX facilities. It was estimated that the number of total shipments to and from Pantex would be 3,640 truck shipments during the approximately 15-year timeframe the surplus plutonium disposition facilities would be built and operated. Alternative 9A would add approximately 2,000 truck shipments to this estimate for a total of 5,640. The annual dose to the MEI from these shipments would be expected to increase from 0.97 mrem per year to about 1.3 mrem/yr (DOE 1997g). This dose

Table 4–281. Maximum Cumulative Radiation Exposures and Impacts at Pantex

	Population Dose Within 80 km		Total Site Workforce	
Impact	**Dose (person-rem)**	**Number of Fatal Cancers**	**Dose (person-rem)**	**Number of Fatal Cancers**
Other site activities	0.11	5.5×10^{-5}	514	0.2
Alternative 9A[a]	5.8	0.0029	3,670	1.5
Cumulative	5.9	0.0030	4,184	1.7

[a] Values are based on the total expected duration of all proposed disposition activities (includes construction and operations).
Source: DOE 1995a, 1996a, 1996b.

corresponds to an LCF risk from 15 years of transportation of 9.8×10^{-6}, which does not significantly increase the risk to the public.

4.32.4 SRS

For SRS, the bounding alternative for this SPD EIS would be Alternative 3A or 3B. Alternative 3A calls for the siting of new pit conversion, immobilization, and MOX facilities near APSF in F-Area. Alternative 3B is identical to Alternative 3A with the exception of the immobilization facility being housed in Building 221–F. In some cases, the impacts associated with Alternative 3A would be greater than those of 3B and vice versa. For the purposes of this section, the greater of the two has been included in the tables.

4.32.4.1 Resource Requirements

Cumulative impacts on resource requirements at SRS are presented in Table 4–282. If Alternative 3 is implemented, the proposed surplus plutonium disposition facilities would require 1 percent of the annual electricity used on the site and about 1 percent of the water. The land used by these facilities would represent less than 1 percent of the developed land on the site; cumulatively, about 68 percent of the electricity, 130 percent of the water capacity, and 8 percent of the land would be used. Projected water requirements exceed current site capacity due to accelerator requirements. If the accelerator is built and operated, additional water would be drawn from the Savannah River to satisfy the demand. Without the accelerator requirements, resource requirements would be well within site capacities. Impacts on resource requirements were evaluated for the year 2007 because that would be the first full year in which all three surplus plutonium disposition facilities operate simultaneously.

Table 4–282. Maximum Cumulative Resource Use and Impacts at SRS—2007

Resource	Other Site Activities	Alternative 3 Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	11,200	1,022	12,222	NA
Electrical consumption (MWh/yr)	3,520,000[a]	38,000	3,558,000[a]	5,200,000
Water usage (million l/yr)	12,350[a]	143	12,493[a]	9,230[b]
Developed land (ha)	6,880	30	6,911	80,130

[a] Includes estimates for operation of an accelerator for tritium production at SRS.
[b] This capacity does not include the existing, separate infrastructure for withdrawals from the Savannah River.
Key: NA, not applicable.

Nuclear facilities within an 80-km (50-mi) radius of SRS include Georgia Power Company's Vogtle Electric Generating Plant across the river from SRS; Chem-Nuclear Services facility, a commercial low-level waste disposal facility just east of SRS; and Starmet CMI, Inc., located southeast of SRS, which processes uranium-contaminated metals. Radiological impacts from the operation of the Vogtle Electric Generating

Plant, a two-unit commercial nuclear power plant, are minimal, but DOE has factored them into the analysis. The South Carolina Department of Health and Environmental Control Annual Report (SCDHEC 1992) indicates that operation of the Chem-Nuclear Services facility and the Starmet CMI facility do not noticeably impact radiation levels in air or liquid pathways in the vicinity of SRS. Therefore, they are not included in this assessment.

The counties surrounding SRS have numerous existing and planned industrial facilities with permitted air emissions and discharges to surface waters. Because of the distances between SRS and the private industrial facilities, there is little opportunity for interactions of plant emissions, and no major cumulative impact on air or water quality.

4.32.4.2 Air Quality

Cumulative impacts on air quality at SRS are presented in Table 4–283. SRS is currently in compliance with all Federal, State, and local regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contributions to overall site concentrations are extremely small.

Table 4–283. Maximum Cumulative Air Pollutant Concentrations at SRS and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline ($\mu g/m^3$)[a]	Alternative 3A Concentration ($\mu g/m^3$)	Estimated Cumulative Concentration ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.341	64.3	0.64
	1 hour	40,000	1.29	280	0.7
Nitrogen dioxide	Annual	100	0.0412	9.34	9.3
PM_{10}	Annual	50	0.00262	4.14	8.3
	24 hours	150	0.0427	56.4	38
Sulfur dioxide	Annual	80	0.0796	15.2	19
	24 hours	365	1.09	220	60
	3 hours	1,300	2.88	965	74
Other regulated pollutants					
Total suspended particulates	Annual	75	0.00262	14.7	20
Hazardous and other *toxic compounds*					
Ethylene glycol	24 hours	650	0.0585	0.254	0.039

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

4.32.4.3 Waste Management

Cumulative impacts on waste management at SRS are presented in Table 4–284. Additional mixed LLW storage capacity could be required, but would likely be augmented by offsite commercial capacity. Although the cumulative waste volume for hazardous waste exceeds the treatment and storage capacities, it is unlikely that there would be major impacts to the waste management infrastructure at SRS, since most hazardous waste is not held in long-term storage, and is treated and disposed of in offsite facilities. Treatment capacity for LLW could be exceeded; however, major impacts are unlikely since most LLW can be disposed of without treatment.

Table 4–284. Cumulative Impacts of Waste Management Activities at SRS Over 15-Year Period From 2002–2016 (m^3)

Waste Type	Other Site Activities	Alternative 3 Maximum Impacts[a]	Cumulative Total	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	19,665	1,872	21,537	25,800	34,400	168,500[c]
LLW	300,000	3,740	803,740	459,045	1,064	1,170,165
Mixed LLW	164,000	44	164,044	543,045	18,757	NA[d]
Hazardous	252,000	548	252,548	79,995	3,198	NA
Nonhazardous						
Liquid	6,341,550	855,400	7,196,950	15,450,000	NA	15,450,000
Solid	100,050	34,958	135,008	NA	NA	NA

a Includes waste generated during lead assembly fabrication.
b Total 15-year capacity derived from Table 3–44.
c Current disposal capacity at WIPP.
d Depending in part on decisions in the RODs for the WM PEIS, mixed LLW could be disposed of on the site or at another DOE site. (See Sections 3.5.8.8, 4.8.2.2, and Appendix F.8.)

Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely, treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Source: DOE 1995b, 1995c, 1996a, 1996h, 1997g, 1997i, 1997j, 1998b.

4.32.4.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at SRS are presented in Table 4–285. The number of LCFs in the general population from SRS operations would be expected to increase from 1.45 to 1.46 if the proposed surplus plutonium disposition facilities were located there, as described in Alternative 3B. Doses to the MEI are based on source location; summing the MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 3.7 mrem (from atmospheric releases), which corresponds to an LCF risk from 15 years of site operations of 2.8×10^{-5}. The MEI for Alternative 3B would receive an additional 0.004 mrem per year, for a cumulative annual dose from all activities of 3.7 mrem, which, along with the corresponding risk of an LCF, would be unchanged when rounded. The regulatory dose limits for individual members of the public are given in DOE Order 5400.5 (DOE 1993). As discussed in that order, the NESHAP dose limit from airborne emissions is 10 mrem/yr, as required by the Clean Air Act; the dose limit from drinking water is 4 mrem/yr, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 mrem/yr. Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations of 2.3, from about 7.6 to 9.9, if all of the proposed surplus plutonium dispositions activities were sited at SRS.

4.32.4.5 Transportation

Transportation requirements associated with Alternative 3 at SRS would include shipments to and from all three of the proposed surplus plutonium disposition facilities. The number of total shipments to and from SRS would be 239,790 truck shipments during the approximately 15-year timeframe the surplus plutonium disposition facilities would be built and operated. Alternative 3 would add approximately 2,500 truck shipments to this estimate for a total of 242,290. The annual dose to the MEI from these shipments would be

Table 4–285. Maximum Cumulative Radiation Exposures and Impacts at SRS

Impact	Population Dose Within 80 km		Total Site Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Other site activities	2,900	1.5	19,000	7.6
Alternative 3B[a]	16	0.008	5,630	2.3
Cumulative	2,916	1.5	24,630	9.9

[a] Values are based on total expected duration of all proposed disposition activities (includes construction, operation, and lead assembly).

Source: DOE 1995b, 1995c, 1996a, 1996d, 1996h, 1997g, 1997i, 1997j, 1998b; NRC 1996.

expected to increase from 0.59 mrem per year to about 0.69 mrem per year (DOE 1997g). This dose corresponds to an LCF risk from 15 years of transportation of 5.2×10^{-6}, which does not significantly increase the risk to the public.

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4.33 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes the major irreversible and irretrievable commitments of resources associated with the maximum number of proposed surplus plutonium disposition facilities that could be located at each site under any of the alternatives described in Chapter 2. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources neither renewable nor recoverable for later use by future generations. This section discusses three major resource categories that are committed irreversibly or irretrievably to the proposed action and alternatives: land, materials, and energy. Values for each are shown in Tables 4–286 and 4–287.

Table 4–286. Irreversible and Irretrievable Commitments of Construction Resources for SPD EIS Facilities

Resource	Hanford (Alternative 2)	INEEL (Alternative 7)	Pantex (Alternative 9)	SRS (Alternative 3)
Electrical energy, (MWh)	50,000	7,400	7,400	64,000
Liquid fuel (l)	1,200,000	1,000,000	1,700,000	2,600,000
Concrete (m^3)	15,000	15,000	27,000	80,000
Steel (t)	3,600	5,000	3,400	23,000

4.33.1 Land Use

The land that might be used for plutonium disposition facilities could be returned, in the long term, to open space and other uses, if the buildings, roads, and other structures were removed, the area decontaminated, and the land revegetated. Alternatively, the land could be reused for some other industrial or DOE mission. Therefore, the commitment of the land for facilities is not necessarily irreversible.

4.33.2 Materials

The irreversible and irretrievable commitment of material resources during the entire life cycle of plutonium disposition activities using existing or new facilities includes construction materials that cannot be recovered or recycled, materials that are rendered radioactive but cannot be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. For construction activities, a variety of common materials, such as wood, sand, gravel, plastics, or aluminum, in addition to those listed below, may be required. At this time, no unusual construction material requirements have been identified. Those construction resources would be generally irretrievably lost. None of these materials are in short supply, and all are readily available in the vicinity of each candidate DOE site. For operational activities, the commitment of materials made into equipment or used as feedstock cannot be recycled at the end of the project and are considered to be irretrievable. Although the use of such materials would be irretrievable, none are in short supply, and all are readily available in the vicinity of each candidate DOE site.

4.33.3 Energy

The irretrievable commitment of resources during construction and operation of the facilities would include the consumption of fossil fuels used to generate heat and electricity for each process. Energy would also be expended in the form of diesel fuel, gasoline, and oil, for construction equipment, and transportation vehicles. The plutonium and associated uranium feedstock materials used in the disposition process can be considered as energy sources irretrievable lost, if immobilized, or after being partially burned in a reactor as MOX fuel. Reactor burnup as MOX fuel would produce some useful electricity which would be a very small percentage of total U.S. electrical capacity and demand.

Table 4–287. Irreversible and Irretrievable Commitments of Operations Resources for SPD EIS Facilities

Resource	Hanford (Alternative 2)	INEEL (Alternative 7)	Pantex (Alternative 9)	SRS (Alternative 3)
Land (ha)	6.5	6.5	8.9	12
Electrical energy (MWh)	680,000	270,000	280,000	380,000
Liquid fuel (l)	1,100,000	810,000	810,000	1,100,000
Coal (t)	NA	37,000	NA	29,000
Natural gas (m^3)	NA	NA	22,000,000	NA
Hydrogen (m^3)	370,000	360,000	360,000	370,000
Nitrogen (m^3)	30,000	22,000	22,000	30,000
Oxygen (m^3)	6,640	4,040	4,040	6,640
Argon (m^3)	220,000	200,000	200,000	211,000
Chlorine (m^3)	620	630	620	600
Helium (m^3)	72,000	50,000	50,000	72,000
Sulfuric acid (kg)	5,700	4,600	4,700	960
Phosphoric acid (kg)	3,400	3,400	3,400	3,400
Oils and lubricants (kg)	30,000	16,000	16,000	30,000
Cleaning solvents (kg)	1,400	1,400	1,400	1,400
Polyphosphate (kg)	1,500	690	700	1,500
Polyelectrolyte (kg)	2,400	2,400	2,400	2,400
Liquid nitrogen (kg)	11,000	11,000	11,000	11,000
Sodium hypochlorite (kg)	570	NA	NA	570
Sodium hydroxide (kg)	760	760	760	760
Sodium nitrate (kg)	5,000	5,000	5,000	5,000
Stainless steel canisters (kg)	1,200,000	NA	NA	1,200,000
Ceramic precursor (kg)	310,000	NA	NA	310,000
Ceramic process lubricant (kg)	500	NA	NA	500
Carbon monoxide (m^3)	90,000	NA	NA	90,000
Carbon dioxide (m^3)	1,600,000	NA	NA	1,600,000
Aluminum sulfate (kg)	9,400	9,700	9,600	9,600
Bentonite (kg)	4,700	4,900	4,800	4,800
Glass frit (kg)	550,000	NA	NA	550,000
Ceramic binder (kg)	9,500	NA	NA	9,500
Ethylene glycol (kg)	3,000	3,000	3,000	3,000
Zinc stearate (kg)	3,000	3,000	3,000	3,000

Key: NA, not applicable.

4.33.4 Waste Minimization, Pollution Prevention, and Energy Conservation

4.33.4.1 Waste Minimization and Pollution Prevention

The *Pollution Prevention Act of 1990* and the *Hazardous and Solid Waste Amendments of 1984* required Federal agencies to develop and implement pollution prevention and waste minimization programs. NEPA's purpose, which is to promote efforts which will prevent or eliminate damage to the environment, is complemented by both acts. This relationship was further strengthened by Executive Order 12856 (Federal Compliance with Right to Know Laws and Pollution Prevention Requirements), 12873 (Federal Acquisition, Recycling, and Waste Prevention), and 12902 (Energy Efficiency and Water Consumption at Federal

Facilities), and a 1993 memorandum from the Council on Environmental Quality (CEQ 1993). The Council on Environmental Quality memorandum recommended that Federal agencies incorporated pollution prevention principles, techniques, and mechanisms in their NEPA planning and decision making processes (DOE 1996b:G-1).

Consistent with overall national policy, DOE programs are directed to incorporate pollution prevention into their planning and implementation activities. This includes reducing the quantity and toxicity of radioactive, hazardous, mixed, and sanitary waste generated; incorporating waste recycle and reuse into program planning and implementation; and conserving resources and energy (DOE 1996e:5-286).

DOE is responding to these initiatives by reducing the use of toxic chemicals; improving emergency planning, response, and accident notification; and encouraging the development and use of clean technologies. DOE's nuclear facilities have reduced the sizes of radiological control areas in order to reduce LLW. Other facilities have scrap metal segregation programs which reduce solid waste and allow useable material to be sold and recycled. DOE facilities also are replacing solvents and cleaners containing hazardous materials with less-toxic or nontoxic materials (DOE 1997j:6-3)

Although the surplus plutonium disposition facilities are still in the early stages of the engineering and design, the program would integrate pollution prevention practices that include waste stream minimization, source reduction and recycling, procurement processes that preferentially procure products made from recycled materials; inventory management, and technology transfer. The surplus plutonium disposition facility designs would minimize the size of radiologically controlled areas, thereby minimizing the generation of TRU waste and LLW. To the extent practicable, the facilities would not use solvents regulated by the Resource Conservation and Recovery Act, thereby minimizing the amount of hazardous and mixed waste generated. Wastewater would be recycled to the extent possible to minimize effluent discharge. Equipment would be installed as modules, so when there is a breakdown, a component, rather than a large piece of equipment, would be replaced. If possible, DOE would recycle materials rather than dispose of them. DOE would store such material for future use or sell these materials to other users or salvage vendors. Additionally, the DOE could burn nonrecyclable waste paper, cardboard and oil for energy recovery rather than disposing of it as waste.

4.33.4.2 Energy Conservation

Energy conservation and efficiency are also part of waste minimization and pollution prevention in terms of incorporating efficiencies into the design process. Energy conservation for each of the alternatives would be achieved primarily in three areas: process configuration, mechanical design, and electrical design. Energy conservation would be maximized by incorporating it into the process and facility design from the outset. Where possible, the process would be configured to conserve energy by using heat exchangers so the hot exit streams could heat cool incoming streams, which would conserve heating energy. Where cooling of process streams would be required, maximum use of cooling water would be employed, which would minimize the amount of refrigeration cooling to be used. Mechanical design would employ energy efficient compressors, pumps, and fans. Ductwork would be designed for minimum pressure drop. Facilities would employ energy-efficient insulation and reflective panels where appropriate. Air conditioning systems would make efficient use of outside air. Electrical design would employ energy efficient motors, actuators, and lighting. Accurate electrical power metering of each system would indicate the major power consumers and give warning of unusually high energy consumption. This would allow corrective measures to be taken promptly.

4.34 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The use of land on any of the four DOE candidate sites under consideration for plutonium disposition activities would be short-term uses of the environment; on completion of the disposition activities, such land could be returned to other uses, including long-term productive uses.

Losses of the natural productivity of terrestrial and aquatic habitats due to construction and operation of new plutonium disposition facilities are possible at any of the DOE candidate locations. Land clearing and construction and operational activities could disperse wildlife and eliminate habitat on a short-term basis. Although some destruction would occur during and after construction, losses would be minimized by careful siting of facilities and incorporation of mitigation measures into all construction activities. In addition, consultation and coordination with State and Federal natural resource and wildlife agencies would occur prior to any site disturbances, in order to ensure that all potential sensitive species, candidate or listed, would be protected to the maximum extent possible.

There are no other activities under plutonium disposition that would affect long-term productivity of environmental resources at each site.

Next Section

Citation

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4.35 REFERENCES

Abbott, D.G., A.B. Crockett, and K.S. Moor, 1997, *INEEL Affected Environment: Supplemental Data Report in Support of the Preparation of the Surplus Plutonium Disposition Environmental Impact Statement (Predecisional Draft)*, INEL/EXT-97-00563, Lockheed Martin Idaho Technologies Company, Idaho Falls, ID, June.

Antonio, E., 1998, Battelle Pacific Northwest National Laboratory, Richland, WA, personal communication (facsimile) to R. Schlegel, Science Applications International Corporation, Germantown, MD, [Doses at 400 Area], March 23.

Battelle (Battelle Memorial Institute), 1989, *Hanford Cultural Resources Management Plan*, PNL-6942, Pacific Northwest Laboratory, Richland, WA, June.

Cabak, M.A., K.E. Sassaman, and J.C. Gillam, 1996, "Distributional Archaeology in the Aiken Plateau: Intensive Survey of E Area, Savannah River Site, Aiken County, South Carolina," *Savannah River Archaeological Research Papers 8, Occasional Papers of the Savannah River Archaeological Research Program,* South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, SC.

CEQ (Council on Environmental Quality), 1993, *Pollution Prevention and the National Environmental Policy Act,* Washington, DC, January 12.

Dirkes, R.L., and R.W. Hanf, eds., 1997, *Hanford Site 1996 Environmental Report*, PNNL-11472, Battelle, Pacific Northwest National Laboratory, Richland, WA, August.

DOE (U.S. Department of Energy), 1992, *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore,* DOE/EIS-0157, University of California, Berkeley, CA, August.

DOE (U.S. Department of Energy), 1993, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, Office of Environment, Safety and Health, January 7.

DOE (U.S. Department of Energy), 1994, *Hanford Site Development Plan,* Richland Operations Office, Richland, WA, May.

DOE (U.S. Department of Energy), 1995a, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, Office of Environmental Management, Idaho Operations Office, Idaho Falls, ID, April.

DOE (U.S. Department of Energy), 1995b, *Final Environmental Impact Statement, Interim Management of Nuclear Materials*, DOE/EIS-0220, Savannah River Operations Office, Aiken, SC, October.

DOE (U.S. Department of Energy), 1995c, *Savannah River Site Waste Management Final Environmental Impact Statement*, DOE/EIS-0217, Savannah River Operations Office, Aiken, SC, July.

DOE (U.S. Department of Energy), 1995d, *Notice of Intent to Prepare a Site-Wide Environmental Impact Statement for the Los Alamos National Laboratory*, 60 FR 25697, Office of the Federal Register, Washington, DC, Friday, May 12.

DOE (U.S. Department of Energy), 1995e, *Occupational Radiation Protection*, 10 CFR 835, January 1.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*, DOE/EIS-0225, Albuquerque Operations Office, Albuquerque, NM, November.

DOE (U.S. Department of Energy), 1996c, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, NV, August.

DOE (U.S. Department of Energy, 1996d, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement*, DOE/EIS-0240, Office of Fissile Materials Disposition, Washington, DC, June.

DOE (U.S. Department of Energy), 1996e, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, Richland Operations Office, Richland, WA, August.

DOE (U.S. Department of Energy), 1996f, *Savannah River Site Future Use Project Report*, Savannah River Operations Office, Aiken, SC, January.

DOE (U.S. Department of Energy), 1996g, *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, vol. I, DOE/EIS-0236, Washington, DC, September.

DOE (U.S. Department of Energy), 1996h, *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, DOE/EIS-0218F, Office of Environmental Management, Washington, DC, February.

DOE (U.S. Department of Energy), 1997a, *Record of Decision for the Storage and Disposition of Surplus Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, 62 FR 3014, Office of the Federal Register, Washington, DC, January 14.

DOE (U.S. Department of Energy), 1997b, *The National TRU Waste Management Plan*, rev.1, DOE/NTP-96-1204, Carlsbad Area Office, Carlsbad, NM, December.

DOE (U.S. Department of Energy), 1997c, *Notice of Intent to Prepare a Hanford Site Solid (Radioactive and Hazardous) Waste Program, Environmental Impact Statement*, Richland, WA, 62 FR 55615–55621, Office of the Federal Register, Washington, DC, October 27.

DOE (U.S. Department of Energy), 1997d, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, NM, September.

DOE (U.S. Department of Energy), 1997e, *1996 Environmental Report for Pantex Plant*, DOE/AL/65030-9704, Albuquerque Operations Office, Amarillo Area Office, Amarillo, TX, May.

DOE (U.S. Department of Energy), 1997f *Idaho National Engineering and Environmental Laboratory, Comprehensive Facility and Land Use Plan*, DOE/ID-10514, Idaho Operations Office, Idaho Falls, ID, April 30.

DOE (U.S. Department of Energy), 1997g, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1997h, *Draft Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site*, DOE/EIS-0277D, Office of Nuclear Material and Facility Stabilization, Washington, DC, November.

DOE (U.S. Department of Energy), 1997i, *Shutdown of the River Water System at the Savannah River Site Final Environmental Impact Statement*, DOE/EIS-0268, Savannah River Operations Office, Aiken, SC, May.

DOE (U.S. Department of Energy), 1997j, *Accelerator for Production of Tritium at Savannah River Site Environmental Impact Statement*, DOE/EIS-0270D, Savannah River Operations Office, Aiken, SC, December.

DOE (U.S. Department of Energy), 1998a, *Accelerating Cleanup, Paths to Closure, Draft*, DOE/EM-0342, Office of Environmental Management, Washington, DC, February.

DOE (U.S. Department of Energy), 1998b, *Construction and Operation of a Tritium Facility at the Savannah River Site*, DOE/EIS-0271D, Savannah River Operations Office, Aiken, SC, March.

DOL (U.S. Department of Labor), 1997a, *National Census of Fatal Occupational Injuries, 1996*, USDL 97-266, Bureau of Labor Statistics, Washington, DC, August 7.

DOL (U.S. Department of Labor), 1997b, *Workplace Injuries and Illnesses in 1996*, USDL 97-453, Bureau of Labor Statistics, Washington, DC, December 17.

EPA (U.S. Environmental Protection Agency), 1988, *Screening Procedure for Estimating the Air Quality Impact of Stationary Sources*, EPA-450/4-88-010, Office of Air and Radiation, Research Triangle Park, NC, August.

EPA (U.S. Environmental Protection Agency), 1997a, *National Primary and Secondary Federal or State Ambient Air Quality Standards*, 40 CFR 50, March 31.

EPA (U.S. Environmental Protection Agency), 1997b, *Requirements for Preparation, Adoption, and Submittal of Implementation Plans*, "Prevention of Significant Deterioration of Air Quality," 40 CFR 51.166, July 1.

EPA, (U.S. Environmental Protection Agency), 1997c, *Integrated Risk Information System*, Ethylene Glycol; CASRN 107-21-1, IRIS Substance File No. 0238, March 1.

EPA, (U.S. Environmental Protection Agency), 1997d, *Designation of Areas for Air Quality Planning Purposes*, "California," 40 CFR 81.305.

EPA (U.S. Environmental Protection Agency), 1997e, *Designation of Areas for Air Quality Planning Purposes: State of California; Redesignation of the San Francisco Bay Area to Nonattainment for Ozone*, proposed rule, 62 FR 66578, Office of the Federal Register, Washington, DC, December 19.

EPA (U.S. Environmental Protection Agency), 1998, *Approval and Promulgation of State Implementation Plans and Redesignation of California's Ten Federal Carbon Monoxide Planning Areas to Attainment*, final rule, 40 CFR 81.305, 63 FR 15305, Office of the Federal Register, Washington, DC, March 31.

ERDA (U.S. Energy Research Development Administration), 1976, *Evaluation of Impact of Potential Flooding Criteria on the Hanford Project*, RLO-76-4, Richland Operations Office, Richland, WA.

ICRP (International Commission on Radiological Protection), 1991, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Elmsford, NY.

ID DHW (Idaho Department of Health and Welfare), 1995, *Rules for the Control of Air Pollution in Idaho*, 577, "*Ambient Standards for Specific Air Pollutants*"; 585, "*Toxic Air Pollutants Non-Carcinogenic Increments*"; 586, "*Toxic Air Pollutants Carcinogenic Increments*"; IDAPA 16, Title 01, Chapter 01, Boise, ID.

M&H (Mason & Hanger Corporation), 1996, *Environmental Information Document: The Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components Environmental Impact Statement*, ES:96:0156, Amarillo, TX, September.

M&H (Mason & Hanger Corporation), 1997, *Pantex Plant Affected Environment Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, Amarillo, TX, June 12.

Mecca, J.E., 1997, U.S. Department of Energy, Richland Operations Office, Richland, WA, personal communication to K.R. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Hanford Site Response to Site Environmental Data Call for Preparation of the Draft Surplus Plutonium Disposition Environmental Impact Statement*, June 11.

Miller, S., 1995, *Final Draft Idaho National Engineering Laboratory Management Plan for Cultural Resources*, rev. 1, DOE/ID-10361, Lockheed Idaho Technologies Company, Idaho Falls, ID, July.

Mitchell, R.G., D. Peterson, D. Roush, R.W. Brooks, L.R. Paulus, and D.B. Martin, 1997, *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1996*, DOE/ID-12082(96), U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID, August.

Murray, R.C., 1998, Lawrence Livermore National Laboratory, Livermore, CA, personal communication to B. Myers, Lawrence Livermore National Laboratory, Livermore, CA, *Collapse Probability of Building 332 Increment III Due to an Earthquake*, April 20.

NAS (National Academy of Sciences and National Research Council), 1990, *Committee on the Biological Effects of Ionizing Radiations, Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V*, Board of Radiation Effects Research, Commission on Life Science, National Academy Press, Washington, DC.

NAS (National Academy of Sciences and National Research Council), 1995, *Management and Disposition of Excess Weapons Plutonium, Reactor-Related Option*, National Academy Press, Washington, DC.

NRC (U.S. Nuclear Regulatory Commission), 1976, *Final Generic Environmental Impact Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors*, NUREG-0002, National Technical Information Service, Springfield, VA, August.

NRC (U.S. Nuclear Regulatory Commission), 1996, *Dose Commitments Due to Radioactive Releases from Nulcear Power Plant Sites in 1992*, NUREG/CR-2850, PNL–4221, vol. 14, Washington, DC, March.

O'Connor, D.G., et al., 1998a, *ANL-W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13478, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998b, *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13481, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998c, *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13480, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998d, *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13482, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998e, *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13483, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998f, *ORR MOX Fuel Lead Assemblies Data Reports for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13479, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

OSHA (Occupational Safety and Health Administration), 1997, *Occupational Noise Exposure*, 29 CFR 1926.52, U.S. Department of Labor, Washington, DC.

PNL (Pacific Northwest Laboratory), 1996, *Safety Analysis Report for 325 Building*, PNL-SAR-325, Richland, WA.

Reed, M.B., 1997, New South Associates, Stone Mountain, GA, personal communication to D. Ryan, U.S. Department of Energy, Savannah River Operations Office, Aiken, SC, *Architectural Assessment of Storage Magazine, Building 217–F and Gate House, Building 701–5F*, November 21.

Sandberg, D., 1998, B&W Hanford Company, Richland, WA, personal communication to J. DiMarzio, Science Applications International Corporation, Germantown, MD, *400 Area and FMEF Electrical Capacity*, February 13.

SCDHEC (South Carolina Department of Health and Environmental Control), 1992, *South Carolina Nuclear Facility Monitoring - Annual Report 1992*, Columbia, SC.

SCDHEC (South Carolina Department of Health and Environmental Control), 1996, *Regulation 61-62, Air Pollution Control Regulations and Standards*, Standard 2, "Ambient Air Quality Standards"; Standard 8, "Toxic Air Pollutants," Air Pollution Control, Columbia, SC.

Sessions, J., 1997x, Westinghouse Savannah River Company, Aiken, SC, personal communication to K. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Surplus Pu Disposition EIS Savannah River Site Affected Environmental Data Call*, ESH-EAP-97-0057, June 9.

SRARP (Savannah River Archaeological Research Program), 1989, *Archaeological Resource Management Plan of the Savannah River Archaeological Research Program*, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, SC, December.

SRARP (Savannah River Archaeological Research Program), 1997, *Preliminary Archaeological Assessment of the Proposed Plutonium Immobilization Plant, Savannah River Site, Aiken County, South Carolina*, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, SC, November 24.

TNRCC (Texas Natural Resource Conservation Commission), 1997a, Toxicology and Risk Assessment (TARA) Section Staff, memo to Interested Parties, *Effects Screening Levels (ESLs) List*, September 5.

TNRCC (Texas Natural Resource Conservation Commission), 1997b, *TNRCC Rules*, 30 TAC Chapters: 101, "General Rules (Air Quality)"; 112, "Control of Air Pollution from Sulfur Compounds (Reg. II)"; 113, "Control of Air Pollution from Toxic Materials (Reg. III)."

UC (Regents of the University of California), 1998a, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Hanford Site*, LA-UR-97-2907, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998b, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford*, UCRL-ID-128275, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998c, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Hanford*, UCRL-ID-128276, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998d, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Hanford Site*, LA-UR-97-2064, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998e, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Savannah River Site*, LA-UR-97-2910, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998f, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in New Facilities at Savannah River Site*, UCRL-ID-128273, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998g, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site*, UCRL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998h, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Savannah River Site*, LA-UR-97-2066, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998i, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Savannah River Site*, UCRL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998j, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Savannah River Site*, UCRL-ID-128272, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998k, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Pantex Plant*, LA-UR-97-2909, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998l, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Idaho National Engineering and Environmental Laboratory*, LA-UR-97-2908, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998m, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Idaho National Engineering and Environmental Laboratory*, LA-UR-97-2065, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998n, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Pantex Plant*, LA-UR-97-2067, Los Alamos National Laboratory, Los Alamos, NM.

WDEC (Washington Department of Ecology), 1994, *Washington Administrative Code*, Title 173, Chapter 173-460, "Controls for New Sources of Toxic Air Pollutants"; Chapter 173-470, "Standards for Particulate Matter"; Chapter 173-474, "Ambient Air Quality Standards for Sulfur Oxide"; Chapter 173-475, "Ambient Air Quality Standards for Carbon Monoxide, Ozone, and Nitrogen Dioxide"; Chapter 173-481, "Ambient Air Quality and Environmental Standards for Fluorides."

Werner, J., 1997, U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID, personal communication to K. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Data Call for the INEEL Affected Environments*, August 4.

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Chapter 5
Environmental Regulations, Permits, and Consultations

5.1 LAWS, REGULATIONS, EXECUTIVE ORDERS, AND DOE ORDERS

The major laws, regulations, Executive orders, and other compliance actions that apply to surplus plutonium disposition activities depending on the various alternatives are identified in Tables 5–1 and 5–2. There are a number of Federal environmental statutes dealing with environmental protection, compliance, or consultation that affect compliance at every U.S. Department of Energy (DOE) location. In addition, certain environmental requirements have been delegated to State authorities for enforcement and implementation. It is DOE policy to conduct its operations in an environmentally safe manner in compliance with all applicable statutes, regulations, and standards. Although this chapter does not address pending legislation or future regulations, DOE recognizes that the regulatory environment is in transition, and subject to many changes, and that the construction, operation, and decommissioning of any surplus plutonium disposition facility must be conducted in compliance with all future regulations and standards.

The Atomic Energy Act (AEA) authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE's jurisdiction. Through a series of DOE orders, an extensive system of standards and requirements has been established to ensure safe operation of facilities. DOE regulations are generally found in Title 10 of the Code of Federal Regulations (CFR). For purposes of this *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), relevant regulations include 10 CFR 820, Procedural Rules for DOE Nuclear Activities; 10 CFR 830, Nuclear Safety Management; 10 CFR 834, Radiation Protection of the Public and the Environment (Draft); 10 CFR 835, Occupational Radiation Protection; 10 CFR 1021, Compliance with the National Environmental Policy Act; and 10 CFR 1022, Compliance with Floodplains/Wetlands Environmental Review Requirements. The DOE orders have been revised and reorganized to reduce duplication and eliminate obsolete provisions (though some older orders remain in effect during the transition). The new organization is by Series and is intended to include all DOE policies, manuals, requirements documents, notices, guides, and orders. Relevant series include Series 400, which deals with Work Process; and within this Series, DOE Order 420.1 addresses Facility Safety; 425.1 addresses Startup and Restart of Nuclear Facilities; 452.1A addresses Nuclear Explosive and Weapons Surety Programs; 452.2A addresses the Safety of Nuclear Explosives Operations; 452.4 addresses the Security and Control of Nuclear Explosives; 460.1A addresses Packaging and Transportation Safety; 470.1 addresses the Safeguards and Security Program; and 474.1 addresses the Control and Accountability of Nuclear Materials. In addition, DOE (older number) Series 5400 addresses environmental, safety, and health programs for DOE operations.

5.2 PERMITS

Permits are a means for the issuing agency to enforce applicable regulatory requirements. It is likely that new or modified permits will be needed before facilities for surplus plutonium disposition may be constructed or operated. Permits regulate many aspects of facility construction and operations, including the quality of construction, treatment and storage of hazardous waste, and discharges of effluents to the environment. These permits will be obtained from the appropriate Federal, State, and local agencies. Potentially applicable permits for Federal agencies are described in Table 5–1, and for State agencies in Table 5–2. Permits for constructing or operating facilities for surplus plutonium disposition would not be obtained or modified before a Record of Decision is issued on this SPD EIS.

5.3 CONSULTATIONS

Certain statutes and regulations require DOE to consider consultations with Federal, State, and local agencies and federally recognized Native American groups regarding the potential for alternatives for surplus plutonium disposition to disturb sensitive resources. The needed consultations must occur on a timely basis and are generally required before any land disturbance can begin. Most of these consultations are related to biotic resources, cultural resources, and Native American rights. The biotic resources consultations generally pertain to the potential for activities to disturb sensitive species or habitats. Cultural resources consultations relate to the potential for disruption of important cultural resources and archaeologic sites. Finally, Native American consultations are concerned with the potential for disturbance of ancestral Native American sites and the traditional practices of Native Americans. These and other consultations that may be required are listed in Table 5–3. DOE is in the process of initiating the required consultations at the sites and will report the status of these consultations in the SPD Final EIS.

5.3.1 Native American Tribal Government Consultations

Upon the publication of this SPD EIS, DOE representatives at the Amarillo, Idaho, Richland, and Savannah River Offices will initiate the government-to-government consultation process with federally recognized American Indian Tribal Governments for the proposed action and alternatives discussed herein. The consultations will be conducted consistent with the direction outlined in DOE Order 1230.2 *American Indian Tribal Government Policy*. A copy of this SPD EIS will be presented to each federally recognized tribe that has acknowledged potential concern for resources at the Hanford Site, Idaho National Engineering and Environmental Laboratory, Pantex Plant, and Savannah River Site during prior consultations initiated for compliance with the American Indian Religious Freedom Act (AIRFA) (P.L. 95-341) and the Native American Graves Protection and Repatriation Act (NAGPRA) (P.L. 101-601).

The consultation process will be initiated by the responsible DOE representative at each office through a formal letter identifying the potential actions at the DOE site accompanied by a copy of this SPD Draft EIS. The letter will request a response from each American Indian Tribal Government regarding concerns under AIRFA and NAGPRA. Among the areas of specific concern that may be identified by American Indian Tribal Governments are religious and sacred places and resources, Native American human remains, associated funerary objects, unassociated funerary objects, sacred objects, and cultural patrimony objects. Each response with be addressed by DOE through a consultation process acceptable to the specific American Indian Tribal Government including, but not limited to, government-to-government meetings, interviews, and site visits. It will be the intent of these consultations to identify all potential American Indian Tribal Government concerns associated with each action discussed in this SPD EIS and to consider the results of the consultation processes in the SPD Final EIS. The individual consultation processes for each site with each American Indian Tribal Government will be formally documented in the SPD Final EIS including a summary of the consultation processes along with copies of formal correspondence.

In the event of inadvertent discovery of potential important materials such as human remains, associated funerary objects, unassociated funerary objects, sacred objects, and cultural patrimony during construction and operation, another consultation process will be initiated. Each DOE site considered in this SPD EIS has plans and procedures which address inadvertent discoveries of cultural material. In each case, the ground disturbing activities would be immediately suspended upon recognition of human remains or potential cultural materials. DOE would be notified and qualified cultural resource specialists would evaluate the materials to determine potential Native American origin. If the remains or materials are determined to be of potential Native American origin and within the criteria of AIRFA and NAGPRA, DOE would immediately initiate an expedited formal consultation process with American Indian Tribal Governments with interest in the locations, as determined during the SPD EIS consultation process described above. Based upon the results of the consultations, DOE would take appropriate action prior to resuming of ground disturbing activities.

5.3.2 Archaeological and Historical Resources Consultations

Each DOE site evaluated in this SPD EIS has cultural (archaeological and historical) resource management plans that prescribe consultation processes for activities which have the potential to adversely affect sites and properties eligible for nomination, or listed on, the National Register of Historic Places. The management plans have been developed consistent with archaeological and historical resource laws (see Table 5–1) as implemented under 36 CFR 800, *Procedures for the Protection of Historic and Cultural Properties.*

Upon the publication of this SPD Draft EIS, DOE representatives at the Amarillo, Idaho, Richland, and Savannah River Offices will initiate formal consultation with the State Historic Preservation Officers of Idaho, Texas, Washington and South Carolina, as appropriate under each site's Programmatic Agreement and management plan. The intent of each consultation will be to determine potential eligibility for nomination to the National Register of Historic Places of archaeological and historic resources which may be associated with the proposed actions and alternatives. Further consultations will be used to determine the potential for adverse effect to any resources determined to be eligible for nomination and any necessary actions required to mitigate potential adverse effects. The specific consultation processes will be conducted in compliance with site specific programmatic agreements among each DOE office, specific State Historic Preservation Offices, and the Advisory Council on Historic Preservation.

The consultation process will be initiated by the responsible DOE representative at each office through a formal letter to the appropriate State Historic Preservation Officer identifying the potential actions at the DOE site accompanied by a copy of this SPD Draft EIS and supporting cultural resource reports. The letter will request a consultation meeting, if necessary, to discuss specific concerns and information needs. A site visit may be appropriate for locations with identified resources. In all cases, the consultation process will conform to 36 CFR 800 requirements and programmatic agreements for the management of archaeological and historic resources and properties. Each consultation process will be documented in the SPD Final EIS, including a summary of the consultation processes along with copies of formal correspondence.

In the event that potential archaeological and historic materials are inadvertently discovered during construction and operation, another consultation process will be initiated. Each DOE site considered in this SPD EIS has plans and procedures that address inadvertent discoveries of cultural material. In each case, the ground-disturbing activities would be immediately suspended upon recognition of human remains or potential archaeological and historical materials. DOE would be notified and qualified cultural resource specialists would evaluate the materials to identify and evaluate their potential archaeological and historical value under 36 CFR 800. If the materials were determined to be potentially eligible for nomination to the National Register of Historic places, DOE would immediately initiate an expedited formal consultation process with the appropriate State Historic Preservation Officer, as appropriate under the programmatic agreement. Based on the results of the consultations, DOE would take appropriate action prior to resuming ground-disturbing activities to ensure mitigation of any adverse effect to resources determined eligible for nomination to the National Register of Historic Places.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders

Statute, Regulation, Executive Order	Citation	Potential Requirements
	Air Quality and Noise	
Clean Air Act of 1970 (CAA)	42 USC 7401 et seq.	Requires sources to meet standards and obtain permits to satisfy: National Ambient Air Quality Standards (NAAQS), State implementation plans, Standards of Performance for New Stationary Sources, National Emission Standards for Hazardous Air Pollutants (NESHAP), and Prevention of Significant Deterioration (PSD). Public radiological dose limits are outlined in paragraph II.1b of 40 CFR 61, subpart H, under the authority of this act.
National Ambient Air Quality Standards	42 USC 7409 et seq.; 40 CFR 50	Establishes primary and secondary ambient air quality standards governing SO_2, NO_2, CO, O_3, Pb, and PM_{10}.
Standards of Performance for New Stationary Sources	42 USC7411; 40 CFR 60	Establishes control/emission standards and recordkeeping requirements for new or modified sources specifically addressed by a standard.
National Emission Standards for Hazardous Air Pollutants	42 USC 7412; 40 CFR 61, 63	Establishes emission levels for carcinogenic or mutagenic pollutants or operation requirements; may require a preconstruction approval, depending on the process being considered and the level of emissions that will result from the new or modified source.
Prevention of Significant Deterioration	42 USC 7470 et seq.; 40 CFR 51.166	Establishes requirements for the State implementation plans for PSD programs. Applies to areas that are in compliance with NAAQS. Requires comprehensive preconstruction review and the application of Best Available Control Technology to major stationary sources (emissions of 100 tons per year [tons/yr]) and major modifications; requires a preconstruction review of air quality impacts and the issuance of a construction permit from the responsible State agency setting forth emission limitations to protect the PSD increment.
Determining conformity of Federal activities to State or Federal implementation plans	40 CFR 93	Requires Federal facilities to demonstrate compliance with State or Federal implementation plans for applicable actions in nonattainment areas.
Executive Order 12843, Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances	April 21, 1993	Requires Federal agencies to minimize procurement of ozone-depleting substances and conform their practices to comply with Title VI of CAA Amendments regarding stratospheric ozone protection and to recognize the increasingly limited availability of Class I substances until final phaseout.
Noise Control Act of 1972	42 USC 4901 et seq.	Requires facilities to maintain noise levels that do not jeopardize the health and safety of the public.
	Water Resources	
Clean Water Act (CWA)	33 USC 1251 et seq.	Requires EPA- or State-issued permits and compliance with provisions of permits regarding discharge of effluents to surface waters.
National Pollutant Discharge Elimination System (section 402 of CWA)	33 USC 1342	Requires permit to discharge effluents (pollutants) to surface waters and stormwaters; permit modifications are required if discharge effluents are altered.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
	Water Resources (Continued)	
Wild and Scenic Rivers Act of 1968	16 USC 1271 et seq.	Requires consultation before construction of any new Federal project associated with a river designated as wild and scenic or under study in order to minimize and mitigate any adverse effects on the physical and biological properties of the river.
Safe Drinking Water Act of 1974	42 USC 300f et seq.; 40 CFR 141	Requires certification of any plant water treatment facility constructed on a site to ensure that the quality of public drinking water is protected and that maximum radioactive contaminant levels do not exceed 4 mrem dose equivalents.
Executive Order 11990, Protection of Wetlands	3 CFR 1977 Comp., p. 121	Requires Federal agencies to avoid the long- and short-term adverse impacts associated with the destruction or modification of wetlands.
Executive Order 11988, Floodplain Management	3 CFR 1977 Comp., p. 117	Directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts be avoided to the extent practical. Requires consultation if project impacts a floodplain.
Compliance with Floodplain/ Wetlands Environmental Review Requirements	10 CFR 1022	Requires DOE to comply with all applicable floodplain and wetlands environmental review requirements.
	Waste Management and Pollution Prevention	
Resource Conservation and Recovery Act, Hazardous and Solid Waste Amendments of 1984 (RCRA)	42 USC 6901 et seq.; PL 98-616	Requires notification and permits for operations involving hazardous waste treatment, storage, or disposal facilities; changes to site hazardous waste operations could require amendments to RCRA hazardous waste permits involving public hearings.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA); Superfund Amendments and Reauthorization Act of 1986	42 USC 9601 et seq.; PL 99-499	Requires cleanup and notification if there is a release or threatened release of a hazardous substance; requires DOE to enter into Interagency Agreements with EPA and State to control the cleanup of each DOE site on the NPL.
Nuclear Waste Policy Act of 1982	42 USC 10101–10270	Establishes a schedule for the siting, construction, and operation of geologic repositories that will provide a reasonable assurance that the public and the environment will be protected from the hazards posed by disposal of high-level radioactive waste and SNF; establishes the Federal responsibility and a Federal policy for the disposal of HLW and SNF; defines the relationship between Federal and State governments with respect to the disposal of HLW and SNF; and establishes a Nuclear Waste Fund.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
Waste Management and Pollution Prevention (Continued)		
Pollution Prevention Act of 1990	42 USC 11001–11050	Establishes a national policy that pollution should be reduced at the source and requires a toxic chemical source reduction and recycling report for an owner or operator of a facility required to file an annual toxic chemical release form under section 313 of SARA.
Toxic Substances Control Act of 1976	15 USC 2601 et seq.	Requires compliance with inventory reporting and chemical control provisions of TSCA to protect the public from the risks of exposure to chemicals; TSCA imposes strict limitations on use and disposal of PCB-contaminated equipment.
Federal Facility Compliance Act of 1992	42 USC 6961	Waives sovereign immunity for Federal facilities under RCRA and requires DOE to develop plans and enter into agreements with States as to specific management actions for specific mixed waste streams.
Executive Order 12088, Federal Compliance with Pollution Control Standards	3 CFR 1978 Comp., p. 243	Requires Federal agency landlords to submit to OMB an annual plan for the control of environmental pollution and to consult with EPA and State agencies regarding the best techniques and methods.
Executive Order 12856, Federal Compliance with Right-To-Know Laws and Pollution Prevention Requirements	August 3, 1993	Requires Federal agencies to achieve 50 percent reduction of agency's total releases of toxic chemicals to the environment and offsite transfers, to prepare a written facility pollution prevention plan not later than 1995, and to publicly report toxic chemicals entering any waste stream from Federal facilities, including any releases to the environment, and to improve local emergency planning, response and accident notification.
Executive Order 12873, Federal Acquisition, Recycling, and Waste Prevention	October 20, 1993	Requires Federal agencies to develop affirmative procurement policies and establishes a shared responsibility between the system program manager and the recycling community to effect use of recycled items for procurement.
Executive Order 12580, Superfund Implementation	January 23, 1987	Delegates to the heads of Executive departments and agencies the responsibility for undertaking remedial actions for releases, or threatened releases that are not on the NPL and removal actions other than emergencies where the release is from any facility under the jurisdiction or control of Executive departments and agencies.
Biotic Resources		
Fish and Wildlife Coordination Act of 1958	16 USC 661 et seq.	Requires consultation on the possible effects on wildlife if there is construction, modification, or control of bodies of water in excess of 10 acres in surface area.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
	Biotic Resources (Continued)	
Bald and Golden Eagle Protection Act of 1972	16 USC 668 et seq.	Requires consultations to determine if any protected birds are found to inhabit the area. If so, DOE must obtain a permit prior to moving any nests due to construction or operation of disposition facilities.
Migratory Bird Treaty Act of 1918	16 USC 703 et seq.	Requires consultation to determine if there are any impacts on migrating bird populations due to construction or operation of disposition facilities. If so, DOE will develop mitigation measures to avoid adverse effects.
Anadromous Fish Conservation Act of 1965	16 USC 757	Requires consultation to determine if there are any impacts on anadromous fish that spawn in fresh water or estuaries and migrate to ocean waters and on anadromous fishery resources that are subject to deplete from water resource development.
Wilderness Act of 1964	16 USC 1131 et seq.	Requires consultation with the Department of Commerce and the Department of Interior and minimize impact.
Wild Free-Roaming Horses and Burros Act of 1971	16 USC 1331 et seq.	Requires consultation with the Department of Interior and minimize impact.
Endangered Species Act of 1973	16 USC 1531 et seq.	Requires consultation to identify endangered or threatened species and their habitats, assess DOE impacts thereon, obtain necessary biological opinions and, if necessary, develop mitigation measures to reduce or eliminate adverse effects of construction or operation.
	Cultural Resources	
Antiquities Act of 1906	16 USC 431–433	Requires protection of historic, prehistoric, and paleontological objects in federal lands from appropriation, excavation, injury, and destruction without permission.
DOE American Indian Tribal Government Policy	DOE Order 1230.2	Establishes government-to-government protocols for DOE interactions with tribal governments.
National Historic Preservation Act of 1966	16 USC 470 et seq.	Requires consultation with the State Historic Preservation Office prior to construction to ensure that no historical properties will be affected.
Archaeological and Historical Preservation Act of 1974	16 USC 469 et seq.	Requires obtaining authorization for any disturbance of archaeological resources.
Archaeological Resources Protection Act of 1979	16 USC 470aa et seq.	Requires obtaining authorization for any excavation or removal of archaeological resources.
American Indian Religious Freedom Act of 1978	42 USC 1996	Requires consultation with local Native American Indian tribes prior to construction to ensure that their religious customs, traditions, and freedoms are preserved.
Native American Graves Protection and Repatriation Act of 1990	25 USC 3001	Requires consultation with local Native American Indian tribes prior to construction to guarantee that no Native American graves are disturbed.
Executive Order 13007, Indian Sacred Sites	May 24, 1996	Requires the protection and preservation of Native American religious practices.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
Cultural Resources (Continued)		
Executive Order 11593, Protection and Enhancement of the Cultural Environment	3 CFR 154, 1971–1975 Comp., p. 559	Requires the preservation of historic and archaeological data that may be lost during construction activities.
Worker Safety and Health		
Occupational Safety and Health Act of 1970	5 USC 5108	Requires that agencies comply with all applicable worker safety and health legislation (including guidelines of 29 CFR 1960) and prepare, or have available, material safety data sheets.
Hazard Communication Standard	29 CFR 1910.1200	Ensures that workers are informed of, and trained to handle, all chemical hazards in the DOE workplace.
Transportation		
Transportation regulations	49 CFR 171, 172, 173, 174, 176, 177, 397	Establishes standards for materials transportation including: packaging, marking and labeling, placarding, monitoring, routes, accident reporting, and manifesting. Includes requirements for transport by rail, air, and public highway.
Hazardous Materials Transportation Act of 1974	49 USC 1801 et seq.	Requires compliance with hazardous materials and waste transportation requirements.
Hazardous Materials Transportation Uniform Safety Act of 1990	49 USC 1801	Restricts shippers of highway route-controlled quantities of radioactive materials to use only permitted carriers.
Regulations of the International Atomic Energy Agency	IAEA Safety 6	Establishes standards for radioactive materials transportation.
International Maritime Organization Regulations	International Maritime Dangerous Goods Code, 1994	Requires segregation of radioactive materials packages from other dangerous goods and other aspects of stowage.
Other		
Atomic Energy Act of 1954	42 USC 2011	Authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE's jurisdiction.
Price Anderson Act	42 USC 2210	Allows DOE to indemnify its contractors if the contract involves the risk of public liability from a nuclear incident.
Nuclear Regulatory Commission	10 CFR 20, 70, 75	Establishes regulations for radioactive materials and the construction and operation of facilities that process and handle radioactive materials.
Department of Energy Orders	Parts 100–500	Establishes standards and requirements to ensure safe operation of facilities.
National Environmental Policy Act (NEPA)	42 USC 4321 et seq.	Requires Federal agency to prepare an environmental impact statement for any major Federal action with significant environmental impact.
Department of Energy NEPA Implementing Regulations	10 CFR 1021	Requires DOE to follow its own implementing regulations to ensure environmental quality.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
Other (Continued)		
Emergency Planning and Community Right-To-Know Act of 1986	42 USC 11001 et seq.	Requires the development of emergency response plans and reporting requirements for chemical spills and other emergency releases, and imposes right-to-know reporting requirements covering storage and use of chemicals that are reported on toxic chemical release forms.
Executive Order 11514, Protection and Enhancement of Environmental Quality	3 CFR 1966–1970 Comp., p. 902	Requires Federal agencies to demonstrate leadership in achieving the environmental quality goals of NEPA; provides for DOE consultation with appropriate Federal, State, and local agencies in carrying out their activities as they affect the environment.
Farmland Protection Policy Act of 1981	7 USC 4201 et seq.	Requires avoidance of any adverse effects to prime and unique farmlands.
Executive Order 12114, Environmental Affects Abroad of Major Federal Actions	January 4, 1979	Requires officials of Federal agencies having ultimate responsibility for authorizing and approving actions encompassed by this order to be informed of pertinent environmental considerations and to take such considerations into account, with other pertinent considerations of national policy in making decisions regarding such actions. While based on independent authority, this order furthers the purpose of NEPA.
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	February 11, 1994	Requires Federal agencies to identify and address as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.
Executive Order 12656, Assignment of Emergency Preparedness Responsibilities	November 18, 1988	Assigns emergency preparedness responsibilities to Federal departments and agencies.

Table 5–2. State Environmental Statutes and Regulations

Legislation or Regulation	Citation	Potential Requirements
	HANFORD, WASHINGTON	
	Air Quality and Noise	
Washington Clean Air Act	Revised Code of Washington (RCW) Chapter 70.94	Provides for development of air pollution control and permitting regulations.
Washington Administrative Code of 1994	Title 173-400, 401, 406–490	Requires permitting of source, control of toxic air pollutants, radionuclides, and other pollutants.
Noise Control Act of 1974	RCW, Chapter 70.107	Provides for development of noise pollution control and permitting regulations.
Washington Administrative Code	Title 173-60	Establishes limits on environmental noise levels by zoning classifications.
	Water Resources	
Coastal Water Protection Act of 1971	RCW, Chapter 90.48	Requires water pollution control; applies to all waters of the State.
Chemical Contaminants and Water Quality	RCW, Chapter 70.142	Requires water pollution control.
Water Pollution Control Act	RCW, Chapter 90.48	Requires that a permit be obtained for any discharge to the soil column, and the quality of the groundwater in the vicinity be protected and not degraded
	Waste Management and Pollution Prevention	
Hazardous Waste Management Act	RCW, Chapter 70.105	Requires permits for various activities involving hazardous waste.
Nuclear Energy and Radiation	RCW, Chapter 70.98	Licenses and permits sources of radiation.
Radioactive Waste Storage and Transport Act of 1980	RCW, Chapter 70.99	Establishes various requirements for handling and storage of radioactive waste.
Radioactive Waste Act	RCW, Chapter 43.200	Establishes various requirements for handling and storage of radioactive waste.
	Biotic Resources	
Various Acts Concerning Fish and Game	RCW, Chapter 77	Requires consultation with responsible agency.
	Cultural Resources	
Archaeology and Historic Preservation	RCW, Chapter 43.51A	Required to follow rules designated to protect State cultural resources.
	Other	
Tri-Party Agreement	May 14, 1989	Establishes the applicability of RCRA and CERCLA and their amendments to Hanford. This is an agreement between DOE, EPA, and Washington State Department of Ecology.
	INEEL, IDAHO	
	Air Quality and Noise	
Idaho Environmental Protection and Health Act	ID Code, Title 39, Chapter 105, 107	Provides for development of air pollution control permitting regulations.

Table 5–2. State Environmental Statutes and Regulations (Continued)

Legislation or Regulation	Citation	Potential Requirements
	Air Quality and Noise (Continued)	
Rules for the Control of Air Pollution in Idaho	IDAPA 16, Title 1, Chapter 1, 000–729	Requires permitting of sources and control of toxic air pollutants and other pollutants.
	Water Resources	
Idaho Wastewater-Land Application Permit Regulations	ID Rules/Regs., Title 1, Chapter 17	Requires permit prior to construction or modification of a water discharge source.
Idaho Water Pollution Control Act	ID Code, Title 39, Chapter 36	Requires permit prior to construction or modification of a water discharge source.
Idaho Water Quality Standards	ID Rules/Regs., Title 1, Chapter 2	Requires permit prior to the construction or operation of a wastewater injection well.
Idaho Stream Channel Protection Act	ID Code, Title 42, Chapter 38	Requires permit prior to dredge or fill of any stream.
Idaho Lake Protection Act	ID Code, Section 58–142 et seq.	Requires permit prior to dredge or fill of any lake.
	Waste Management and Pollution Prevention	
Idaho Hazardous Waste Management Act	ID Code, Title 39, Chapter 44	Requires permit prior to construction or modification of a hazardous waste disposal facility.
Idaho Hazardous Waste Management Regulations	ID Rules/Regs., Title 1, Chapter 5	Requires permit prior to construction or modification of a hazardous waste disposal facility.
	Biotic Resources	
Various Acts Regarding Fish and Game	ID Code, Title 36	Requires consultation with responsible agency.
	Cultural Resources	
Idaho Historic Preservation Act	ID Code, Title 67, Chapter 46	Requires consultation with responsible local governing body.
	Other	
Spent Fuel Settlement Agreement (also known as the Batt Agreement)	October 16, 1995	Allows INEEL to receive spent nuclear fuel and establishes a schedule for removal of all spent fuel from the State.
Tribal Working Agreement	September 29, 1992	Requires consultation with Shoshone-Bannock tribes.
Federal Facility Agreement and Consent Order	December 9, 1991	Establishes a process for evaluating past potential releases to the environment at INEEL.
	PANTEX, TEXAS	
	Air Quality and Noise	
Texas Clean Air Act	382.017	Provides for the development of air pollution permitting regulations.
Texas Air Pollution Control Regulations	TX Admin Code, Title 30, Chapters 101–125	Requires permit prior to construction or modification of an air contaminant source and control of toxic air pollutants and other pollutants.
	Water Resources	
Texas Water Quality Standards	TX Admin. Code, Title 30, Chapters 305, 308–325	Requires permitting prior to any modification of waters of the State, including stream alteration for the construction of intakes, discharges, bridges, submarine utility crossings, etc. discharge source.
Texas Consolidated Permit Rules	TX Admin. Code, Title 30	Requires permit prior to construction or modification of a water discharge source.

Table 5–2. State Environmental Statutes and Regulations (Continued)

Legislation or Regulation	Citation	Potential Requirements
	Water Resources (Continued)	
Texas Water Quality Acts	TX Code, Title 30, Chapter 290	Requires permit prior to construction or modification of a water discharge source affecting a public water supply.
	Waste Management and Pollution Prevention	
Texas Solid Waste Management Regulations and Solid Waste Disposal Act	TX Admin. Code, Title 30, Chapters 305, 335; Statutes, Article 4477-7	Requires permit prior to construction or modification of a solid waste disposal facility.
	Biotic Resources	
Texas Parks and Wildlife Regulations	TX Parks and Wildlife Code, Chapters 67, 68, and 88	Requires permit by anyone who possesses, takes, or transports endangered, threatened, or protected plants or animals.
	Cultural Resources	
Antiquities Code of Texas	TX Natural Resource Code, Title 9, Chapter 191	Requires permit for the examination or excavation of sites and the collection or removal of objects of antiquity.
	SRS, South Carolina	
	Air Quality and Noise	
South Carolina Pollution Control Act	SC Code, Title 48, Chapter 1	Provides for the development of air pollution permitting regulations and air pollution control regulations.
South Carolina Air Pollution Control Regulations and Standards	Regulations 61 and 62	Requires permit prior to construction or modification of an air contaminant source and control of toxic air pollutants and other pollutants.
South Carolina Atomic Energy & Radiation Control Act	SC Code, Title 13, Chapter 7	Establishes standards for radioactive air emissions.
	Water Resources	
South Carolina Pollution Control Act	SC Code, Title 48, Chapter 1	Requires permit prior to construction or modification of a water discharge source.
South Carolina Water Quality Standards	SC Code, Title 61, Chapter 68	Requires permit required prior to construction or modification of a water discharge source.
South Carolina Safe Drinking Water Act	SC Code, Title 44, Chapter 55	Establishes drinking water standards.
	Waste Management and Pollution Prevention	
South Carolina Solid Waste Regulations	SC Code, Title 61, Chapter 60	Requires permit to store, collect, dispose, or transport solid wastes.
South Carolina Industrial Solid Waste Disposal Site Regulations	SC Code, Title 61, Chapter 66	Requires permit for industrial solid waste disposal systems.
South Carolina Hazardous Waste Management Act	SC Code, Title 44, Chapter 56	Requires permit to operate, construct, or modify a hazardous waste treatment, storage, or disposal facility.
South Carolina Solid Waste Management Act	SC Code, Title 44, Chapter 96	Establishes standards to treat, store, or dispose of solid waste.

Table 5–2. State Environmental Statutes and Regulations (Continued)

Legislation or Regulation	Citation	Potential Requirements
Biotic Resources		
South Carolina Nongame and Endangered Species Conservation Act	SC Code, Title 50, Chapter 15	Requires consultation with Wildlife and Marine Resources Department and minimization of impact.
Cultural Resources		
South Carolina Institute of Archaeology and Anthropology	SC Code, Title 60, Chapter 13-210	Requires consultation with State Historic Preservation Office and minimization of impact.

Table 5–3. Consultations

Basis for Consultation	Agency
Water Resources	
Wild and Scenic Rivers Act of 1968	USFWS, Bureau of Land Management, Forest Service, National Park Service
Biotic Resources	
Endangered Species Act of 1973	USFWS, National Marine Fisheries Service
Migratory Bird Treaty Act of 1918	USFWS
Bald and Golden Eagle Protection Act of 1972	USFWS
Fish and Wildlife Coordination Act of 1934	USFWS
Anadromous Fish Conservation Act of 1965	USFWS
Wilderness Act of 1964	Department of Commerce, Department of Interior
Wild Free-Roaming Horses and Burros Act of 1971	Department of Interior
Various Acts Concerning Fish and Game	Washington Department of Ecology
Various Acts Regarding Fish and Game	Idaho Department of Fish and Game
Texas Parks and Wildlife regulations	Texas Parks and Wildlife Department
South Carolina Nongame and Endangered Species Conservation Act	Wildlife and Marine Resources Department
Archaeological, Historical, and Cultural Resources	
National Historic Preservation Act of 1966	State Historic Preservation Office
American Indian Religious Freedom Act of 1978	Local Native American Indian Tribes
Native American Graves Protection and Repatriation Act of 1990	Local Native American Indian Tribes
Archaeology and Historic Preservation	Washington Office of Archaeology and Historic Preservation
Idaho Historic Preservation Act	Idaho Historic Preservation Commission
Tribal Working Agreement	Shoshone-Bannock Tribes
Antiquities Code of Texas	Texas State Historical Survey Committee
South Carolina Institute of Archaeology and Anthropology	State Historic Preservation Office

Key: USFWS, U.S. Fish and Wildlife Service.

Next Section

Chapter 6
Glossary

acute Extremely severe or intense for a limited time.

air pollutant Any substance borne through the air that can, in high enough concentrations, harm man, other animals, vegetation, or material.

Air Quality Control Region An area designated by a State or the U.S. Environmental Protection Agency for the attainment and maintenance of National Ambient Air Quality Standards.

ALARA See *as low as is reasonably achievable.*

alternative With reference to surplus plutonium disposition, a discrete sequence of disposition actions carried out in a dedicated group of facilities.

ambient air The atmosphere around people, plants, and structures.

Ambient Air Quality Standards Regulations prescribing the levels of airborne pollutants that may not be exceeded during a specified time in a defined area.

American Indian Religious Freedom Act of 1978 An act that protects and preserves for Native Americans their traditional religious rights, including the rights of access to religious sites, use and possession of sacred objects, and worship through traditional ceremonies and rites.

anadromous Migrating from salt water to fresh water to spawn.

Anadromous Fish Conservation Act An act seeking to enhance conservation and development of the anadromous fishery resources of the United States that are subject to depletion from water resources development.

aqueous process An operation involving chemicals dissolved in water.

aquifer A saturated geologic unit through which significant quantities of water can migrate under natural hydraulic gradients.

aquitard A less-permeable geologic unit in a stratigraphic sequence. Aquitards separate aquifers.

Archaeological Resources Protection Act of 1979 An act protecting cultural resources on federally owned lands. This act requires a permit for archaeological excavations or the removal of any archaeological resources on public or Native American lands. It also prohibits interstate or foreign trafficking in cultural resources taken in violation of State or local laws, and requires Federal agencies to develop plans for surveying lands under their control.

archaeological site Any location where humans have altered the terrain or discarded artifacts during prehistoric or historic times.

artifact An object produced or shaped by human beings and of archaeological or historical interest.

as low as is reasonably achievable An approach to radiation management and control by which exposures (individual and collective) of the workforce and the general public and releases of radioactive material to the environment are kept at levels as low as reasonable, taking into account social, technical, economic, practical, and public policy considerations.

Atomic Energy Act of 1954 An act setting up ". . . a program for Government control of the possession, use, and production of atomic energy and special nuclear material whether owned by the Government or others, so directed as to make the maximum contribution to the common defense and security and the national welfare, and to provide continued assurance of the Government's ability to enter into and enforce agreements with nations or groups of nations for the control of special nuclear materials and atomic weapons. . . ." (Section 3(c)).

attainment area An area considered to have air quality as good as or better than the National Ambient Air Quality Standards for a given pollutant. An area may be in attainment for one pollutant and nonattaining for others. See also *nonattainment area.*

background radiation Ionizing radiation present in the environment emanating from cosmic rays and natural sources in the Earth. Such radiation varies considerably with location.

badged (worker) A worker susceptible to exposure to radiation and thus equipped with an individual dosimeter.

Bald and Golden Eagle Protection Act An act making it unlawful to take, pursue, molest, or disturb the American bald eagle and golden eagle, their nests, or their eggs, anywhere in the United States.

basalt The most common volcanic rock, dark-gray to black in color, high in iron and magnesium, and low in silica. It is typically found in lava flows.

baseline A quantitative expression of conditions, costs, schedule, or technical progress that constitutes the standard against which to measure the performance of an effort.

basin Geologically, a circular or elliptical downwarp in whose center younger beds occur; topographically, a depression into which water from the surrounding area drains.

BEIR V A designation for the fifth in a series of committee reports from the National Research Council's Committee on the Biological Effects of Ionizing Radiation.

benthic Dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

beyond-design-basis accident An accident generally with more severe impacts on onsite personnel and the public than a design basis accident, and an estimated probability of occurrence of less than 10^{-6} per year. This accident is used for estimating the impacts of a facility or process. See also *design basis accident.*

boiling water reactor A type of nuclear reactor in which fission heat is used to generate steam in the reactor to drive turbines and generate electricity.

calcareous Containing calcium carbonate (as, for example, calcite or limestone).

cancer The name given to a group of diseases characterized by uncontrolled cellular growth, with the cells having invasive characteristics such that the disease can be transferred from one organ to another.

Canadian Deuterium Uranium Reactor A Canadian nuclear reactor in which circulating heavy water (deuterium-rich water) is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions.

can-in-canister An approach to plutonium immobilization wherein cans of either ceramic or glass forms containing plutonium are encapsulated within canisters of high-level-waste glass.

canyon A remotely operated, heavily shielded plutonium- or uranium-processing facility. A deep, steep-sided valley.

capable fault As defined in 10 CFR 100, Appendix A, III (g), "a fault which has exhibited one or more of the following characteristics: (1) movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years; (2) macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; and (3) a structural relationship to a capable fault according to characteristics (1) or (2) . . . such that movement on one could be reasonably expected to be accompanied by movement on the other. Notwithstanding the foregoing . . . , structural association of a fault with geologic structural features which are geologically old (at least pre-Quarternary) . . . shall, in the absence of conflicting evidence, demonstrate that the fault is not a capable fault."

carbon dioxide A colorless, odorless, nonpoisonous gas that is a normal component of the ambient air and an expiration product of normal animal life.

carbon monoxide A colorless, odorless gas that is toxic if breathed in high concentrations over an extended period.

cask (for radioactive materials) A container that meets all applicable regulatory requirements for shipping spent nuclear fuel or high-level waste.

Cenozoic A geologic era dating from 65 million years ago to the present and characterized by the dominance of advanced mollusks and mammals.

ceramic Surplus plutonium and other materials mixed to form a porcelain end product.

cesium A silver-white alkali metal. A radioactive isotope of cesium, cesium 137, is a common fission product.

chronic Lasting for a long period or marked by frequent recurrence.

chronic exposure Low-level radiation exposure incurred over a long period due to residual contamination.

cladding An external layer of material applied directly to nuclear fuel or other material to provide protection from a chemically reactive environment, containment of radioactive products produced during irradiation of the composite, or structural support.

Clean Air Act An act mandating and providing for the enforcement of regulations to control air pollution from various sources.

Code of Federal Regulations A publication in codified form of all Federal regulations in force.

coliform bacteria The normally harmless bacteria that reside in the intestinal tract of human beings and other animals whose presence in water is an indicator that the water may be contaminated with untreated human and animal waste.

committed effective dose equivalent The predicted total effective dose equivalent to a tissue or organ over a 50-year period after the intake of a radionuclide into the body, exclusive of external dose contributions. The committed effective dose equivalent is the sum of the committed dose equivalents to the various tissues of the body, each multiplied by the appropriate weighting factor. It is expressed in units of rem or sievert.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund) An act providing the regulatory framework for the remediation of past contamination from hazardous waste. If a site meets the act's requirements for designation, it is ranked along with other Superfund sites on the National Priorities List. This ranking is the U.S. Environmental Protection Agency's way of determining the priority of sites for cleanup.

conceptual design Efforts to develop a project scope that will meet stipulated program needs; ensure project feasibility and attainable performance goals; develop project criteria and design parameters for all concerned engineering disciplines; and identify applicable codes and standards, quality assurance requirements, environmental studies, construction materials, space allowances, energy conservation features, health and safety safeguards, security requirements, and any essential features of the project.

confined aquifer A permeable geologic unit bounded above and below by aquitards and containing water at a pressure higher than atmospheric pressure.

conformity As defined in the Clean Air Act, "the nation's compliance with an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards and achieving expeditious attainment of such standards. Activities in conformity will not (1) cause or contribute to any new violation of any standard in any area, (2) increase the frequency or severity of any existing violation of any standard in any area, or (3) delay timely attainment of any standard or any required interim emission reduction or other milestones in any area."

container The primary containment designed to meet the requirements of 10 CFR 60.

conversion An operation for changing material from one form, use, or purpose to another.

cosmic radiation Streams of highly penetrating, charged particles composed of protons, alpha particles, and a few heavier nuclei that bombard the earth from outer space.

credible accident An accident that has a probability of occurrence greater than or equal to one in a million years.

Cretaceous The geologic period making up the end of the Mesozoic era, dating from approximately 144 million to 66 million years ago.

criteria pollutants Common, widespread pollutants for which air quality standards have been established in accordance with the Clean Air Act. The U.S. Environmental Protection Agency developed these standards on the basis of its research into scientific knowledge about their health effects. Today, standards are in effect for six criteria pollutants: sulfur dioxide, carbon monoxide, particulate matter with aerodynamic diameters of less than or equal to 10 microns and less than or equal to 2.5 microns, nitrogen dioxide, ozone, and lead.

critical habitat As defined in the Endangered Species Act of 1973, "specific areas within the geographical area occupied by [an endangered or threatened] species . . . , essential to the conservation of the species and which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species . . . that are essential for the conservation of the species."

criticality A state in which a self-sustaining nuclear chain reaction is achieved.

cultural resources Archaeological sites, architectural features, traditional-use areas, and Native American sacred sites.

cumulative impacts The incremental impact on the environment of an action in combination with other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal), private industry, or individual undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7.)

curie A unit of radioactivity equal to 37 billion disintegrations per second; also a quantity of any nuclide or mixture of nuclides having 1 curie of radioactivity.

deactivation A process for removing hazardous and radioactive materials and placing a facility in a safe and stable condition.

decay (radioactive) The decrease in the amount of any radioactive material with the passage of time, due to the spontaneous transformation of an unstable nuclide into a different nuclide or into a different energy state of the same nuclide. The emission of nuclear radiation (alpha, beta, or gamma) is part of the process.

day-night average sound level The 24-hour, A-weighted equivalent sound level expressed in decibels. A 10-decibel penalty is added to sound levels between 10:00 p.m. and 7:00 a.m. to account for increased annoyance due to noise during night hours.

decibel A logarithmic unit of sound measurement that describes the magnitude or particular quantity of sound pressure or power with respect to a standard reference value. In general, a sound doubles in loudness with every increase of 10 decibels.

decibel, A-weighted A unit of sound measurement that incorporates a metering characteristic and the "A" weighting specified by the the American National Standards Institute in S1.4–1983(R1994) to account for the frequency response of the human ear.

decommissioning Actions taken at the end of life of facility to make it suitable for reuse, including surveillance, maintenance, decontamination, and/or dismantlement.

decontamination The removal of radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

depleted uranium Uranium whose content of the isotope uranium 235 is less than 0.7 percent, which is the uranium 235 content of naturally occurring uranium.

deposition In geology, the laying down of potential rock-forming materials—that is, sedimentation; in atmospheric transport, the settling out on ground and building surfaces of atmospheric aerosols and particles ("dry deposition") or their removal from the air to the ground by precipitation ("wet deposition" or "rainout").

derived concentration guide The concentration of a radionuclide in air or water which, under conditions of continuous exposure by one exposure mode (that is, ingestion of water or submersion in or inhalation of air) for 1 year, could cause a "reference man" to receive the more restrictive of two doses of that radionuclide: (1) an effective dose equivalent of 100 mrem, or (2) a dose equivalent of 5 rem to any tissues, including skin and the lens of the eye.

design basis For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component and the specific values (or ranges of values) chosen as reference bounds for design. These values may reflect: (1) restraints derived from generally accepted, state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (calculation or experiment) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

design basis accident For nuclear facilities, a postulated abnormal event used to establish the performance requirements of structures, systems, and components that are necessary to keep the facility in a safe shutdown condition indefinitely, or to prevent or mitigate the consequences of such an event, so as to ensure that the public and operating staff are not exposed to radiation in excess of appropriate guideline values. See also *beyond-design-basis accident.*

dewatering The removal of water. Saturated soils are "dewatered" to make construction of building foundations easier.

direct jobs The number of workers required at a site to implement an alternative.

dismantlement The process of taking apart a nuclear warhead and removing the subassemblies, components, and individual parts.

disposal The process of placing waste in a final repository.

disposition A process of use or disposal of materials that results in the remaining material being converted to a form that is substantially and inherently more proliferation resistant than the original form.

dissolution The chemical dispersal (dissolving) of a solid throughout a liquid medium.

dolomite A mineral composed of calcium magnesium carbonate; the chief constituent of the rock commonly called dolomite and of some kinds of marble.

dose The energy imparted to matter by ionizing radiation. The term encompasses absorbed dose, measurable in units of rem or gray, as well as dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, and total dose equivalent, all measurable in rem or sievert (1 rem = 0.01 sievert).

dose commitment The dose an organ or tissue would receive during a specified period of time (for example, 50 to 100 years) as a result of intake (by ingestion or inhalation) of one or more radionuclides from a defined release, frequently over a year's time.

dose equivalent The product of the absorbed dose in rad or gray, the effect of this type of radiation on tissue, and a quality factor. Dose equivalent is expressed in units of rem or sievert, where 1 rem equals 0.01 sievert. The dose equivalent delivered to an organ, tissue, or the whole body will be the dose received from direct exposure plus the 50-year committed dose equivalent received from the radionuclides taken into the body during a year.

drainage basin An aboveground area of the Earth's surface that supplies the water to a particular stream.

drawdown The height difference between the natural water level in an aquifer and the lower level caused by the withdrawal of groundwater.

drinking water standards The level of constituents or characteristics in a drinking water supply that cannot be exceeded legally.

ecology The study of the interrelationships of organisms and their environment.

ecosystem The biotic and abiotic components of a particular area (for example, a pond, a forest).

effective dose equivalent The summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value that can be used to estimate the risk of health effects to the exposed individual. The tissue-specific weighting factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The effective dose equivalent includes the committed effective dose equivalent from the internal deposition of radionuclides and the effective dose equivalent due to penetrating radiation from sources external to the body. It is expressed in units of rem or sievert.

effluent A gas or fluid discharged into the environment.

emission standards Legally enforceable limits on the quantities and kinds of air contaminants that can be emitted into the atmosphere.

endangered species As defined in the Endangered Species Act of 1973, "any species which is in danger of extinction throughout all or a significant part of its ranges."

Endangered Species Act of 1973 An act requiring Federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions will not likely jeopardize the continued existence of any endangered or threatened species or adversely affect the habitat of such species.

environment, safety, and health program A program encompassing those DOE requirements, activities, and functions in the conduct of all DOE and DOE-controlled operations concerned with: impacts on the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; reduction of risks to the well-being of both operating personnel and the general public to acceptably low levels; and adequate protection of property against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, process and facilities safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

environmental assessment A written environmental analysis prepared pursuant to the National Environmental Policy Act to determine whether a Federal action would significantly affect the environment and thus require preparation of a more detailed environmental impact statement. If the action does not significantly affect the environment, then a Finding of No Significant Impact is prepared.

environmental documentation Documents describing information and results of studies and evaluations required by the National Environmental Policy Act. This documentation includes a categorical exclusion, an environmental assessment, and an environmental impact statement.

environmental impact statement A document required of Federal agencies by the National Environmental Policy Act for major proposals or legislation that will or could significantly affect the environment. A tool for decisionmaking, it describes the positive and negative effects of the proposed and alternative actions.

environmental justice The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic strength.

Eocene A geologic epoch early in the Cenozoic era, dating from approximately 54 to 38 million years ago.

ephemeral stream A stream that flows intermittently, typically only after periods of heavy precipitation.

epicenter The point on the Earth's surface directly above the focus of an earthquake.

equivalent sound (pressure) level The equivalent, steady sound level that, if continuous during a specified time period, would contain the same total energy as the actual time-varying sound. L_{eq} (1-h) and L_{eq} (24-h) are the 1-hour and 24-hour equivalent sound levels, respectively.

Farmland Protection Policy Act An act whose purpose is to reduce the conversion of farmland to nonagricultural uses as a result of Federal projects and programs. The Act requires that Federal agencies comply to the fullest extent possible with State and local government policies to preserve farmland. It includes a recommendation that evaluations and analyses of prospective farmland conversion impacts be made early in the planning process—before a site or design is selected—and that, where possible, agencies make such evaluations and analyses part of the National Environmental Policy Act process.

fault A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall has been depressed in relation to the footwall. A reverse fault occurs when the hanging wall has been raised in relation to the footwall. A thrust fault is a low-angle (dip less than about 30 degrees) reverse fault.

fauna Animals, especially those of a specific region, considered as a group. See also *flora.*

Finding of No Significant Impact A document from a Federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment and will not require an environmental impact statement.

fissile A term referring to nuclear materials that are fissionable by slow (thermal) neutrons. Fissile materials include uranium 233 and 235 and plutonium 239. Materials such as uranium 238 and thorium 232, which can be converted into fissile materials, are called fertile materials. Thorium 232, uranium 238, and all plutonium isotopes are fissionable by fast but not slow neutrons; that is, they are fissionable but not fissile.

fission The splitting of a heavy atomic nucleus into at least two nuclei of lighter elements, accompanied by the release of energy and generally one or more neutrons. Fission can occur spontaneously or be induced by neutron bombardment.

fission products Nuclei formed by the fission or decay of heavy elements (primary fission products), many of which are radioactive.

fissionable material Material whose nuclei fission when bombarded by neutrons.

floodplain The lowlands adjoining inland and coastal waters and relatively flat areas, including, at a minimum, that area inundated by a 1-percent or greater-chance flood in any given year. The base floodplain is defined as the 100-year (1.0 percent) floodplain; the critical action floodplain, as the 500-year (0.2 percent) floodplain.

flora Plants, especially those of a specific region, considered as a group. See also *fauna.*

formation In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

fossil An impression or trace of an animal or plant of past geologic ages that has been preserved in the Earth's crust.

frit Finely ground glass used as feedstock for vitrification.

fugitive emissions Emissions to the atmosphere from pumps, valves, flanges, seals, and other process points not vented through a stack. Also included are emissions from area sources such as ponds, lagoons, landfills, piles of stored material, and exposed soil.

geologic repository (mined geologic repository) A repository meeting the specifications of the Nuclear Waste Policy Act, as amended, for the disposal of high-level nuclear waste and spent nuclear fuel. The waste is isolated by placement in a continuous, stable geologic formation at depths greater than 300 meters (984 feet).

geology The science that deals with the study of the materials, processes, environments, and history of the Earth, including the rocks and their formation and structure.

glass An amorphous material formed by the melting of silica.

glovebox An airtight box used to work with hazardous material. It is vented to a closed filtering system, and has gloves attached inside to protect the worker.

groundwater The supply of water found beneath the Earth's surface, usually in aquifers, which may supply wells and springs.

half-life (radiological) The time in which half the atoms of a radioactive substance decay to another nuclear form, varying for different radioisotopes from millionths of a second to billions of years.

hazardous material A material, including a hazardous substance as defined by 49 CFR 171.8, that poses a risk to health, safety, and property when transported or handled.

hazardous waste According to the Resource Conservation and Recovery Act, a solid waste that because of its characteristics may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, or (2) pose a substantial hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes appear on special U.S. Environmental Protection Agency lists and possess at least one of the following characteristics: (1) ignitability, (2) corrosivity, (3) reactivity, or (4) toxicity. The term does not include source, special nuclear, or by-product material as defined by the Atomic Energy Act.

hazardous/toxic air pollutants Air pollutants known or suspected to cause serious health problems such as cancer, poisoning, or sickness, and possibly having immunological, neurological, reproductive, developmental, or respiratory effects.

high-efficiency particulate air filter A filter used to remove particulates from dry, gaseous effluent streams.

high-level waste The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid. Such waste contains a combination of transuranic elements and fission products in concentrations requiring permanent isolation.

highly enriched uranium Uranium enriched in the isotope uranium 235 to 20 percent or above, which thus becomes suitable for weapons use.

historic resources Archaeological sites, architectural structures, and objects dating from 1492 or later, after the arrival of the first Europeans to the Americas.

homogenous A term describing an approach to the immobilization of plutonium and other fission products (for example, high-level-waste glass) wherein such products are blended uniformly as a single waste form.

immobilization A process by which plutonium is converted to a chemically stable form for disposal.

incident-free risk The radiological or chemical impacts of packages aboard vehicles in normal transport. This includes the radiation or hazardous chemical exposure of specific population groups such as crew, passengers, and bystanders.

indirect jobs Jobs generated or lost in related industries within a regional economic area as a result of a change in direct employment.

infrastructure The basic facilities, services, and utilities needed for the functioning of an industrial facility or DOE site. Transportation and electrical systems are part of the infrastructure.

interbedded Occurring between beds (layers) or lying in a bed parallel to other beds of a different material.

interfluvial Occurring in the land area between two streams.

interim (permit) status Period during which treatment, storage, and disposal facilities subject to the Resource Conservation and Recovery Act are temporarily permitted to operate while awaiting the issuance or denial of a permanent permit.

interim storage Safe, secure storage supportive of continuing operations until long-term storage or disposition actions are implemented.

invertebrate An animal without vertebrae (a backbone).

ion exchange A physiochemical process that removes anions and cations, including radionuclides, from liquid streams (usually water) for the purpose of purification or decontamination.

ionizing radiation Radiation that can displace electrons from atoms or molecules, thereby producing ions.

isotope An atom of an element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons (atomic number) but different numbers of neutrons (mass number).

land resources All of the terrestrial areas available for economic production, residential or recreational use, Government activities (such as military bases), or natural resources consumption. The patterns and densities of land use and the quality of visual resources are included in evaluations of land resources.

land use A characterization of land surface in terms of its potential utility for various activities.

landscape character The variety and intensity of the landscape features (land, water, vegetation, and structures) and the four basic elements (form, line, color, and texture) that distinguish an area from its immediate surroundings.

large release A release of radioactive material that would result in doses greater than 25 rem to the whole body or 300 rem to the thyroid at 1.6 kilometers (1 mile) from the control perimeter (security fence) of a facility.

latent fatalities Fatalities that occur within 30 years of acute and chronic environmental exposures to chemicals or radiation.

light water The common form of water: a molecule with two hydrogen atoms and one oxygen atom in which the hydrogen atom consists largely or completely of the normal hydrogen isotope (one proton).

light water reactor Either of two types of thermal reactors, a pressurized water reactor or a boiling water reactor, in which circulating light water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions. All commercially operating reactors in the United States and most commercial reactors worldwide are of this type.

low-enriched uranium Uranium enriched in the isotopic content of uranium 235 (greater than 0.7 percent but less than 20 percent of the total mass) for use as light water reactor fuel. Naturally occurring uranium contains only about 0.7 percent uranium 235, and almost all the rest is uranium 238.

low-level waste Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel, or the tailings of wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. Test specimens of fissionable materials irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranics is less than 100 nanocuries per gram of waste.

mandatory standards Standards adopted by DOE that define the minimum requirements with which DOE and its contractors must comply. Standards may be classified as mandatory because of applicable Federal or State statutes or implementing requirements, or as a matter of DOE policy.

marsh An area of low-lying wetland dominated by grasslike plants.

maximally exposed individual A person who, hypothetically, could receive the maximum dose of radiation or hazardous chemicals.

megawatt A unit of power equal to 1 million watts. Megawatt-thermal is commonly used to define heat produced, while megawatt-electric defines electricity produced.

meteorology The science dealing with the atmosphere and its phenomena, especially as relating to weather.

migration The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

Migratory Bird Treaty Act An act making it unlawful, except in connection with permitted activities, to pursue, take, attempt to take, capture, possess, or kill any migratory bird, or any part, nest, or egg of any such bird.

Miocene A geologic epoch of the Cenozoic era dating from 26 to 7 million years ago.

Mississippian (geologic) A period of the Paleozoic era in North America dating from 360 to 330 million years ago (following the Devonian period and preceding the Pennsylvanian period).

mitigation A series of actions implemented to ensure that projected impacts will result in no net loss of habitat value or wildlife populations. The purpose of these actions is to avoid, minimize, rectify, or compensate for any adverse environmental impact.

mixed low-level waste Low-level waste that contains hazardous components regulated under the Resource Conservation and Recovery Act.

mixed oxide A physical blend of uranium oxide and plutonium oxide.

mixed transuranic waste Transuranic waste that also contains hazardous components regulated under the Resource Conservation and Recovery Act.

mixed waste Waste that contains both hazardous and radioactive components.

Modified Mercalli Intensity A level of the perceived intensity of earthquake ground shaking on the modified Mercalli scale. The scale is a unitless expression of observed effects with 12 divisions, from I (not felt by people) to XII (nearly total damage).

National Ambient Air Quality Standards Air quality standards established by the U.S. Environmental Protection Agency for certain widespread "criteria" pollutants in accordance with the Clean Air Act, as amended. The "primary" standards are intended to protect the public health with an adequate margin of safety; the "secondary" standards, to protect the public welfare, including plant and animal life, visibility, and materials, from any known or anticipated adverse effects of a pollutant.

National Emission Standards for Hazardous Air Pollutants A set of national standards governing the emission of listed hazardous pollutants from specific classes or categories of new and existing sources.

National Environmental Policy Act of 1969 An act constituting the basic national charter for protection of the environment. The act calls for the preparation of an environmental impact statement for every major Federal action that may significantly affect the quality of the human or natural environment. Its main purpose is to provide environmental information to decisionmakers so that their actions are based on an understanding of the potential environmental consequences of a proposed action and the reasonable alternatives.

National Environmental Research Park An outdoor laboratory set aside for research into the environmental impacts of energy developments. Such parks were established by DOE to provide protected land areas for research and education in the environmental sciences and to demonstrate the environmental compatibility of energy technology development and use.

National Historic Preservation Act of 1966, as amended An act providing that property resources with significant national historic value be placed on the National Register of Historic Places. It does not require permits; rather, it mandates consultation with the proper agencies whenever it is determined that a proposed action might impact a historic property.

National Pollutant Discharge Elimination System A Federal permitting system controlling the discharge of effluents to surface waters of the United States and regulated through the Clean Water Act, as amended.

National Register of Historic Places A list of districts, sites, buildings, structures, and objects of prehistoric or historic local, State, or national significance. The list, maintained by the Secretary of the Interior, is expanded as authorized by Section 2(b) of the Historic Sites Act of 1935 (16 U.S.C. 462) and Section 101(a)(1)(A) of the National Historic Preservation Act of 1966, as amended.

Native American Graves and Repatriation Act of 1990 An act established to protect Native American graves and associated funerary objects. This act requires Federal agencies and museums to inventory human remains and associated funerary objects, to provide culturally affiliated tribes with the documented results of that inventory, and to return, on request, items in the inventory to the culturally affiliated tribes.

natural uranium Uranium in its pre-enriched state, having a uranium 235 concentration of approximately 0.7 percent.

nitrogen oxides The oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide, produced in the combustion of fossil fuels. Nitrogen dioxide emissions constitute an air pollution problem, as they contribute to acid deposition and the formation of atmospheric ozone.

noise Any sound that is undesirable because it interferes with speech and hearing, is intense enough to damage hearing, or is otherwise annoying (unwanted sound).

Noise Control Act of 1972 An act directing all Federal agencies to carry out programs in a manner that furthers the national policy of promoting an environment free from noise that jeopardizes health or welfare.

nonattainment area The U.S. Environmental Protection Agency's designation for an air quality control region (or portion thereof) in which ambient air concentrations of one or more "criteria" pollutants exceed National Ambient Air Quality Standards.

nonproliferation Preventing the spread of nuclear weapons, nuclear weapons materials, and nuclear weapons technology.

Nonproliferation Treaty A treaty aimed at controlling the spread of nuclear weapons technologies, limiting the number of nuclear weapons states, and pursuing, in good faith, effective measures relating to cessation of the nuclear arms race. The treaty does not invoke stockpile reductions by nuclear states, nor does it address actions of nuclear states relative to stockpile maintenance.

Notice of Intent A notice that an environmental impact statement will be prepared and considered. Prepared in accordance with 40 CFR 1508.22, the Notice of Intent describes the proposed action the agency is considering, provides information on issues and potential impacts, and invites comments and suggestions on the scope of the environmental impact statement.

nuclear criticality See *criticality*.

nuclear facility A facility whose operations involve radioactive materials in such form and quantity as to pose a hazard to the employees or the public. Included are facilities that produce, process, or store radioactive liquid or solid waste, fissionable materials, or tritium; conduct separations operations; conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations; or conduct fuel enrichment operations. Incidental operational use of radioactive materials (for example, as check sources, as radioactive sources, in x-ray machines) does not necessarily qualify that facility for designation as nuclear.

nuclear material A term encompassing (1) special nuclear material; (2) source material such as uranium or thorium or ores containing uranium or thorium; and (3) by-product material, which is any radioactive material made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material.

nuclear power plant A facility that converts nuclear energy into electric power. Heat produced in a nuclear reactor is used to make steam, which drives a turbine connected to an electric generator.

nuclear reactor A device in which a fission chain reaction is maintained for the purpose of irradiating materials or producing heat for the generation of electricity.

nuclear weapon The general name given to any weapon in which the explosion results from the energy released by reactions (fission, fusion, or both) of atomic nuclei.

outfall The discharge point of a drain, sewer, or pipe into a body of water.

oxidation The combination of an element with oxygen wherein the element's atoms lose electrons and its positive charge (that is, valence) is correspondingly increased.

oxide A compound formed when an element (for example, plutonium) is bonded to oxygen.

ozone The triatomic form of oxygen that in the stratosphere protects the Earth from the Sun's ultraviolet rays, but at lower atmospheric levels is an air pollutant. Ozone is a major constituent of smog.

packaging For radioactive materials, a container consisting of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shock—all to ensure compliance with regulations of the U.S. Department of Transportation.

paleontology The study of plant and animal life that existed in former geologic times, particularly through the analysis of fossils.

Paleozoic The longest era of geologic time, dating from 570 million to 245 million years ago. Seed-bearing plants, amphibians, and reptiles first appeared in the Paleozoic era.

particulate matter Air pollutants, including dust, dirt, soot, smoke, and liquid droplets. Total suspended particulates were first used as the indicator of particulate concentrations. Current indicators are PM_{10} and $PM_{2.5}$ (PM for "particulate matter"), which include only those particles with aerodynamic diameters smaller than or equal to 10 and 2.5 micrometers, respectively. The smaller particles are more responsible for adverse health effects because they penetrate farther into the respiratory tract.

perched groundwater A body of groundwater of small lateral dimensions separated from an underlying body of groundwater by an unsaturated zone.

person-rem The unit of the collective radiation dose commitment of a given population; the sum of the individual doses received by a population segment.

pH A numeric value that indicates the relative acidity or alkalinity of a substance on a scale of 0 to 14, with the neutral point at 7.0. Acid solutions have pH values lower than 7.0; basic (alkaline) solutions, values higher than 7.0.

phytoplankton Aquatic, free-floating, microscopic, photosynthetic organisms.

pit The core element of a nuclear weapon's "primary" or fission component.

pit cladding The material that encapsulates a pit, forming a hermetic seal around it.

playa A dry lake bed in a desert basin or a closed depression that seasonally contains water.

Pleistocene The geologic time of the earliest epoch of the Quaternary period, occurring approximately 11,000 to 2 million years ago and characterized by a succession of northern glaciations and the appearance of human beings.

Pliocene The geologic time of the latest epoch of the Tertiary period, occurring approximately 7 million to 2 million years ago and characterized by the appearance of distinctly modern animals.

plume The elongated pattern of contaminated air or water originating at a point source such as a smokestack or a hazardous waste disposal site.

plutonium A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially in a reactor by the bombardment of uranium with neutrons and is used in the production of nuclear weapons. Plutonium has 15 isotopes with mass numbers ranging from 232 to 246. Weapons-usable plutonium consists mainly of plutonium 239, which has a radiological half-life of 24,110 years. See also *half-life (radiological).*

potable water Water that is fit to drink.

pounds per square inch A measure of pressure. Atmospheric pressure is about 14.7 pounds per square inch.

power reactor–grade material Plutonium and highly enriched uranium in any of various forms (for example, metals, oxides) that can be used in commercial nuclear power reactors. Power reactor–grade plutonium contains plutonium 240 in concentrations higher than 19 percent.

precipitate To cause a solid substance to become separate from a solution.

prehistoric Predating written history; in North America, also predating contact with Europeans.

pressurized water reactor A nuclear power reactor that uses water under pressure as a coolant. The water boiled to generate steam is in a separate (secondary) system.

prevention of significant deterioration The designation for regulations established by the Clean Air Act to limit increases in "criteria" air pollutant concentrations above the baseline; also, actions consistent with those regulations.

Prevention of Significant Deterioration Class I, II, and III Areas A Clean Air Act classification of clean air areas in terms of the levels of increased pollution allowed. Very little increase in pollution is allowed in Class I areas, and progressively more in Classes II and III. National parks and wilderness areas receive mandatory Class I protection; all other areas start out as Class II. States can reclassify Class II areas up or down, subject to Federal requirements.

prime farmland Land with the best combination of physical and chemical characteristics (soil quality, growing season, and moisture supply) for economically producing high yields of food, feed, forage, fiber, and oilseed crops, with minimum inputs of fuel, fertilizer, pesticides, and labor without intolerable soil erosion (Farmland Protection Policy Act of 1981, 7 CFR 7, paragraph 658). Land classified as prime farmland includes cropland, pastureland, rangeland, and forest land, but not urban or built-up land or land covered with water. Prime farmlands are designated by the Soil Conservation Service.

probabilistic risk assessment A comprehensive, logical, and structured method for identifying and quantitatively evaluating the sequences and consequences of hypothetical accidents.

probable maximum flood Flood levels predicted for hydrological conditions that maximize the flow of surface waters.

process The act of extracting, separating, or purifying a substance by physical or chemical means.

programmatic environmental impact statement A document that evaluates the environmental impacts of Federal programs potentially affecting one or more sites. The document is prepared in accordance with Section 102(2)(C) of the National Environmental Policy Act.

proliferation The spread of nuclear, biological, and chemical capabilities and the weapons (for example, missiles) capable of delivering them.

protected area An area designated for the protection of material assets and typically encompassed by physical barriers, subject to access controls, surrounding material access areas, and meeting the standards of DOE 5632.1C, *Protection and Control of Safeguards and Security Interests*.

Quaternary The second geologic period of the Cenozoic era, lasting from 2 million years ago to the present and characterized by the appearance of human beings.

rad See *radiation absorbed dose*.

radiation The emitted particles or photons from the nuclei of radioactive atoms. Some elements are naturally radioactive; others are induced to become radioactive by bombardment in a reactor. Naturally occurring radiation is indistinguishable from induced radiation.

radiation absorbed dose The basic unit of absorbed radiation, equivalent to 0.01 joule per kilogram of absorbing material.

radioactive accident risk As described in the *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG–0170), the probability of an accident in which the release of radioactive material is likely to occur, and its consequences. The consequences are expressed in terms of the potential effects of the release of a specified quantity of dispersible radioactive material to the environment or the exposure resulting from damaged package shielding. The risk calculations incorporate accident rates and package release fraction estimates, both of which are functions of accident severity. Radiological accident risks are expressed in terms of the probabilities of early cancer fatalities and annual latent cancer fatalities.

radioactive waste Materials that are radioactive or are contaminated with radioactive materials, and for which use, reuse, or recovery are impractical.

radioactivity The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

radioisotopes Radioactive nuclides of the same element (that is, having the same number of protons in their nuclei) that differ in the number of neutrons.

radionuclide A radioactive element characterized according to its atomic mass and atomic number Radionuclides can be man-made or naturally occurring, can have a long life, and have potentially mutagenic or carcinogenic effects on the human body.

radon A gaseous radioactive element resulting from the radioactive decay of radium. Radon (atomic number 86) occurs naturally in the environment and can collect in enclosed, unventilated areas such as basements. Large concentrations of radon can cause lung cancer in humans.

Record of Decision A document providing a concise public record of DOE's decision on a proposed action for which an environmental impact statement was prepared. Prepared in accordance with 40 CFR 1505.2, the Record of Decision identifies the alternatives considered in reaching the decision, the environmentally preferable alternative, factors balanced by DOE in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they have not.

region of influence A site-specific geographic area that includes the counties where approximately 90 percent of the site's current DOE and contractor employees reside.

regional economic area A geographic area consisting of an economic node and the surrounding, economically related counties, including the places of work and residences of the labor force. Regional economic areas are defined by the Bureau of Economic Analysis.

rem See *roentgen equivalent man.*

reprocessing The chemical separation of spent reactor fuel into uranium, transuranic elements, and fission products.

Resource Conservation and Recovery Act, as amended The Act that establishes a "cradle-to-grave" regulatory program for hazardous waste, including a system for managing such waste from its generation until its ultimate disposal.

rhyolite A volcanic rock rich in silica; the volcanic equivalent of granite.

Richter scale A logarithmic scale used to express the total amount of energy released by an earthquake. The scale has 10 divisions, from 1 (not felt by humans) to 10 (nearly total destruction).

riparian On or around rivers or streams.

risk A quantitative or qualitative expression of possible loss that takes into account both the probability that an event will cause harm and the consequences of that event.

risk assessment (chemical or radiological) The qualitative and quantitative evaluation performed to define the risk posed to human health or the environment by the presence, potential presence, or use of specific chemicals or radionuclides.

roentgen A unit of exposure to ionizing X- or gamma radiation equal to or producing 1 electrostatic unit of charge per cubic centimeter of air. It is approximately equal to 1 rad. See also *radiation absorbed dose.*

roentgen equivalent man The unit of biologically absorbed radiation, equal to the product of the absorbed dose, in rads, and a quality factor that accounts for the variation in biological effectiveness of different types of radiation.

runoff The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

Safe Drinking Water Act, as amended An act protecting the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

safe, secure trailer A specially designed semitrailer, pulled by a specially designed tractor, that is used for the safe, secure transportation of cargo containing nuclear weapons or special nuclear material.

safety analysis report A safety document providing a complete description and safety evaluation of a site; a design; normal and emergency facility operations; and potential accidents, predicted consequences of such accidents, and the means proposed to prevent such accidents or mitigate their consequences. A Safety Analysis Report is designated as final when it is based on final design information; otherwise, as preliminary.

safety document A document prepared specifically to ensure that the safety aspects of part or all of the activities conducted are formally and thoroughly analyzed, evaluated, and recorded. Examples include Technical Specifications, Safety Analysis Reports and addenda, and documented reports of special safety reviews and studies.

saltstone Concrete block formed by mixing the low-radioactivity fraction of high-level waste from the in-tank precipitation process with cement, ash, and slag.

sandstone A sedimentary rock composed mostly of sand-size particles cemented usually by calcite, silica, or iron oxide.

sanitary wastes Nonhazardous, nonradioactive liquid and solid wastes generated by normal housekeeping activities.

scintillation Minute flash of light caused when alpha, beta, or gamma rays strike certain phosphors.

scoping The solicitation of comments from interested persons, groups, and agencies at public meetings, in public workshops, in writing, electronically, or via fax to assist DOE in defining a proposed action, identifying alternatives, and developing preliminary issues to be addressed in an environmental impact statement.

security Controls instituted or actions taken to minimize the likelihood of unauthorized access to, or loss of custody of, a nuclear weapon or weapon system, and to ensure that the weapon can be recovered should unauthorized access or loss of custody occur.

seismic Pertaining to any earth vibration, especially that of an earthquake.

seismic zone An area defined by the Uniform Building Code (1991) on the basis of its susceptibility to damage as the result of earthquakes. The United States is divided into six zones distinguished as to the level of damage that can be expected: (1) Zone 0, no damage; (2) Zone 1, minor damage, corresponding to intensities V and VI of the Modified Mercalli Intensity scale); (3) Zone 2A, moderate damage, corresponding to intensity VII of the Mercalli scale (Eastern United States); (4) Zone 2B, slightly more damage than 2A (Western United States); (5) Zone 3, major damage, corresponding to intensity VII and higher of the Mercalli scale; and (6) Zone 4, areas within Zone 3 nearer certain major fault systems.

seismicity The frequency and distribution of earthquakes.

sensitivity level A basis for the characterization of a landscape that takes into account the visibility of specific features, the potential number of viewers, viewer interest in and concern for the landscape, and viewer attitudes toward proposed landscape changes.

severe accident An accident that would have more severe consequences than a design basis accident in terms of damage to a facility, offsite consequences, or both; an accident with a frequency rate of less than 10^{-6} per year.

sewage The total nonhazardous organic waste and wastewater generated by an industrial establishment or a community.

shale A type of easily split rock composed of layers of claylike, fine-grained sediments.

shielding Any material of obstruction (bulkheads, walls, or other structures) that absorbs radiation in order to protect personnel or equipment.

shutdown That condition in which a DOE reactor has ceased operation and DOE has declared officially that it does not intend to operate it further.

silt A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

siltstone A fine-grained, elastic (fragmented) sedimentary rock whose particles range from 1/6 to 1/256 millimeter in diameter.

sinter To form a homogenous mass by heating without melting.

sitewide environmental impact statement A legal document prepared in accordance with the requirements of Section 102(2)(C) of the National Environmental Policy Act that reflects an evaluation of the environmental impacts of proposed Government actions at a large, multiple-facility site.

solid waste Discarded solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. Solid waste does not include solid or dissolved materials in domestic sewage; industrial discharges subject to permit under the Clean Water Act; or source, special nuclear, or byproduct material as defined by the Atomic Energy Act.

source term The estimated quantities of radionuclides or chemical pollutants released to the environment.

special nuclear materials As defined in Section 11 of the Atomic Energy Act, "(1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the NRC determines to be special nuclear material, or (2) any material artificially enriched by any of the foregoing."

Spent Fuel Standard A term, coined by the National Academy of Sciences and modified by DOE, denoting the main objective of alternatives for the disposition of surplus weapons-usable plutonium: that such plutonium be made roughly as inaccessible and unattractive for weapons use as the much larger and growing stock of plutonium in civilian spent nuclear fuel.

spent nuclear fuel Fuel that has been withdrawn from a nuclear reactor following irradiation, and whose constituents have not been separated.

stabilization Treatment, packaging, and removal of hazardous and radioactive materials in such a manner as to ensure that a facility is safe and environmentally secure.

stabilize To convert a compound, mixture, or solution to a nonreactive form.

staging An interim storage or gathering of items pending their use, transportation, consumption, or other disposition.

standby That condition in which a reactor facility is neither operable nor declared excess, and as authorized in writing, is being kept in readiness for possible future operation.

State Historic Preservation Officer State officer charged with the identification and protection of prehistoric and historic resources in accordance with the National Historic Preservation Act.

steppe A semiarid, grass-covered, generally treeless plain.

steppe climate (semiarid climate) The type of climate in which precipitation is very slight but sufficient for the growth of short, sparse grass.

stored weapons standard A storage standard that invokes the high standards of security and accounting for the storage of intact nuclear weapons. Invocation of the standard for weapons-usable fissile materials implies maintenance thereof to the extent practical through the processes of dismantlement, storage, and disposition.

Superfund Amendments and Reauthorization Act of 1986 An environmental act that, in addition to certain freestanding provisions of law, extensively amends the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund) and the Safe Drinking Water Act. The act's major goals are a stepped-up pace of cleanup, increased public participation, and more stringent and better-defined cleanup standards, emphasizing remedial actions. See also *Comprehensive Environmental Response, Compensation, and Liability Act of 1980; Safe Drinking Water Act, as amended.*

surface water Water on the Earth's surface, as distinguished from water in the ground (groundwater).

surplus fissile materials Weapons-usable fissile materials that have no identified programmatic use or do not fall into one of the categories of national security reserves.

Tertiary The first geologic period of the Cenozoic era, dating from 66 million to about 3 million years ago. During this period, mammals became the dominant life form.

threatened species As defined in the Endangered Species Act of 1973, "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

total effective dose equivalent The sum of the internal dose (committed effective dose equivalent) and the external dose (effective dose equivalent).

toxic air pollutants See *hazardous/toxic air pollutants.*

Toxic Substances Control Act of 1976 An act authorizing the U.S. Environmental Protection Agency to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the Agency before such chemicals are manufactured for commercial purposes.

transmissivity A measure of a water-bearing unit's capacity to transmit fluid, expressed as the product of the thickness and the average hydraulic conductivity of the unit. Also, the rate at which water is transmitted through a strip of an aquifer of a unit width under a unit hydraulic gradient at a prevailing temperature and pressure.

transuranic Of, relating to, or being any element whose atomic number is higher than that of uranium (that is, 92). All transuranic elements are produced artificially and are radioactive.

transuranic waste Waste containing more than 100 nanocuries per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years, except for (1) high-level waste; (2) waste that DOE has determined, with the concurrence of the U.S. Environmental Protection Agency, does not need the degree of isolation called for by 40 CFR 191; or (3) waste that the U.S. Nuclear Regulatory Commission has approved for disposal case by case in accordance with 10 CFR 61.

treatment An operation necessary to prepare material for storage, disposal, or transportation.

Triassic The first period of the Mesozoic era, dating from 245 to 208 million years ago.

tritium A radioactive isotope of the element hydrogen having two neutrons and one proton.

tritium recycling The recovery, purification, and reuse of tritium contained in tritium reservoirs within the nuclear weapons stockpile.

unconfined aquifer A permeable geologic unit having the following properties: a water-filled pore space (saturated), the capability to transmit significant quantities of water under ordinary differences in pressure, and an upper water boundary at atmospheric pressure.

uranium A heavy, silvery-white metallic element (atomic number: 92) with many radioactive isotopes. One isotope, uranium 235, is most commonly used as a fuel for nuclear fission; another, uranium 238, is transformed into fissionable plutonium 239 following its capture of a neutron in a nuclear reactor.

vadose zone A region in a porous medium in which the pore space is not filled with water (unsaturatured zone).

viewshed The extent of the area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

Visual Resource Management A process devised by the Bureau of Land Management to assess analytically the aesthetic quality of a landscape, and consistent with the results of that analysis, to so design proposed activities as to minimize their visual impact on that landscape. The process consists of a rating of site visual quality followed by a measurement of the degree of contrast between proposed development activities and the existing landscape.

Visual Resource Management Class Any of the classifications of visual resources established through application of the Visual Resources Management process of the Bureau of Land Management. Five classifications are employed to define the different degrees of modification to landscape elements: Class 1, pristine areas, including designated wilderness and wild and scenic rivers; Class 2, areas with very limited land development activity, resulting in contrasts that are seen but do not attract attention; Class 3, areas in which contrasts caused by development activity are evident, but the natural landscape still dominates; Class 4, areas in which contrasts caused by human activities attract attention and are dominant features of the landscape in terms of scale, but repeat the contrasts of the characteristic landscape; Class 5, areas in which contrasts caused by cultural activities are such dominant features of the landscape that the natural landscape character no longer exists.

visual resources Natural and cultural features by which the appearance of a particular landscape is defined.

vitrification A process by which glass (for example, borosilicate glass) is used to encapsulate or immobilize radioactive wastes.

volatile organic compounds A broad range of organic compounds, often halogenated, that vaporize at rather low ambient temperatures. Examples include certain solvents, paint thinners, degreasers (for example, benzene), chloroform, and methyl alcohol.

waste A discardable residue of a manufacturing or purification process.

Waste Isolation Pilot Plant A facility in southeastern New Mexico that is being developed as the national disposal site for transuranic and mixed transuranic waste.

waste minimization and pollution prevention An action that economically avoids or reduces the generation of waste and pollution by means of source reduction, reduction in the toxicity of hazardous waste and pollution, improvement in energy use, and recycling. These actions are consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

waste package The waste, waste container, and any absorbent that are intended for disposal as a unit. In the case of surface-contaminated, damaged, leaking, or breached waste packages, any overpack is considered the waste container, and the original container is considered part of the waste.

wastewater Water originating from human sanitary water use (domestic wastewater) and from a variety of industrial processes (industrial wastewater).

water quality standards and criteria Limits on the concentrations of specific constituents or on the characteristics of water, often based on water use classifications (for example, drinking water, recreation, propagation of fish and aquatic life, agricultural and industrial use). Water quality standards are legally enforceable, whereas water quality criteria are nonenforceable recommendations based on biotic impacts.

water table The boundary between the unsaturated zone and the deeper, saturated zone. The upper surface of an unconfined aquifer.

weapons-grade material Plutonium or highly enriched uranium, in metallic form, that was manufactured for weapons application. Weapons-grade plutonium contains less than 7 percent plutonium 240.

weapons-usable material Plutonium or highly enriched uranium in forms (for example, metals, oxides) that can be readily converted for use in nuclear weapons. Weapons-grade, fuel-grade, and power reactor–grade plutonium are all weapons usable.

wetland Land areas exhibiting hydric soil conditions, saturated or inundated soil during some portion of the year, and plant species tolerant of such conditions.

whole-body dose Dose of radiation resulting from the uniform exposure of all organs and tissues in a human body. See also *effective dose equivalent*.

Wild and Scenic Rivers Act The Act that established the National Wild and Scenic Rivers System with a view to preserving and protecting the free-flowing condition of selected rivers having outstanding natural, cultural, or recreational features. For federally owned land within the boundaries of rivers in the system, certain activities that would have a direct and adverse effect on river values may be controlled.

zooplankton A collective term for nonphotosynthetic organisms present in plankton.

6M A container, resembling a 55-gallon stainless steel drum, that is used by the U.S. Department of Energy for the shipment of radioactive material. This container is one unit of a containment package that includes an inner impact absorber material (Type B packaging), which protects another inner container (usually Type 2R) in which the radioactive material is placed.

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Chapter 7
List of Preparers

Borghi, Louis C., ***Ecological Resources,*** **SAIC**
M.S., Ecology (1977), The Pennsylvania State University, State College, PA
B.A., Biology (1975), LaSalle University, Philadelphia, PA
Years of Experience: 20

Brin, Gerald L., ***Plutonium Polishing,*** **SAIC**
Indentured Apprenticeship Certification (1976), Denver, CO
Years of Experience: 30

Brown, Tracy L., ***Crosscutting Functions,*** **SAIC**
B.A., Environmental Engineering Science (1994), Dartmouth College, Hanover, NH
Years of Experience: 4

Collins, Michael G., ***Land Use and Visual Resources,*** **SAIC**
M.E.P., Master of Environmental Planning (1996), Arizona State University, Tempe, AZ
B.S., Urban Planning and Development (1990),
University of Southern California, Los Angeles, CA
Years of Experience: 6

Crede, Suzanne C., ***Cumulative Impacts,*** **SAIC**
M.A., Counseling and Guidance (1977), West Virginia University, Morgantown, WV
B.S., General Science and Safety Education (1976),
West Virginia University, Morgantown, WV
Years of Experience: 18

DeMoss, Gary M., ***Transportation Accidents,*** **SAIC**
M.A., Engineering Administration (1991),
Virginia Polytechnic Institute and State University, Blacksburg, VA
B.S., Mechanical Engineering (1981), University of Virginia, Charlottesville, VA
Years of Experience: 16

DiMarzio, John A., ***Waste Management,*** **SAIC**
M.S., Geology (1984), The George Washington University, Washington, DC
B.S., Geology (1981), University of Maryland, College Park, MD
Years of Experience: 14

Eichner, John M., ***Deputy Project Manager,*** **SAIC**
B.S., Accounting and Finance (1980), Syracuse University, Syracuse, NY
Years of Experience: 17

Everett, H. Christopher, ***Facility Accidents,*** **SAIC**
B.S., Physics (1985), Tufts University, Medford, MA
Years of Experience: 12

Ford, Dennis G., *Cumulative Impacts*, SAIC
Ph.D., Zoology (1972), SUNY College of Environmental Science and Forestry at Syracuse University, Syracuse NY
B.A., Biology (1966), SUNY College of Arts, Geneseo, NY
Years of Experience: 32

Frost, Donna R., *Geology and Soils,* SAIC
M.S., Geology (1971), Iowa State University, Ames, IA
B.A., Psychology (1968), Iowa State University, Ames, IA
Years of Experience: 25

Frost, James C., *Water Resources,* SAIC
M.A., Business Administration (1973), Sangamon State University, Springfield, IL
B.A., Biology (1969), Blackburn University, Carlynville, IL
Years of Experience: 27

Gandee, Kitty B., *Impact Analysis,* SAIC
M.S., Nuclear Engineering (1978), Oregon State University, Corvallis, OR
M.L.S., Library Science (1975), University of Pittsburgh, Pittsburgh, PA
M.S., Materials Engineering (1974), University of Maryland, College Park, MD
B.S., Metallurgical Engineering (1972), Chen Kung University, Taiwan
Years of Experience: 20

Groome, Chadi D., *MOX Fuel Options,* SAIC
M.S., Environmental Engineering Sciences (1977), University of Florida, Gainesville, FL
B.S., Zoology (1973), Clemson University, Clemson, SC
Years of Experience: 18

Haley, Timothy A., *Transportation Analysis,* SAIC
B.S., Engineering, Nuclear Engineering (1989), University of Cincinnati, Cincinnati, OH
Years of Experience: 7

Hanson, Glen T, *Cultural Resources,* SAIC
M.A., Anthropology/Archaeology (1976), Arizona State University, Tempe, AZ
B.S., Anthropology (1971), Grand Valley State College, Allendale, MI
Years of Experience: 21

Hirrlinger, Diana N., *Crosscutting Functions/Quality Assurance,* SAIC
M.B.A., Marketing and Organizational Behavior (1987), University of Maryland, College Park, MD
B.S., Conservation of Natural Resources (1980), University of California, Berkeley, CA, 1980
Years of Experience: 17

Hoffman, Robert G., *Immobilization Options,* SAIC
B.S., Environmental Resource Management (1986), The Pennsylvania State University, State College, PA
Years of Experience: 12

Jones, Marcus E., *EIS Document Manager*, Reactors Group, Office of Fissile Materials Disposition (MD-4), U.S. Department of Energy
M.S.E., Environmental Engineering (1986), University of Alabama, Tuscaloosa, AL
B.S., Biology (1980), University of Alabama, Tuscaloosa, AL
Years of Experience: 15

Lam, Ying, *Affected Environment*, SAIC
M.S., Environmental Science (1997), Indiana University, Bloomington, IN
M.P.A., Master of Public Affairs (1997), Indiana University, Bloomington, IN
B.S., Environmental Biology (1993), Jinan University, Guangzhu, China
Years of Experience: 1

Mahosky, Paul R., *Infrastructure*, SAIC
M.S.E., Engineering Management (1993),
The Catholic University of America, Washington, DC
B.S., Ocean Engineering (1983), United States Naval Academy, Annapolis, MD
Years of Experience: 14

Mancino, Frank P., *Comment Response Systems Manager*, SAIC
M.S., Natural Resources Management and Policy (1979),
University of Michigan, Ann Arbor, MI
B.S., Environmental Studies (1976), Florida International University, Miami, FL
Years of Experience: 20

Martin, James F., *Editor*, SAIC
M.S., Theoretical Linguistics (1969), Georgetown University, Washington, DC
B.S., Modern Languages (1959), Memphis State University, Memphis, TN
Years of Experience: 39

Martin, Karen L., *Impact Analysis*, SAIC
B.A., Conservation and Resource Development (1981),
University of Maryland, College Park, MD
Years of Experience: 16

Nemeth, Diane M., *Socioeconomics*, SAIC
M.S., Urban Planning (1978), Columbia University, New York, NY
B.A., Economics (1973), Miami University, Oxford, OH
Years of Experience: 24

Nulton, J. David, *Director, Reactor Group*, Office of Fissile Materials Disposition (MD-4), U.S. Department of Energy
M.S., Mechanical Engineering (1970), Stanford University, Stanford, CA
B.S., Mechanical Engineering (1968), Drexel University, Philadelphia, PA
Years of Experience: 29

Outlaw, Douglas A., *Facility Accidents*, SAIC
Ph.D., Nuclear Physics (1974), North Carolina State University, Raleigh, NC
M.S., Nuclear Physics (1970), North Carolina State University, Raleigh, NC
B.S., Physics (1969), North Carolina State University, Raleigh, NC
Years of Experience: 20

Papa, Patricia, E., *Socioeconomics*, SAIC
B.A., Journalism and Psychology (1966), Syracuse University, Syracuse, NY
Years of Experience: 15

Pietzyk, Sharon M., *Ecological Resources*, SAIC
M.S., Systems Management (1988), Univ. of Southern California, Los Angeles, CA
B.S., Biology (1981), James Madison University, Harrisonburg, VA
Years of Experience: 16

Rhone, Jacquelyn L., *Production*, SAIC
A.Sc., Radiological Health Technology (1972), Central Florida Community College, Ocala, FL
Years of Experience: 25

Sawyer, Cheri A., *Document Production Manager*, SAIC
B.S., Journalism (1977), University of Maryland, College Park, MD
Years of Experience: 20

Schlegel, Robert L., *Human Health Risk*, SAIC
Degree of Nuclear Engineer (1964), Columbia University, New York, NY
M.S., Nuclear Engineering (1961), Columbia University, New York, NY
B.S., Chemical Engineering (1959),
Massachusetts Institute of Technology, Cambridge, MA
Years of Experience: 35

Stevenson, G. Bert, *NEPA Compliance Officer*, Office of Fissile Materials Disposition (MD-4), U.S. Department of Energy
B.S., Physics (1963), Marshall University, Huntington, WV
Years of Experience: 34

Updike, Paul J., *Infrastructure, Impact Summary*, SAIC
M.A., International Affairs (1997), University of Pittsburgh, Pittsburgh, PA
B.S., Economics (1985), Clarion University, Clarion, PA
Years Experience: 9

Waldman, Gilbert H., *Human Health Risk*, SAIC
B.S., Nuclear Engineering (1991), University of Florida, Gainesville, FL
Years of Experience: 6

Werth, Robert H., *Air Quality and Noise*, SAIC
B.A., Physics (1973), Gordon College, Wenham, MA
Years of Experience: 24

Wherley, Patricia L., *EIS Project Manager*, SAIC
B.A., Geography (1980), The George Washington University, Washington, DC
Years of Experience: 21

Wilkinson, Matthew C., ***Environmental Justice*****, SAIC**
M.A., Professional Studies; Soil and Water Conservation Engineering (1997), Cornell University, Ithaca, NY
B.S., Environmental Systems Technology (1995), Cornell University, Ithaca, NY
Years of Experience: 1

Williams, Alan K., ***Aqueous Processing*****, SAIC**
B.A., Physical Science (1952), University of Northern Colorado, Greeley, CO
Years of Experience: 46

Williams, John W., ***Environmental Justice,*** **SAIC**
Ph.D., Physics (1972), New Mexico State University, Las Cruces, NM
M.S., Physics (1970), New Mexico State University, Las Cruces, NM
B.S., Mathematics (1962), North Texas State University, Denton, TX
Years of Experience: 22

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Chapter 8
Distribution List

The U.S. Department of Energy is providing copies of the *Surplus Plutonium Disposition Draft Environmental Impact Statement* to Federal, State, and local elected and appointed government officials and agencies; Native American groups; and other organizations and individuals listed below. Copies will be distributed in bulk to some individuals and organizations for further distribution (e.g., the State single points of contact for the National Environmental Policy Act [NEPA]). Copies will be provided to other organizations and individuals on request.

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- Mayors, council members, etc., from areas near the Hanford Site; Idaho National Engineering and Environmental Laboratory; Lawrence Livermore National Laboratory; Los Alamos National Laboratory; Pantex Plant; and Savannah River Site

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- Other Federal agencies including: General Accounting Office, National Academy of Sciences, National Oceanic and Atmospheric Administration, National Science Foundation, U.S. Bureau of Indian Affairs, U.S. National Park Service

State-Appointed Officials

- NEPA single points of contact for the States of California, Georgia, Idaho, New Mexico, Oregon, South Carolina, Texas, and Washington
- State agencies including: Georgia Emergency Management Agency, South Carolina Nuclear Waste Program, Southern States Energy Board, State of Idaho's Idaho National Engineering and Environmental Laboratory Oversight Program, State of Texas' Division of Emergency Management, State of Texas' Office of the Attorney General, Texas

Natural Resources Conservation Commission, State of Texas' Department of Health, State of Washington's Department of Ecology, State of Washington's Energy Office

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Organizations and individuals who have requested copies of the *Surplus Plutonium Disposition Draft Environmental Impact Statement*

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Office of
Fissile Materials Disposition

United States Department of Energy

Surplus Plutonium Disposition Draft Environmental Impact Statement

Volume II

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For Further Information Contact:
U.S. Department of Energy
Office of Fissile Materials Disposition, P.O. Box 23786, Washington, DC 20026-3786

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Title: *Surplus Plutonium Disposition Draft Environmental Impact Statement* (SPD EIS) (DOE/EIS-0283-D)

Locations of Candidate Sites: California, Idaho, New Mexico, South Carolina, Texas, and Washington

Contacts:

For further information on the SPD EIS contact:

Mr. G. Bert Stevenson, NEPA Compliance Officer
Office of Fissile Materials Disposition
U.S. Department of Energy
P.O. Box 23786
Washington, DC 20026-3786
Voice: (202) 586–5368

For further information on the DOE National Environmental Policy Act (NEPA) process contact:

Ms. Carol Borgstrom, Director
Office of NEPA Policy and Assistance
Office of Environment, Safety and Health
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585
Voice: (202) 586–4600 or (800) 472–2756

Abstract: On May 22, 1997, DOE published a Notice of Intent (NOI) in the Federal Register (62 Federal Register 28009) announcing its decision to prepare an environmental impact statement (EIS) that would tier from the analysis and decisions reached in connection with the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS (Storage and Disposition PEIS)*. DOE's disposition strategy allows for both the immobilization of surplus plutonium and its use as mixed oxide (MOX) fuel in existing domestic, commercial reactors. The disposition of surplus plutonium would also involve disposal of the immobilized plutonium and MOX fuel (as spent nuclear fuel) in a geologic repository.

The *Surplus Plutonium Disposition Environmental Impact Statement* analyzes alternatives that would use the immobilization approach (for some of the surplus plutonium) and the MOX fuel approach (for some of the surplus plutonium); alternatives that would immobilize all of the surplus plutonium; and the No Action Alternative. The alternatives include three disposition facilities that would be designed so that they could collectively accomplish disposition of up to 50 metric tons (55 tons) of surplus plutonium over their operating lives: 1. The pit disassembly and conversion facility would disassemble pits (a weapons component) and convert the recovered plutonium, as well as plutonium metal from other sources, into plutonium dioxide suitable for disposition. 2. The immobilization facility would include a collocated capability for converting nonpit plutonium materials into plutonium dioxide suitable for immobilization and would be located at either Hanford or SRS. DOE has identified SRS as the preferred site for an immobilization facility. 3. The MOX fuel fabrication facility would fabricate plutonium dioxide into MOX fuel.

Public Involvement: Comments on the SPD Draft EIS may be submitted: by mail to DOE, Office of Fissile Materials Disposition, c/o SPD EIS, P.O. Box 23786, Washington, DC 20026–3786; by calling DOE at 1–800–820–5156; or by sending a facsimile (fax) message to DOE at 1–800–820–5156. To ensure consideration in the SPD Final EIS, these comments should be submitted within 60 days after the U.S. Environmental Protection Agency Notice of Availability is published in the Federal Register. Comments received after the end of the comment period will be considered to the extent possible. Public meetings will be held on the dates and times specified in a DOE Federal Register notice and announced in local media. Comments on the SPD Draft EIS can also be submitted at these meetings. Preregistration for the public meetings is available by calling 1–800–820–5134 or by fax at 1–800–820–5156. Additional information can be obtained by calling the contacts listed above, or by visiting the Office of Fissile Materials Disposition web site at http://www.doe-md.com.

DOE/EIS-0283-D

Surplus Plutonium Disposition Draft Environmental Impact Statement

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United States Department of Energy
Office of Fissile Materials Disposition

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List of Acronyms

AEA	Atomic Energy Act of 1954
AECL	Atomic Energy of Canada Limited
AIRFA	American Indian Religious Freedom Act
ALARA	as low as is reasonably achievable
ANL–W	Argonne National Laboratory–West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARF	airborne release fraction
BEA	Bureau of Economic Analysis
BEIR–V	Report V of the Committee on the Biological Effects of Ionizing Radiations
BIO	Basis for Interim Operation
BLM	Bureau of Land Management
BWR	boiling water reactor
CAA	Clean Air Act
CANDU	Canadian Deuterium Uranium (reactors)
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CPP	Chemical Processing Plant
CWA	Clean Water Act of 1972, 1987
D&D	decontamination and decommissioning
DBA	design-basis accident
DNFSB	Defense Nuclear Facilities Safety Board
DOC	U.S. Department of Commerce
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DR	damage ratio
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor (I or II)
EIS	environmental impact statement

EPA	U.S. Environmental Protection Agency
ES&H	environment, safety, and health
ETB	Engineering Test Bay
FAA	U.S. Federal Aviation Administration
FDP	fluorinel dissolution process
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFF	Uranium Fuel Fabrication Facility
FFTF	Fast Flux Test Facility
FI	field investigation
FM	Farm-to-Market (road)
FMF	Fuel Manufacturing Facility
FMEA	failure modes and effects analysis
FMEF	Fuels and Materials Examination Facility
FONSI	finding of no significant impact
FPF	Fuel Processing Facility
FPPA	Farmland Protection Policy Act
GDP	gaseous diffusion plant
GE	General Electric Company
GENII	Generation II, Hanford Environmental Radiation Dosimetry Software System
GPS	global positioning satellite
HE	high explosive
HEPA	high-efficiency particulate air (filter)
HEU	highly enriched uranium
HFEF	Hot Fuel Examination Facility
HIGHWAY	(computer code: distances and populations along U.S. highways)
HLW	high-level waste
HLWVF	high-level-waste vitrification facility
HWTPF	Hazardous Waste Treatment and Processing Facility
HYDOX	hydride oxidation
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission on Radiological Protection
ID DHW	Idaho Department of Health and Welfare
INEEL	Idaho National Engineering and Environmental Laboratory
INRAD	Intrinsic Radiation

INTEC	Idaho Nuclear Technology and Engineering Center
ISC3	Industrial Source Complex Model, Version 3
ISCST3	Industrial Source Complex Model, Short-Term, Version 3
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LDR	Land Disposal Restrictions
LEU	low-enriched uranium
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LPF	leak path factor
LWR	light-water reactor
M&H	Mason & Hanger Corporation
MACCS2	Melcor Accident Consequence Code System (computer code)
MAR	material at risk
MEI	maximally exposed individual
MMI	Modified Mercalli Intensity
MOX	mixed oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NCRP	National Council on Radiation Protection and Measurements
NDA	nondestructive analysis
NEPA	National Environmental Policy Act of 1969
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPH	natural phenomena hazard
NPS	U.S. National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRU	National Research Universal
NTS	Nevada Test Site
NWCF	New Waste Calcining Facility
NWS	National Weather Service

ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
ORNL	Oak Ridge National Laboratory
PBF	Power Burst Facility
PEIS	programmatic environmental impact statement
PFP	Plutonium Finishing Plant
PIE	postirradiation examination
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 microns
PNNL	Pacific Northwest National Laboratory
PRA	probabilistic risk assessment
PSD	prevention of significant deterioration
PUREX	Plutonium-Uranium Extraction (Facility)
PWR	pressurized water reactor
R&D	research and development
RADTRAN4	(computer code: risks and consequences of radiological materials transport)
RAMOD	Radioactive Materials Research, Operations, and Demonstration
RCRA	Resource Conservation and Recovery Act, as amended
REA	regional economic area
RF	respirable fraction
RfC	reference concentration
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System II (computer code)
RISKIND	(computer code: risks and consequences of radiological materials transport)
ROD	Record of Decision
ROI	region of influence
RMF	Radiation Measurements Facility
RWMC	Radioactive Waste Management Complex
S/A	Similarity of Appearance (provision of Endangered Species Act)
SAR	safety analysis report
SARA	Superfund Amendments and Reauthorization Act of 1986
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric & Gas Company
SCSHPO	South Carolina State Historic Preservation Officer
SDWA	Safe Drinking Water Act, as amended
SHPO	State Historic Preservation Officer

SMC	Specific Manufacturing Complex
SNF	spent nuclear fuel
SNM	special nuclear material
SPD	surplus plutonium disposition
SPD EIS	*Surplus Plutonium Disposition Environmental Impact Statement*
SPERT	Special Power Excursion Reactor Test
SRS	Savannah River Site
SST	safe, secure trailer
SWMU	solid waste management unit
SWP 1	Service Waste Percolation Pond 1
TA	Technical Area
TCE	trichloroethylene
TNRCC	Texas Natural Resource Conservation Commission
TPBAR-LTA	tritium-producing burnable absorber rod lead test assembly
TRU	transuranic
TRUPACT	TRU waste package transporter
TSCA	Toxic Substances Control Act
TSP	total suspended particulates
TWRS	tank waste remediation system
TWRS EIS	*Tank Waste Remediation System Final Environmental Impact Statement*
UC	Regents of the University of California
USACE	U.S. Army Corps of Engineers
USEC	United States Enrichment Corporation
USFWS	U.S. Fish and Wildlife Service
UV	ultraviolet
VOC	volatile organic compounds
VORTAC	Very High Frequency Omnidirection Radio Tactical Air Navigation Device
VRM	Visual Resource Management
WAG 3	Waste Area Grouping 3
WERF	Waste Experimental Reduction Facility
WIPP	Waste Isolation Pilot Plant
WM PEIS	*Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*
WNP–2	Washington Nuclear Plant–2

WPPSS	Washington Public Power Supply System
WROC	Waste Reduction Operations Complex
WSRC	Westinghouse Savannah River Company
ZPPR	Zero Power Physics Reactor

Chemicals and Units of Measure

μCi	microcurie
μg	microgram
μm	micrometer (micron)
46°26'07"	46 degrees, 26 minutes, 7 seconds
Ci	curie
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
dB	decibel
dBA	decibel, A-weighted
ft	foot
ft^2	square foot
ft^3	cubic foot
g	gram
g	gravitational acceleration
gal	gallon
ha	hectare
hr	hour (in compound units)
in	inch
kg	kilogram
km	kilometer
km^2	square kilometers
kV	kilovolt
l	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
mg	milligram
mi	mile
min	minute
mph	miles per hour

mrem	millirem
MVA	megavolt-ampere
MW	megawatt
MWe	megawatt electric
MWh	megawatt-hour
N_2	nitrogen
nCi	nanocurie
NO_2	nitrogen dioxide
pCi	picocurie
person-rem	person-rem
$PM_{2.5}$	particulate matter less than or equal to 2.5 μm in diameter
PM_{10}	particulate matter less than or equal to 10 μm in diameter
rad	radiation absorbed dose
rem	roentgen equivalent man
s	second
SO_2	sulfur dioxide
t	metric ton
ton	short ton
UF_6	uranium hexafluoride
UO_2	uranium dioxide
yd	yard
yd^3	cubic yard
yr	year (in compound units)
°C	degrees Celsius (Centigrade)
°F	degrees Fahrenheit

Metric Conversion Chart

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

Metric Prefixes

Prefix	Symbol	Multiplication Factor
exa-	E	$1\ 000\ 000\ 000\ 000\ 000\ 000 = 10^{18}$
peta-	P	$1\ 000\ 000\ 000\ 000\ 000 = 10^{15}$
tera-	T	$1\ 000\ 000\ 000\ 000 = 10^{12}$
giga-	G	$1\ 000\ 000\ 000 = 10^{9}$
mega-	M	$1\ 000\ 000 = 10^{6}$
kilo-	k	$1\ 000 = 10^{3}$
hecto-	h	$100 = 10^{2}$
deka-	da	$10 = 10^{1}$
deci-	d	$0.1 = 10^{-1}$
centi-	c	$0.01 = 10^{-2}$
milli-	m	$0.001 = 10^{-3}$
micro-	μ	$0.000\ 001 = 10^{-6}$
nano-	n	$0.000\ 000\ 001 = 10^{-9}$
pico-	p	$0.000\ 000\ 000\ 001 = 10^{12}$
femto-	f	$0.000\ 000\ 000\ 000\ 001 = 10^{-15}$
atto-	a	$0.000\ 000\ 000\ 000\ 000\ 001 = 10^{-18}$

Next Section

Appendix A
Federal Register Notices

A.1 RECORD OF DECISION FOR THE STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Responses: 18,620 Burden Hours: 64,310.

Abstract: The LESCP is being conducted in response to the legislative requirement in P.L. 103-382, Section 1501 to assess the implementation of Title I and related education reforms. The information will be used to examine changes—over a 3-year period—that are occurring in schools and classrooms. Teachers and teacher aides will complete a mail survey, and district Title I administrators, principals, school-based staff, and parents will be interviewed during on-site field work.

[FR Doc. 97-1307 Filed 1-17-97; 8:45 am]

BILLING CODE 4000-01-P

DEPARTMENT OF ENERGY

Record of decision for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

AGENCY: Department of Energy.

ACTION: Record of Decision.

SUMMARY: The Department of Energy (DOE) has decided to implement a program to provide for safe and secure storage of weapons-usable fissile materials (plutonium and highly enriched uranium [HEU]) and a strategy for the disposition of surplus weapons-usable plutonium, as specified in the Preferred Alternative in the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (S&D Final PEIS, DOE/EIS-0229, December 1996). The fundamental purpose of the program is to maintain a high standard of security and accounting for these materials while in storage, and to ensure that plutonium produced for nuclear weapons and declared excess to national security needs (now, or in the future) is never again used for nuclear weapons.

DOE will consolidate the storage of weapons-usable plutonium by upgrading and expanding existing and planned facilities at the Pantex Plant in Texas and the Savannah River Site (SRS) in South Carolina, and continue the storage of weapons-usable HEU at DOE's Y-12 Plant at the Oak Ridge Reservation (ORR) in Tennessee, in upgraded and, as HEU is dispositioned, consolidated facilities. After certain conditions are met, most plutonium now stored at the Rocky Flats Environmental Technology Site (RFETS) in Colorado will be moved to Pantex and SRS. Plutonium currently stored at the Hanford Site (Hanford), the Idaho National Engineering Laboratory (INEL), and the Los Alamos National Laboratory (LANL) will remain at those sites until disposition (or movement to lag storage at the disposition facilities).

DOE's strategy for disposition of surplus plutonium is to pursue an approach that allows immobilization of surplus plutonium in glass or ceramic material for disposal in a geologic repository pursuant to the Nuclear Waste Policy Act, and burning of some of the surplus plutonium as mixed oxide (MOX) fuel in existing, domestic, commercial reactors, with subsequent disposal of the spent fuel in a geologic repository pursuant to the Nuclear Waste Policy Act. DOE may also burn MOX fuel in Canadian Deuterium Uranium [CANDU] reactors in the event of an appropriate agreement among Russia, Canada, and the United States, as discussed below. The timing and extent to which either or both of these disposition approaches (immobilization or MOX) are ultimately deployed will depend upon the results of future technology development and demonstrations, follow-on (tiered) site-specific environmental review, contract negotiations, and detailed cost reviews, as well as nonproliferation considerations, and agreements with Russia and other nations. DOE's program will be subject to the highest standards of safeguards and security throughout all aspects of storage, transportation, and processing, and will include appropriate International Atomic Energy Agency verification.

Due to technology, complexity, timing, cost, and other factors that would be involved in purifying certain plutonium materials to make them suitable for potential use in MOX fuel, approximately 30 percent of the total quantity of plutonium (that has or may be declared surplus to defense needs) would require extensive purification to use in MOX fuel, and therefore will likely be immobilized. DOE will immobilize at least 8 metric tons (MT) of currently declared surplus plutonium materials that DOE has already determined are not suitable for use in MOX fuel. DOE reserves the option of using the immobilization approach for all of the surplus plutonium.

The exact locations for disposition facilities will be determined pursuant to a follow-on, site-specific disposition environmental impact statement (EIS) as well as cost, technical and nonproliferation studies. However, DOE has decided to narrow the field of candidate disposition sites. DOE has decided that a vitrification or immobilization facility (collocated with a plutonium conversion facility) will be located at either Hanford or SRS, that a potential MOX fuel fabrication facility will be located at Hanford, INEL, Pantex, or SRS (only one site), and that a "pit" disassembly and conversion facility will be located at Hanford, INEL, Pantex, or SRS (only one site). ("Pits" are weapons components containing plutonium.) The specific reactors, and their locations, that may be used to burn the MOX fuel will depend on contract negotiations, licensing, and environmental reviews. Because there are a number of technology variations that could be used for immobilization, DOE will also determine the specific immobilization technology based on the follow-on EIS, technology developments, cost information, and nonproliferation considerations. Based on current technological and cost information, DOE anticipates that the follow-on EIS will identify, as part of the proposed action, immobilizing a portion of the surplus plutonium using the "can-in-canister" technology at the Defense Waste Processing Facility (DWPF) at the Savannah River Site.

The use of MOX fuel in existing reactors would be undertaken in a manner that is consistent with the United States' policy objective on the irreversibility of the nuclear disarmament process and the United States' policy discouraging the civilian use of plutonium. To this end, implementing the MOX alternative would include government ownership and control of the MOX fuel fabrication facility at a DOE site, and use of the facility only for the surplus plutonium disposition program. There would be no reprocessing or subsequent reuse of spent MOX fuel. The MOX fuel would be used in a once-through fuel cycle in existing reactors, with appropriate arrangements, including contractual or licensing provisions, limiting use of MOX fuel to surplus plutonium disposition.

The Department of Energy also retains the option of using MOX fuel in Canadian Deuterium Uranium (CANDU) reactors in Canada in the event a multilateral agreement is negotiated among Russia, Canada, and the United States to use CANDU reactors for surplus United States' and Russian plutonium. DOE will engage in a test and demonstration program for CANDU MOX fuel as appropriate and consistent with future cooperative efforts with Russia and Canada.

These efforts will provide the basis and flexibility for the United States to initiate disposition efforts either multilaterally or bilaterally through negotiations with other nations, or unilaterally as an example to Russia and

other nations. Disposition of the surplus plutonium will serve as a nonproliferation and disarmament example, encourage similar actions by Russia and other nations, and foster multilateral or bilateral disposition efforts and agreements.

EFFECTIVE DATE: The decisions set forth in this Record of Decision (ROD) are effective upon issuance of this document, in accordance with DOE's National Environmental Policy Act (NEPA) Implementing Procedures and Guidelines (10 CFR Part 1021) and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR Parts 1500-1508).

ADDRESSES: Copies of the S&D Final PEIS, the Technical Summary Report For Long-Term Storage of Weapons-Usable Fissile Materials, the Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition, the Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition, and this ROD may be obtained by writing to the U.S. Department of Energy, Office of Fissile Materials Disposition, MD-4, 1000 Independence Avenue, SW., Washington, DC 20585, or by calling (202) 586-4513. The 56-page Summary of the S&D Final PEIS, the other documents noted above (other than the full PEIS), and this ROD are also available on the Fissile Materials Disposition World Wide Web Page at: http://web.fie.com/htdoc/fed/DOE/fsl/pub/menu/any/

FOR FURTHER INFORMATION CONTACT: For information on the storage and disposition of weapons-usable fissile materials program or this ROD contact: Mr. J. David Nulton, Director, NEPA Compliance and Outreach, Office of Fissile Materials Disposition (MD-4), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, telephone (202) 586-4513.

For information on the DOE NEPA process, contact: Carol M. Borgstrom, Director, Office of NEPA Policy and Assistance (EH-42), U.S. Department of Energy, 1000 Independence Ave., SW, Washington, DC 20585, telephone (202) 586-4600 or leave a message at (800) 472-2756.

SUPPLEMENTARY INFORMATION:

I. Background

The end of the Cold War has created a legacy of surplus weapons-usable fissile materials both in the United States and the former Soviet Union. Further agreements on disarmament may increase the surplus quantities of these materials. The global stockpiles of weapons-usable fissile materials pose a danger to national and international security in the form of potential proliferation of nuclear weapons and the potential for environmental, safety, and health consequences if the materials are not properly safeguarded and managed.

In September 1993, President Clinton issued a Nonproliferation and Export Control Policy in response to the growing threat of nuclear proliferation. Further, in January 1994, President Clinton and Russia's President Yeltsin issued a Joint Statement Between the United States and Russia on Nonproliferation of Weapons of Mass Destruction and the Means of Their Delivery. In accordance with these policies, the focus of the U.S. nonproliferation efforts in this regard is five-fold: (i) To secure nuclear materials in the former Soviet Union; (ii) to assure safe, secure, long-term storage and disposition of surplus weapons-usable fissile materials; (iii) to establish transparent and irreversible nuclear arms reductions; (iv) to strengthen the nuclear nonproliferation regime; and (v) to control nuclear exports. The policy also states that the United States will not encourage the civil use of plutonium and that the United States does not engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes.

To demonstrate the United States' commitment to these objectives, President Clinton announced on March 1, 1995, that approximately 200 metric tons of U.S.-origin weapons-usable fissile materials, of which 165 metric tons are HEU and 38 metric tons are weapons-grade plutonium, had been declared surplus to the United States' defense needs.[1] The safe and secure storage of weapons-usable plutonium and HEU, and the disposition of surplus weapons-usable plutonium, consistent with the Preferred Alternative in the S&D Final PEIS and the decisions described in section V of this ROD, are consistent with the President's nonproliferation policy.

[1] The Secretary of Energy's Openness Initiative announcement of February 6, 1996, announced that the United States has about 213 metric tons of surplus fissile materials, including the 200 metric tons the President announced in March, 1995. Of the 213 metric tons of surplus materials, the Openness Initiative announcement indicated that about 174.3 metric tons are HEU and about 38.2 metric tons are weapons-grade plutonium. Additional quantities of plutonium may be declared surplus in the future; therefore, the S&D Final PEIS analyzes the disposition of a nominal 50 metric tons of plutonium, as well as the storage of 89 metric tons of plutonium and 994 metric tons of HEU.

II. Decisions Made in This ROD

This ROD encompasses two categories of decisions: (1) The sites and facilities for storage of non-surplus weapons-usable plutonium and HEU, and storage of surplus plutonium and HEU pending disposition; and (2) the programmatic strategy for disposition of surplus weapons-usable plutonium. This ROD does not encompass the final selection of sites for plutonium disposition facilities, nor the extent to which the two plutonium disposition approaches (immobilization or MOX) will ultimately be implemented. Those decisions will be made pursuant to a follow-on EIS. However, DOE does announce in this ROD that the slate of candidate sites for plutonium disposition has been narrowed. This ROD does not include decisions about the disposition of surplus HEU, which were made in July 1996 in the separate ROD for the Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement, 61 FR 40619 (Aug. 5, 1996).[2]

III. NEPA Process

A. S&D Draft PEIS

On June 21, 1994, DOE published a Notice of Intent (NOI) in the Federal Register (59 FR 31985) to prepare a Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement (S&D PEIS), which was originally to address the storage and disposition of both plutonium and HEU. DOE subsequently concluded that a separate EIS on surplus HEU disposition would be appropriate. Accordingly, DOE published a notice in the Federal Register (60 FR 17344) on April 5, 1995, to inform the public of the proposed plan to prepare a separate EIS for the disposition of surplus HEU.

DOE published an implementation plan (IP) for the S&D PEIS in March 1995 (DOE/EIS-0229-IP). The IP recorded the issues identified during the scoping process, indicated how they would be addressed in the S&D PEIS, and provided guidance for the preparation of the S&D PEIS. DOE issued the Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement (S&D Draft PEIS, DOE/EIS-0229-D) for public comment in February 1996. On March 8, 1996, both DOE and the Environmental Protection

[2] The material considered in the S&D Final PEIS, and covered by the decisions in this ROD, does not include spent nuclear fuel, irradiated targets, uranium-233, plutonium-238, plutonium residues of less than 50-percent plutonium by weight, or weapons program materials-in-use.

Agency (EPA) published Notices of Availability of the S&D Draft PEIS in the Federal Register (61 FR 9443 and 61 9450), announcing a public comment period from March 8 until May 7, 1996. In response to requests from the public, DOE on May 13, 1996 published another Notice in the Federal Register (61 FR 22038) announcing an extension of the comment period until June 7, 1996. Eight public meetings on the S&D Draft PEIS were held during March and April 1996 in Washington, DC and in the vicinity of the DOE sites under consideration for the proposed actions.

During the 92-day public comment period, the public was encouraged to provide comments via mail, toll-free fax, electronic bulletin board (Internet), and toll-free telephone recording device. By these means, DOE received 8,442 comments from 6,543 individuals and organizations for consideration. In addition, 250 oral comments were recorded from some of the 734 individuals who attended the eight public meetings. All of the comments received, and the Department's responses to them, are presented in Volume IV (the Comment Response Document) of the S&D Final PEIS. All of the comments were considered in preparation of the S&D Final PEIS, and in many cases resulted in changes to the document. The Notice of Availability for the S&D Final PEIS was published by EPA in the Federal Register on December 13, 1996 (61 FR 65572). DOE published its own Notice of Availability for the S&D Final PEIS in the Federal Register on December 19, 1996 (61 FR 67001).

B. Alternatives Considered

The S&D PEIS analyzes the reasonable action alternatives in addition to the Preferred Alternative and the No Action Alternative. The Preferred Alternative, which is described below in section V, Decisions, and which DOE has decided to implement, represents a combination of alternatives for both storage and disposition.

1. The Proposed Action

The proposed action, as described in the S&D PEIS, would involve the following actions for U.S. weapons-usable fissile materials:

- Storage—provide a long-term storage system (for up to 50 years) for nonsurplus plutonium and HEU that meets the Stored Weapons Standard[3] and applicable environmental, safety, and health standards while reducing storage and infrastructure costs.
- Storage Pending Disposition—provide storage that meets the Stored Weapons Standard for inventories of weapons-usable plutonium and HEU[4] that have been or may be declared surplus.
- Disposition—convert surplus plutonium and plutonium that may be declared surplus in the future to forms that meet the Spent Fuel Standard,[5] thereby providing evidence of irreversible disarmament and setting a model for proliferation resistance.

2. Long-Term Storage Alternatives and Related Activities

a. No Action. Under the No Action Alternative, all weapons-usable fissile materials would remain at existing storage sites. Maintenance at existing storage facilities would be done as required to ensure safe operation for the balance of the facility's useful life. Sites covered under the No Action Alternative included Hanford, INEL, Pantex, the ORR, SRS, RFETS, and LANL. Although there are no weapons-usable fissile materials within the scope of the S&D PEIS stored currently at Nevada Test Site (NTS), it was also analyzed under No Action to provide an environmental baseline against which impacts of the storage and disposition action alternatives were analyzed.

b. Upgrade at Multiple Sites. Under this alternative for storage, DOE would either modify certain existing facilities or build new facilities, depending on the site's ability to meet standards for nuclear material storage facilities, and would utilize existing site infrastructure to the extent possible. These modified or new facilities would be designed to operate for up to 50 years. Plutonium materials currently stored at Hanford, INEL, Pantex, and SRS would remain at those four sites (in upgraded or new facilities), and HEU would remain at ORR (in upgraded, consolidated facilities). This alternative does not apply to NTS because NTS does not currently store weapons-usable fissile materials.

A sub-alternative of relocating portions of the plutonium inventory (a total of 14.4 metric tons according to DOE's Openness Initiative announcements of December 7, 1993, and February 6, 1996, respectively) from RFETS and LANL to one or more of the four existing plutonium storage sites is analyzed. Storage of surplus materials without strategic reserve and weapons research and development (R&D) materials is also included as a sub-alternative. Within some of the five candidate storage sites under this alternative, there are also multiple storage options.

c. Consolidation of Plutonium. Under this alternative, plutonium materials at existing sites would be removed, and the entire DOE inventory of plutonium would be consolidated at one site, while the HEU inventory would remain at ORR. Again, Hanford, INEL, Pantex and SRS would be candidate sites for plutonium consolidation. In addition, NTS would be a candidate site for this alternative. Consolidation of plutonium at ORR would result in a situation in which inventories of plutonium and HEU were collocated at one site; this alternative was therefore analyzed as one option under the Collocation Alternative (see below). A sub-alternative to account for the separate storage of surplus materials without strategic reserve and weapons R&D materials was also included.

d. Collocation of Plutonium and Highly Enriched Uranium. Under the Collocation Alternative, the entire DOE inventory of plutonium and HEU would be consolidated and collocated at the same site. The six candidate sites would be Hanford, NTS, INEL, Pantex, ORR, and SRS. A sub-alternative for the separate storage of surplus materials without strategic reserve and weapons R&D materials was also included.

3. Plutonium Disposition Alternatives and Related Activities

The disposition technologies analyzed in the S&D PEIS were those that would convert surplus plutonium into a form that would meet the Spent Fuel Standard. For the purpose of environmental impact analyses of the various disposition alternatives, both generic and specific sites were used to provide perspective on these

[3] The "Stored Weapons Standard" for weapons-usable fissile materials storage was initially defined in Management and Disposition of Excess Weapons Plutonium, National Academy of Sciences, 1994. DOE defines the Stored Weapons Standard as follows: The high standards of security and accounting for the storage of intact nuclear weapons should be maintained, to the extent practical, for weapons-usable fissile materials throughout dismantlement, storage, and disposition.

[4] The S&D PEIS covers long-term storage of nonsurplus HEU and storage of surplus HEU pending disposition. Until storage decisions are implemented, surplus HEU that has not gone to disposition will continue to be stored pursuant to, and not to exceed the 10-year interim storage time period evaluated in, the Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant, Oak Ridge, Tennessee (Y-12 EA) (DOE/EA-0929, September 1994) and Finding of No Significant Impact (FONSI).

[5] The "Spent Fuel Standard" for disposition was also initially defined in Management and Disposition of Excess Weapons Plutonium, National Academy of Sciences, 1994. DOE defines the Spent Fuel Standard as follows: The surplus weapons-usable plutonium should be made as inaccessible and unattractive for weapons use as the much larger and growing quantity of plutonium that exists in spent nuclear fuel from commercial power reactors.

alternatives. Under each alternative, there are various ways to implement the alternative. These "variants" (such as the can-in-canister[6] approach) are shown in Table 1 to provide a range of available options for consideration.

TABLE 1.—DESCRIPTION OF VARIANTS UNDER PLUTONIUM DISPOSITION ALTERNATIVES

Alternatives analyzed	Possible variants
• Deep Borehole Direct Disposition • Deep Borehole Immobilized Disposition	• Arrangement of plutonium in different types of emplacement canisters. • Emplacement of pellet-group mix. • Pumped emplacement of pellet-grout mix. • Plutonium concentration loading, size and shape of ceramic pellets.
• New Vitrification Facilities	• Collocated pit disassembly/conversion, plutonium conversion, and immobilization facilities. • Use of either Cs–137 from capsules or HLW as a radiation barrier. • Wet or dry feed preparation technologies. • An adjunct melter adjacent to the DWPF at SRS, in which borosilicate glass frit with plutonium (without highly radioactive radionuclides) is added to borosilicate glass containing HLW from the DWPF. • A can-in-canister approach at SRS in which cans of plutonium glass (without highly radioactive radionuclides) are plaed in DWPF canisters which are then filled with borosilicate glass containing HLW in the DWPF (see Appendix O of the Final PEIS). • A can-in-canister approach similar to above but using new facilities at sites other than SRS.
• New Ceramic Immobilization Facilities	• Collocated pit disassembly/plutonium conversion, and immobilization facilities. • Use of either Cs–137 from capsules or HLW as a radiation barrier. • Wet or dry feed preparation technologies. • A can-in-canister approach at SRS in which the plutonium is immobilized without highly radioactive radionuclides in a ceramic matrix and then placed in the DWPF canisters that are then filled with borosilicate glass containing HLW (See Appendix O of the Final PEIS). • A can-in-canister approach similar to above but using new facilities at sites other than SRS.
• Electrometallurgical Treatment (glass-bonded zeolite form)	• Immobilize plutonium into metal ingot form. • Locate at DOE sites other than ANL–W at INEL.
• Existing LWR With New MOX Facilities	• Pressurized or Boiling Water Reactors. • Different numbers of reactors. • European MOX fuel fabrication. • Modification/completion of existing facilities for MOX fabrication. • Collocated pit disassembly/conversion, plutonium conversion, and MOX facilities. • Reactors with different core management schemes (plutonium loadings, refueling intervals).
• Partially Completed LWR With New MOX Facilities	• Same as for existing LWR (except that MOX fuel would not be fabricated in Europe).
• Evolutionary LWR With New MOX Facilities	• Same as for partially completed LWR.
• Existing CANDU Reactor With New MOX Facilities	• Different numbers of reactors. • Modification/completion of existing facilities for MOX fabrication. • Collocated pit disassembly/conversion, plutonium conversion, and MOX facilities. • Reactors with different core management schemes (plutonium loadings, refueling intervals).

Note: ANL–W=Argonne National Laboratory-West; Cs–137=cesium-137; HLW=high-level waste; LWR=light water reactor

The first step in plutonium disposition is to remove the surplus plutonium from storage, then process this material in a pit disassembly/conversion facility (for pits) or in a plutonium conversion facility (for non-pit materials). The processing would convert the plutonium material into a form suitable for each of the disposition alternatives described in the following sections. The pit disassembly/conversion facility and the plutonium conversion facility would be built at a DOE site. The six candidate sites for long-term storage were evaluated for the potential environmental impacts of constructing and operating these facilities.

a. No Disposition Action. A "No Plutonium Disposition" action means disposition would not occur, and surplus plutonium-bearing weapon components (pits) and other forms, such as metal and oxide, would remain in storage in accordance with decisions on the long-term storage of weapons-usable fissile materials.

b. Deep Borehole Category. Under this category of alternatives, surplus weapons-usable plutonium would be disposed of in deep boreholes that would be drilled at least 4 kilometers (km) (2.5 miles [mi]) into ancient, geologically stable rock formations beneath the water table. The deep borehole would provide a geologic barrier against potential proliferation. A generic site was evaluated for the construction and operation of a borehole complex where the surplus plutonium would be prepared for emplacement in the borehole. This complex would consist of five major facilities: Processing; drilling; emplacing/sealing; waste management; and support (security, maintenance, and utilities).

(1) Direct Disposition (Borehole). Under the Direct Disposition Alternative, surplus plutonium would be removed from storage, processed as necessary, converted to a form suitable for emplacement, packaged, and placed in a deep borehole. The deep borehole would be sealed to isolate the

[6] In the can-in-canister variant, cans of plutonium in a glass or ceramic matrix would be placed in a canister. This canister would then be filled with borosilicate glass containing high-level radioactive waste (HLW) or highly radioactive material such as cesium. This variant, at an existing facility (the Defense Waste Processing Facility [DWPF] at SRS), is described in Appendix O of the S&D Final PEIS.

plutonium from the accessible environment. Long-term performance of the deep borehole would depend on the stability of the geologic system. A generic site was used for the borehole complex to analyze the environmental impact of this alternative.

(2) Immobilized Disposition (Borehole). Under the Immobilized Disposition Alternative, the surplus plutonium would be removed from storage, processed, and converted to a suitable form for shipment to a ceramic immobilization facility. The output of this facility would be spherical ceramic pellets containing plutonium, facilitating handling during transportation and emplacement. The ceramic pellets (about 2.54 centimeters [cm] [1 inch {in}] in diameter and containing 1 percent plutonium by weight) would then be placed in drums and shipped to the borehole complex. At the deep borehole site, the ceramic pellets would be mixed with non-plutonium ceramic pellets and fixed with grout during emplacement. The deep borehole would be sealed to isolate the plutonium from the accessible environment. Long-term performance of the deep borehole would depend on the stability of the geologic system.

Although a generic site was used for analyses of the borehole complex in this alternative, the ceramic immobilization facility would be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impacts of the borehole immobilization facility.

c. Immobilization Category. Under this category of alternatives, surplus plutonium would be immobilized to create a chemically stable form for disposal in a geologic repository pursuant to the Nuclear Waste Policy Act (NWPA).[7] The plutonium material would be mixed with or surrounded by high-level waste (HLW) or other radioactive isotopes and immobilized to create a radiation field that could serve as a proliferation deterrent, along with safeguards and security comparable to those of commercial spent nuclear fuel, thereby achieving the Spent Fuel Standard. All immobilized plutonium would be encased in stainless steel canisters and would remain in onsite vault-type storage until a geologic repository pursuant to the NWPA is operational.

(1) Vitrification. Under the Vitrification Alternative, surplus plutonium would be removed from storage, processed, packaged, and transported to the vitrification facility. In this facility, the plutonium would be mixed with glass frit and highly radioactive cesium-137 (Cs-137) or HLW to produce borosilicate glass logs (a slightly different process, using HLW, would be used for the can-in-canister variant, as discussed in Appendix O of the S&D Final PEIS). The Cs-137 isotope could come from the cesium chloride (CsCl) capsules currently stored at Hanford or from existing HLW if the site selected for vitrification already manages HLW. Each glass log produced from the vitrification facility would contain about 84 kilograms (kg) (185 pounds [lb]) of plutonium. The vitrification facility would be built at a DOE site. The six candidate sites for long-term storage were analyzed for this alternative.

(2) Ceramic Immobilization. Under the Ceramic Immobilization Alternative, surplus plutonium would be removed from storage, processed, packaged, and transported to a ceramic immobilization facility. In this facility, the plutonium would be mixed with nonradioactive ceramic materials and Cs-137 or HLW to produce ceramic disks (a slightly different process, using HLW, would be used for the can-in-canister variant, as discussed in Appendix O of the S&D Final PEIS). Each disk would be approximately 30 cm (12 in) in diameter and 10 cm (4 in) thick, and would contain approximately 4 kg (9 lb) of plutonium. The Cs-137 or HLW would be provided as previously described. The ceramic immobilization facility would be built at a DOE site. The six candidate sites for long-term storage were analyzed for this alternative.

(3) Electrometallurgical Treatment. Under the Electrometallurgical Treatment Alternative, surplus plutonium would be removed from storage, processed, packaged, and transported to new or modified facilities for electrometallurgical treatment. This process could immobilize surplus fissile materials into a glass-bonded zeolite (GBZ) form. With the GBZ material, the plutonium would be in the form of a stable, leach-resistant mineral that is incorporated in durable glass materials.[8] Existing electrometallurgical facilities at INEL were used as a representative site for analysis of potential environmental impacts.

d. Reactor Category. Under the reactor alternatives considered in the S&D PEIS, DOE would fabricate surplus plutonium into MOX fuel for use in reactors. The irradiated MOX fuel would reduce the proliferation risks of the plutonium material, and the reactors would also generate electricity. MOX fuel would be used in a once-through fuel cycle, with no reprocessing or subsequent reuse of spent fuel. The spent nuclear fuel generated by the reactors would then be sent to a geologic repository pursuant to the NWPA.

Because the United States does not have a MOX fuel fabrication facility or capability, a new dedicated MOX fuel fabrication facility would be built at a DOE or commercial site.[9] The surplus plutonium from storage would be processed, converted to plutonium dioxide (PuO_2), and transferred to the MOX fuel fabrication facility. In this facility, PuO_2 and uranium dioxide (UO_2) (from existing domestic sources) would be blended and fabricated into MOX pellets, loaded into fuel rods, and assembled into fuel bundles suitable for use in the reactor alternatives under consideration.

(1) Existing Light Water Reactors. Under the Existing Light Water Reactor (LWR) Alternative, the MOX fuel containing surplus plutonium would be fabricated and transported to existing commercial LWRs in the United States, where the MOX fuel would be used instead of conventional UO_2 fuel. The LWRs employed for domestic electric power generation are pressurized water reactors (PWRs) and boiling water reactors (BWRs). Both types of reactors use the heat produced from nuclear fission reactions to generate steam that drives turbines and generates electricity. Three to five reactor units would be needed.[10]

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[7] Also referred to as a permanent, or HLW repository. Pursuant to the Nuclear Waste Policy Act, DOE is currently characterizing the Yucca Mountain Site in Nevada as a potential repository for spent nuclear fuel and HLW. Legislative clarification, or a determination by the Nuclear Regulatory Commission that the immobilized plutonium should be isolated as HLW, may be required before the material could be placed in Yucca Mountain should DOE and the President recommend, and Congress approve, its operation. No Resource Conservation and Recovery Act (RCRA) wastes would be immobilized unless the immobilization would constitute adequate treatment under RCRA. The immobilized product would be consistent with the repository's waste acceptance criteria.

[8] In May 1996, the Department issued a Finding of No Significant Impact (FONSI) (61 Fed. Reg. 25647) and decision to proceed with the limited demonstration of the electrometallurgical treatment process at Argonne National Laboratory-West (ANL-W) at INEL for processing up to 125 spent fuel assemblies from the Experimental Breeder Reactor II (100 drivers and 25 blanket assemblies). Although this alternative could be conducted at other DOE sites, ANL-W is described in the S&D PEIS as the representative site for analysis.

[9] Although a generic commercial site was evaluated in the S&D PEIS, it is not part of the Preferred Alternative or the decisions in this ROD.

[10] It is possible that an existing LWR can be configured to produce tritium, consume plutonium as fuel, and generate revenue through the production of electricity. This configuration is called a multipurpose reactor. Environmental

(2) Partially Completed Light Water Reactors. Under the Partially Completed LWR Alternative, commercial LWRs on which construction has been halted would be completed. The completed reactors would use MOX fuel containing surplus plutonium. The characteristics of these LWRs would be the same as those of the existing LWRs discussed in the Existing LWR Alternative. The Bellefonte Nuclear Plant located along the west bank of the Tennessee River in Alabama was used as a representative site for the environmental analysis of this alternative. Two reactor units (such as those at the Bellefonte Nuclear Plant) would be needed to implement this alternative.

(3) Evolutionary Light Water Reactors. The evolutionary LWRs are improved versions of existing commercial LWRs. Two design approaches were considered in the S&D PEIS. The first is a large PWR or BWR similar to the size of the existing PWR and BWR. The second is a small PWR approximately one-half the size of the large PWR. Two large or four small evolutionary LWRs would be needed to implement this alternative.

Under each design approach for this alternative, evolutionary LWRs would be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impacts of this alternative.

(4) Canadian Deuterium Uranium Reactor. Under the CANDU Reactor Alternative, the MOX fuel containing surplus plutonium would be fabricated in a U.S. facility, then transported for use in one or more commercial heavy water reactors in Canada. The Ontario Hydro Bruce-A Nuclear Generating Station identified by the Government of Canada was used as a representative site for evaluation of this alternative. This station is located on Lake Huron about 300 km (186 mi) northeast of Detroit, Michigan. Environmental analysis of domestic activities up to the U.S./Canadian border is presented in the S&D PEIS. The use of CANDU reactors would be subject to the policies, regulations, and approval of the Federal and Provincial Canadian Governments. Pursuant to Section 123 of the Atomic Energy Act, any export of MOX fuel from the United States to Canada must be made under the agreement for cooperation between the two countries. Spent fuel generated by a CANDU reactor would be disposed under the Canadian spent fuel program.

C. Preferred Alternative

The S&D Final PEIS presented the Department's Preferred Alternative for both storage and disposition. DOE has decided to implement the Preferred Alternative as described in the S&D Final PEIS. Thus, the Preferred Alternative is described in Section V of this ROD, Decisions.

D. Environmental Impacts

Chapter 4 and the appendices of the S&D Final PEIS analyzed the potential environmental impacts of the storage and disposition alternatives in detail. The S&D Final PEIS also evaluated the maximum site impacts that would result at Hanford, INEL, Pantex, and SRS from combining the Preferred Alternative for storage with the Preferred Alternative for disposition. Consistent with the Preferred Alternative, Hanford, INEL, Pantex, and SRS are each a possible location for all or some plutonium disposition activities. The siting, construction, and operation of disposition facilities will be covered in a separate, follow-on EIS. The S&D Final PEIS described the total life cycle impacts that would result from the Preferred Alternative at the DOE sites identified for potential placement of the disposition facilities.

Based on analyses in the S&D Final PEIS, the areas where impacts might be significant are as follows:

• The use of groundwater at the Pantex Plant for storage and disposition facilities could contribute to the overall declining water levels of the Ogallala Aquifer. The projected No Action Alternative water usage at Pantex in the year 2005 reflects a reduction from current usage due to planned downsizing over the next few years. The Preferred Alternative would require a 72-percent increase in the projected No Action Alternative water use; the total amount (428 million liters per year) is considerably less than what is currently being withdrawn (836 million liters per year) at Pantex.

• A set of postulated accidents was used for each plutonium disposition alternative over the life of the campaign to obtain potential radiological impacts at the four DOE sites where disposition facilities could be built. The PEIS analyzes the risk of latent cancer fatalities (reflecting the probability of accident occurrence and the latent cancer fatalities potentially caused by the accident) for accidents that have low probabilities of occurrence and severe consequences, as well as those that have higher probabilities and low consequences. For potential severe accidents, the risk of latent cancer fatalities to the population located within 80 kilometers (50 miles) of the accident for the "front-end" disposition process campaign would range from 4.5×10^{-16} (that is, approximately 1 chance in 2 quadrillion) to 1.7×10^{-4} (approximately 1 chance in 6,000) for the pit disassembly/conversion facility, and from 1.5×10^{-16} to 1.3×10^{-4} for the plutonium conversion facility. This risk would range from 2.8×10^{-14} to 1.8×10^{-5} for the vitrification facility, from 7.0×10^{-16} to 1.9×10^{-7} for the ceramic immobilization facility, and from 4.6×10^{-16} to 4.3×10^{-4} for the MOX fuel fabrication facility. To estimate the change in risk associated with using MOX fuel instead of uranium fuel in existing LWRs, the severe accident scenarios assumed a large population distribution near a generic existing LWR and extreme meteorological conditions for dispersal, leading to large doses that were not necessarily reflective of actual site conditions. The resultant change in risk of cancer fatalities to a generic population located within 80 km (50 mi) of the severe accidents was estimated to range from -2.0×10^{-4} to 3.0×10^{-5} per year[11], reflecting a postulated risk of using MOX fuel that ranges from seven percent lower to eight percent higher than the risk of using uranium fuel. Under the Preferred Alternative, the estimated risk of cancer fatalities under severe accident conditions using MOX fuel in existing LWRs ranges from 0.01 to 0.098 for an 11-year campaign.

• Under the Preferred Alternative, HEU would continue to be stored at the Y-12 Plant at ORR in existing facilities that would be upgraded to meet requirements for withstanding natural phenomena, including earthquakes and tornadoes. This upgrade would reduce the expected risk for the design basis accidents analyzed in the Y-12 EA (for example, Building 9212) by approximately 80 percent, resulting in a latent cancer fatality risk of 7.4×10^{-6} (approximately 7 in a million) to the maximally exposed individual, 5.7×10^{-8} (approximately 6 in 100

analysis of the multipurpose reactor is included in Chapter 4 of the Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling (TSR PEIS) (DOE/EIS-0161, October 1995) and Appendix N of the S&D PEIS. In the TSR PEIS ROD (December 1995), the multipurpose reactor was preserved as an option for future consideration. The Fast Flux Test Facility (FFTF) at Hanford has been under consideration for tritium production, and could also use surplus plutonium as reactor fuel if it were shown to be useful for tritium production. This ROD does not preclude use of the FFTF for tritium production or the potential use of surplus plutonium as fuel for the FFTF.

[11] Accidents severe enough to cause a release of plutonium involved combinations of events that are highly unlikely. Estimates and analyses presented in Chapter 4 and summarized in Table 2.5-3 of the PEIS indicate a range of latent cancer fatalities of 5,900 to 7,300 and a risk of 0.016 to 0.15 of a fatality in the population for the 17-year campaign analyzed under the Existing LWR Alternative.

million) to a non-involved worker, and 5.1×10^{-7} (approximately 5 in 10 million) to the 80-km offsite population.

• Under the Preferred Alternative, safe, secure storage would continue for materials at Hanford, INEL, and ORR, pending disposition. Therefore, there would be no transportation impact at these sites until disposition. The storage transportation impact would come from movement of the RFETS materials to Pantex and SRS. If, following the EIS for construction and operation of plutonium disposition facilities, potential plutonium disposition activities were added to Hanford, INEL, Pantex, and SRS, the estimated total health effects for the life of the project from transportation of surplus plutonium (including transportation of those materials from RFETS to Pantex and SRS) would range from 0.193 fatalities for transportation to Pantex, to 1.87 fatalities for transportation to SRS (primarily from normal expected traffic accidents, not from radiological releases). In addition to the disposition activities at DOE sites, there would be transportation of the MOX fuel from the DOE fuel fabrication site to existing LWRs. The location of the LWRs and the destination of the MOX fuel could be either the eastern or western United States. For 4,000 km (2,486 mi) of such transportation, there could be up to an additional 3.61 potential fatalities (primarily from normal expected traffic accidents, not from radiological releases) for the life of the campaign, assuming 100 percent of the surplus plutonium would be used in commercial reactors. The actual amount would be smaller, and therefore potential fatalities would be lower, under the Preferred Alternative.

• At Hanford, INEL, Pantex, and SRS the Preferred Alternative would slightly increase regional employment and income. At RFETS, phaseout of plutonium storage would result in the loss of approximately 2,200 direct jobs. Compared to the total employment in the area, the loss of these jobs and the impacts to the regional economy would not be severe.

DOE has fully considered all of the environmental analyses in the S&D Final PEIS in reaching the decisions set forth in Section V, below.

E. Avoidance/Minimization of Environmental Harm

For the long-term storage of fissile material, there are four sites (Hanford, NTS, INEL, and LANL) where the Preferred Alternative is "no action"; that is, no plutonium would be stored at NTS, and at Hanford, INEL, and LANL, DOE would continue storage at existing facilities, using proven nuclear materials safeguards and security procedures, until disposition. These existing facilities would be maintained to ensure their safe operation and compliance with applicable environmental, safety and health requirements. At RFETS, the Preferred Alternative is to phase out storage of weapons-usable fissile materials, thus mitigating environmental impacts at RFETS. There are three sites (Pantex, ORR, and SRS) where the Preferred Alternative is to upgrade existing and planned new facilities. Site-specific mitigation measures for storage at these sites have been described in the S&D Final PEIS, and are summarized as follows:

• At Pantex, to alleviate the effects from using groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use; the Department will use such treated wastewater to the extent possible. Radiation doses to individual workers will be kept low by maintaining comprehensive badged monitoring and programs to keep worker exposures "as low as reasonably achievable" (ALARA).

• At ORR, radiation doses to individual workers will be kept low by maintaining comprehensive badged monitoring and ALARA programs, including worker rotations. Upgrades for HEU storage to meet performance requirements will include seismic structural modifications as documented in Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities. These modifications will reduce the risk of accidents to workers and the public.

• At SRS, to minimize soil erosion impacts during construction, storm water management and erosion control measures will be employed. Mitigation measures for potential Native American resources will be identified through consultation with the potentially affected tribes. Radiation doses to individual workers will be kept low by maintaining comprehensive badged monitoring and ALARA programs including worker rotations. The modified Actinide Packaging and Storage Facility (APSF) will be designed and operated in accordance with contemporary DOE Orders and regulations to reduce risks to workers and the public.

From a nonproliferation standpoint, the highest standards for safeguards and security will be employed during transportation, storage, and disposition. With respect to transportation, DOE will coordinate the transport of plutonium and HEU with State officials, consistent with current policy. Although the actual routes will be classified, they will be selected to circumvent populated areas, maximize the use of interstate highways, and avoid bad weather. DOE will continue to coordinate emergency preparedness plans and responses with involved states through a liaison program. The packaging, vehicles, and transport procedures being used are specifically designed and tested to prevent a radiological release under all credible accident scenarios.

For the Preferred Alternative for disposition, site-specific mitigation measures will be addressed in the follow-on, site-specific EIS. In the Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives, measures are proposed to reduce the possibility of the theft or loss of material. For both immobilization and MOX fuel fabrication, bulk processing is the point in the disposition process when the material is most vulnerable to covert attempts to steal or divert it. A variety of opportunities for improving safeguards, some of which are already implemented at large, modern facilities, include near real-time accounting, increased automation in the process design, and improved containment and surveillance.

The security risks posed by transportation can be reduced by minimizing the amount of transportation required (for example, putting the plutonium processing and MOX fabrication operations at the same site), minimizing the number of sites to which material has to be shipped, and minimizing the distance between those sites.

F. Environmentally Preferable Alternatives

The environmental analyses in Chapter 4 of the S&D Final PEIS indicate that the environmentally preferable alternative (the alternative with the lowest environmental impacts over the 50 years considered in the PEIS) for storage of weapons-usable fissile materials would be the Preferred Alternative, which consists of No Action at Hanford, NTS, INEL, and LANL pending disposition, phaseout of storage at RFETS, and upgrades that would ultimately reduce environmental vulnerabilities at ORR, SRS, and Pantex.

For disposition of surplus plutonium, the environmentally preferable alternative would be the No Disposition Action alternative, because the plutonium would remain in storage in accordance with decisions on the long-term storage of weapons-usable fissile materials, and there would be no new Federal actions that could impact the environment. For normal operations, analyses show that immobilization would be somewhat preferable to the existing LWR and preferred alternatives, although these alternatives, with the exception of waste generated, would be essentially environmentally comparable.[12]

Severe facility accident considerations indicate that immobilization options would be environmentally preferable to the existing reactor and preferred alternatives, although the likelihood of occurrence of severe accidents and the risk to the public are expected to be fairly low. Although No Disposition Action would be environmentally preferable, it would not satisfy the purpose and need for the Proposed Action, because the stockpile of surplus plutonium would not be reduced, and the Nonproliferation and Export Control Policy would not be implemented.

The hybrid approach (pursuing both reactors/MOX and immobilization) is being chosen over immobilization alone because of the increased flexibility it will provide by ensuring that plutonium disposition can be initiated promptly should one of the approaches ultimately fail or be delayed. Establishing the means for expeditious plutonium disposition will also help provide the basis for an international cooperative effort that can result in reciprocal, irreversible plutonium disposition actions by Russia. (See discussion in sections IV and V, below.)

IV. Non-Environmental Considerations

A. Technical Summary Reports

To assist in the preparation of this ROD, DOE's Office of Fissile Materials Disposition prepared and in July 1996 issued a *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition and a Technical Summary Report for Long-Term Storage of Weapons-Usable Fissile Materials.* These Technical Summary Reports (TSRs) summarize technical, cost, and schedule data for the storage and disposition alternatives that are considered in the S&D PEIS. After receiving comments on each of the TSRs, DOE issued revised versions of the reports in October and November, 1996, respectively.

1. Storage Technical Summary Report

This report provides technical, cost and schedule information for long-term storage alternatives analyzed in the S&D PEIS. The cost information for each alternative is presented in constant 1996 dollars and also discounted or present value dollars. It identifies both capital costs and life cycle costs. The following costs are in 1996 dollars.

The cost analyses show that the combination (preferred) alternative for the storage of plutonium would provide advantages to the Department with respect to implementing disposition technologies and would be the least expensive compared to other storage alternatives. The cost of the combination (preferred) alternative would be approximately $30 million in investment and $360 million in operating costs from inception until disposition occurs. The cost of the upgrade at multiple sites alternative would be approximately $380 million in investment and $3.2 billion in operating costs for 50 years. The costs for the consolidation alternative could range from approximately $40 million to $360 million in investment and $600 million to $1.1 billion for operating costs for 50 years, depending on the extent to which existing facilities and capabilities can be shared with other programs at the sites.

The schedule analysis shows that the upgraded storage facilities for plutonium under the combination (preferred) alternative could be operational by 2004 at Pantex (Zone 12), and by 2001 at SRS. The upgrade for the storage of HEU could be completed by 2004 (or earlier). RFETS pits could be received at Pantex beginning in 1997 in Zone 4 on a temporary basis until Zone 12 upgrades are completed. The other analyzed alternatives (upgrade and consolidation) would require about six years to complete.

2. Disposition Technical Summary Report

This report provides technical viability, cost, and schedule information for plutonium disposition alternatives and variants analyzed in the S&D PEIS. The variants analyzed in the report are based on pre-conceptual design information in most cases.

a. Technical Viability Estimates. The report indicates that each of the alternatives appears to be technically viable, although each is currently at a different level of technical maturity. There is high confidence that the technologies are sufficiently mature to allow procurement and/or construction of facilities and equipment to meet plutonium disposition technical requirements and to begin disposition in about a decade.[13]

Reactor Alternatives—Light water reactors (LWRs) can be readily converted to enable the use of MOX fuels. Many European LWRs currently operate on MOX fuel cycles. Although some technical risks exist, they are all amenable to engineering resolution. Sufficient existing domestic reactor capacity exists, unless significant delays occur in the disposition mission. CANDU reactors appear to be capable of operating on MOX fuel cycles, but this has never been demonstrated on any industrial scale. Therefore, additional development would be required to achieve the level of maturity for the CANDU reactors that exists for light water reactors. Partially complete and evolutionary LWRs would involve increased technical risk relative to existing LWRs, as well as the need to complete or build (and license) new reactor facilities. The spent MOX fuel waste form that results from reactor disposition of surplus plutonium will have to satisfy waste acceptance criteria for the geologic repository.

Immobilization Alternatives—All vitrification alternatives require additional research and development prior to implementation of immobilization of weapons-usable plutonium. However, a growing experience base exists relating to the vitrification of high-level waste. These existing technologies can be adapted to the plutonium disposition mission, though different equipment designs and glass formulations will generally be necessary due to criticality considerations and chemical differences between plutonium and HLW that may affect the stability of the glass matrix. Vitrification and ceramic immobilization alternatives are similar with regard to the technical maturity of incorporating plutonium in their respective matrices. The technical viability of electrometallurgical treatment has not yet been established for the plutonium disposition mission. The experimental data base for this alternative is limited, and critical questions on waste form performance are not yet resolved. This alternative is considered practical only if the underlying technology is further

[12] The potential risk of latent cancer fatality for a maximally exposed individual of the public from lifetime accident-free operation under the various alternatives are: 1.2×10^{-9} to 1.2×10^{-7} for boreholes, 1.2×10^{-9} to 1.2×10^{-7} for immobilization (vitrification or ceramic immobilization), 1.3×10^{-6} to 2.6×10^{-6} for existing LWRs, and 9.0×10^{-7} to 1.7×10^{-6} for the Preferred Alternative.

[13] Actual timing would depend on technical demonstrations, follow-on site-specific environmental review, detailed cost estimates, and international agreements.

developed for spent nuclear fuels.[14] All of the immobilization alternatives will require qualification (to meet acceptance criteria) of the waste form for the geologic repository, and may require legislative clarification or NRC rulemaking.

Deep Borehole Alternatives—Uncertainties for the deep borehole alternatives relate to selecting and qualifying a site; additional legislation and regulations, or legislative and regulatory clarification, may be required. The front-end feed processing operations for the deep borehole alternatives are much simpler than for other alternatives because no highly radioactive materials are processed, thus avoiding the need for remote handling operations. Emplacement technologies are comprised of largely low-technology operations which would be adaptations from existing hardware and processes used in the oil and gas industry.

Hybrid Approaches—Two hybrid approaches that combine technologies were considered as illustrative examples, using existing LWR or CANDU reactors in conjunction with a can-in-canister (immobilization) approach. Hybrids provide insurance against technical or institutional hurdles which could arise for a single technology approach for disposition. If any significant roadblock is encountered in any one area of a hybrid, it would be possible to simply divert the feed material to the more viable technology. In the case of a single technology, such roadblocks would be more problematic.

b. Cost Estimates. The following discussion is in constant 1996 dollars unless otherwise stated.

(1) Investment Costs.

- The investment costs for existing reactor variants tends to be about $1 billion; completing or building new reactors increases the investment cost to between $2 billion and $6 billion.
- The investment cost for the immobilization alternatives ranges from approximately $0.6 billion for the can-in-canister variants to approximately $2 billion for new greenfield variants.[15]
- Hybrid alternatives (combining both immobilization and reactor alternatives) require approximately $200 million additional investment over the existing light water reactor stand-alone alternatives.
- Investment costs for the deep borehole alternatives range from about $1.1 billion for direct emplacement to about $1.4 billion for immobilized emplacement.
- Alternatives that utilize existing facilities for plutonium processing, immobilization, or fuel fabrication would realize significant investment cost savings over building new facilities for the same function.
- Large uncertainties in the cost estimates exist, relating to both engineering and institutional factors.
- A significant fraction of the investment cost for an alternative/variant is related to the front-end facilities for the extraction of the plutonium from pits and other plutonium-bearing materials and for other functions that are common to all alternatives.

(2) Life Cycle Costs.

- The life cycle costs for hybrid alternatives are similar to the stand-alone reactor alternatives. For the existing LWR/immobilization hybrid alternative (preferred alternative), the cost is $260 million higher than the stand-alone reactor alternative; for the CANDU/immobilization hybrid alternative, the cost is $70 million higher.
- The combined investment and net operating costs for MOX fuel are higher than for commercial uranium fuel; thus, the cost of MOX fuel cannot compete economically with low-enriched uranium fuel for LWRs or natural uranium fuel for CANDU reactors.
- The can-in-canister approaches are the most attractive variants for immobilization based on cost considerations.
- The deep borehole alternatives are more expensive than the can-in-canister and existing reactor alternatives. The immobilized borehole alternative life cycle cost is $1 billion greater than that for the direct emplacement alternative ($3.6 billion vs. $2.6 billion).
- Large uncertainties in the cost estimates exist, relating to engineering, regulatory, and policy considerations.

c. Schedule Estimates. The key conclusions of the Disposition Technical Summary Report with respect to schedules are as follows:

- Significant schedule uncertainties exist, relating to both engineering and institutional factors.
- Opportunities for compressing or expanding schedules exist.

(1) Reactor Alternatives. • The rate at which MOX fuel is consumed in reactors will depend on the rate that MOX fuel is provided and fabricated, and the rate that plutonium oxide is provided to the MOX fuel fabrication facility.

- The time to attain production scale operation in existing LWRs and CANDU reactors could be about 8–12 years, depending on the need for and source of test assemblies that might be required.
- The time to complete the disposition mission is a function of the number of reactors committed to the mission, among other factors. For the variants considered, the time to complete varies from about 24 to 31 years.

(2) Immobilization Alternatives.

- The time to start the disposition mission ranges from 7 to 13 years, depending on the technology used and whether existing facilities are used.
- The operating campaign for the immobilization alternatives at full-scale operation would be about 10 years; it is possible to compress or expand the operating schedule by several years, if desired, by resizing the immobilization facility designs selected for analysis in this study. The overall mission duration (including research and development, construction, and operation) is expected to be about 18 to 24 years.
- Potential delays for start-up of the immobilization alternatives involve completing process development and demonstration, and qualifying the waste form for a geologic repository.

(3) Deep Borehole Alternatives. • The time to start-up is expected to be 10 years.

- The operating duration of the mission would be about 10 years, although completing all burial operations at the borehole site in 3 years is possible. Therefore, the overall mission duration is estimated to be 20 years with accelerated emplacement reducing the duration by about 7 years.
- The schedule for the deep borehole alternatives would depend in part on selecting and qualifying a site, and obtaining legislative and regulatory clarification as well as any necessary permits.

(4) Hybrid Approaches. • In general, the schedule data that apply to the component technologies apply to the hybrid alternatives as well.

- Confidence in an early start-up and an earlier completion can both be improved with a hybrid approach, relative to stand-alone alternatives.
- Hybrid alternatives provide an inherent back-up technology approach to enhance confidence in attaining schedule goals.

[14] A recent study by the National Research Council concludes that the electrometallurgical treatment technology is not sufficiently mature to provide a reliable basis for timely plutonium disposition. "An Evaluation of the Electrometallurgical Approach for Treatment of Excess Weapons Plutonium" (National Academy Press, Washington, D.C., 1996).

[15] "Greenfield" means a variant involving a new facility, with no existing plutonium-handling infrastructure.

B. Nonproliferation Assessment

To assist in the development of this ROD, DOE's Office of Arms Control and Nonproliferation, with support from the Office of Fissile Materials Disposition, prepared a report, Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives. The report was issued in draft form in October 1996, and following a public comment period, was issued in final form in January 1997. It analyzes the nonproliferation and arms reduction implications of the alternatives for storage of plutonium and HEU, and disposition of excess plutonium. It is based in part on a Proliferation Vulnerability Red Team Report prepared for the Office of Fissile Materials Disposition by Sandia National Laboratory. The assessment describes the benefits and risks associated with each option. Some of the "options" and "alternatives" discussed in the Nonproliferation Assessment are listed as "variants" (such as can-in-canister) in the S&D Final PEIS. The key conclusions of the report, as presented in its Executive Summary, are reproduced below.

1. Storage. • Each of the options under consideration for storage of U.S. weapons-usable fissile materials has the potential to support U.S. nonproliferation and arms reduction goals, if implemented appropriately.

• Each of the storage options could provide high levels of security to prevent theft of nuclear materials, and could provide access to excess materials for international monitoring.

• Making excess plutonium and HEU available for bilateral U.S.-Russian monitoring and International Atomic Energy Agency (IAEA) safeguards, while protecting proliferation-sensitive information, would help demonstrate the U.S. commitment never to return this material to nuclear weapons, providing substantial arms reduction and nonproliferation benefits in the near-term.

2. Disposition of U.S. Excess Plutonium

a. *In General.* • Each of the options for disposition of excess weapons plutonium that meets the Spent Fuel Standard would, if implemented appropriately, offer major nonproliferation and arms reduction benefits compared to leaving the material in storage in directly weapons-usable form. Taking into account the likely impact on Russian disposition activities, the no-action alternative appears to be by far the least desirable of the plutonium disposition options from a nonproliferation and arms reduction perspective.

• Carrying out disposition of excess U.S. weapons plutonium, using options that ensured effective nonproliferation controls and resulted in forms meeting the Spent Fuel Standard, would:

• reduce the likelihood that current arms reductions would be reversed, by significantly increasing the difficulty, cost, and observability of returning this plutonium to weapons;

• increase international confidence in the arms reduction process, strengthening political support for the nonproliferation regime and providing a base for additional arms reductions, if desired;

• reduce long-term proliferation risks posed by this material by further helping to ensure that weapons-usable material does not fall into the hands of rogue states or terrorist groups; and

• lay the essential foundation for parallel disposition of excess Russian plutonium, reducing the risks that Russia might threaten U.S. security by rebuilding its Cold War nuclear weapons arsenal, or that this material might be stolen for use by potential proliferators.

• Choosing the "no-action alternative" of leaving U.S. excess plutonium in storage in weapons-usable form indefinitely, rather than carrying out disposition:

• would represent a clear reversal of the U.S. position seeking to reduce excess stockpiles of weapons-usable materials worldwide;

• would make it impossible to achieve disposition of Russian excess plutonium;

• could undermine international political support for nonproliferation efforts by leaving open the question of whether the United States was maintaining an option for rapid reversal of current arms reductions; and

• could undermine progress in nuclear arms reductions.

• The benefits of placing U.S. excess plutonium under international monitoring and then transforming it into forms that met the Spent Fuel Standard would be greatly increased, and the risks of these steps significantly decreased, if Russia took comparable steps with its own excess plutonium on a parallel track. The two countries need not use the same plutonium disposition technologies, however.

• As the 1994 NAS committee report[16] concluded, options for disposition of U.S. excess weapons plutonium will provide maximum nonproliferation and arms control benefits if they:

• minimize the time during which the excess plutonium is stored in forms readily usable for nuclear weapons;

• preserve material safeguards and security during the disposition process, seeking to maintain to the extent possible the same high standards of security and accounting applied to stored nuclear weapons (the Stored Weapons Standard);

• result in a form from which the plutonium would be as inaccessible and unattractive for weapons use as the larger and growing quantity of plutonium in commercial spent fuel (the Spent Fuel Standard).

• In order to achieve the benefits of plutonium disposition as rapidly as possible, and to minimize the risks and negative signals resulting from leaving the excess plutonium in storage, it is important for disposition options to begin, and to complete the mission as soon as practicable taking into account nonproliferation, environment, safety, and health, and economic constraints. Timing should be a key criterion in judging disposition options. Beginning the disposition quickly is particularly important to establishing the credibility of the process, domestically and internationally.

• Each of the options under consideration for plutonium disposition has its own advantages and disadvantages with respect to nonproliferation and arms control, but none is clearly superior to the others.

• Each of the options under consideration for plutonium disposition can potentially provide high levels of security and safeguards for nuclear materials during the disposition process, mitigating the risk of theft of nuclear materials.

• Each of the options under consideration for plutonium disposition can potentially provide for effective international monitoring of the disposition process.

• Plutonium disposition can only reduce, not eliminate, the security risks posed by the existence of excess plutonium, and will involve some risks of its own:

• Because all plutonium disposition options would take decades to complete, disposition is not a near-term solution to the problem of nuclear theft and smuggling. While disposition will make a long-term contribution, the near-term problem must be addressed through programs to improve security and safeguarding for nuclear materials, and to ensure adequate police, customs, and intelligence capabilities to interdict nuclear smuggling.

[16] See footnote 3, above.

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• All plutonium disposition options under consideration would involve processing and transport of plutonium, which will involve more risk of theft in the short term than if the material had remained in heavily guarded storage, in return for the long-term benefit of converting the material to more proliferation-resistant forms.

• Both the United States and Russia will still retain substantial stockpiles of nuclear weapons and weapons-usable fissile materials even after disposition of the fissile materials currently considered excess is complete. These weapons and materials will continue to pose a security challenge regardless of what is done with excess plutonium.

• None of the disposition options under consideration would make it impossible to recover the plutonium for use in nuclear weapons, or make it impossible to use other plutonium to rebuild a nuclear arsenal. Therefore, disposition will only reduce, not eliminate, the risk of reversal of current nuclear arms reductions.

• A U.S. decision to choose reactor alternatives for plutonium disposition could offer additional arguments and justifications to those advocating plutonium reprocessing and recycle in other countries. This could increase the proliferation risk if it in fact led to significant additional separation and handling of weapons-usable plutonium. On the other hand, if appropriately implemented, plutonium disposition might also offer an opportunity to develop improved procedures and technologies for protecting and safeguarding plutonium, which could reduce proliferation risks and would strengthen U.S. efforts to reduce the stockpiles of separated plutonium in other countries.

• Large-scale bulk processing of plutonium, including processes to convert plutonium pits to oxide and prepare other forms for disposition, as well as fuel fabrication or immobilization processes, represents the stage of the disposition process when material is most vulnerable to covert theft by insiders or covert diversion by the host state. Such bulk processing is required for all options, however; in particular, initial processing of plutonium pits and other forms is among the most proliferation-sensitive stages of the disposition process, but is largely common to all the options. More information about the specific process designs is needed to determine whether there are significant differences between the various immobilization and reactor options in the overall difficulty of providing effective assurance against theft or diversion during the different types of bulk processing involved, and if so, which approach is superior in this respect.

• Transport of plutonium is the point in the disposition process when the material is most vulnerable to overt armed attacks designed to steal plutonium. With sufficient resources devoted to security, however, high levels of protection against such overt attacks can be provided. International, and particularly overseas, shipments would involve greater transportation concerns than domestic shipments.[17]

b. Conclusions Relating to Specific Disposition Options.

• The reactor options, homogeneous immobilization[18] options, and deep borehole immobilized emplacement option can all meet the Spent Fuel Standard. The can-in-canister options are being refined to increase the resistance to separation of the plutonium cans from the surrounding glass, with the goal of meeting the Spent Fuel Standard. The deep borehole direct emplacement option substantially exceeds the Spent Fuel Standard with respect to recovery by sub-national groups, but could be more accessible and attractive for recovery by the host state than spent fuel.

• The reactor options have some advantage over the immobilization options with respect to perceived irreversibility, in that the plutonium would be converted from weapons-grade to reactor-grade, even though it is possible to produce nuclear weapons with both weapons and reactor-grade plutonium. The immobilization and deep borehole options have some advantage over the reactor options in avoiding the perception that they could potentially encourage additional separation and civilian use of plutonium, which itself poses proliferation risks.

• Options that result in accountable "items" (for purposes of international safeguards) whose plutonium content can be accurately measured (such as fuel assemblies or immobilized cans without fission products in the "can-in-canister" option) offer some advantage in accounting to ensure that the output plutonium matches the input plutonium from the process. Other options (such as homogeneous immobilization or immobilized emplacement in deep boreholes) would require greater reliance on containment and surveillance to provide assurance that no material was stolen or diverted—but in some cases could involve simpler processing, easing the task of providing such assurance.

• The principal uncertainty with respect to using excess weapons plutonium as MOX in U.S. LWRs relates to the potential difficulty of gaining political and regulatory approvals for the various operations required.

• Compared to the LWR option, the CANDU option would involve more transport and more safeguarding issues at the reactor sites themselves (because of the small size of the CANDU fuel bundles and the on-line refueling of the CANDU reactors). Demonstrating the use of MOX in CANDU reactors by carrying out this option for excess weapons plutonium disposition could somewhat detract from U.S. efforts to convince nations operating CANDU reactors in regions of proliferation concern not to pursue MOX fuel cycles, but these nations are likely to base their fuel cycle decisions primarily on factors independent of disposition of this material. Disposing of excess weapons plutonium in another country long identified with disarmament could have significant symbolic advantages, particularly if carried out in parallel with Russia. Disposition of Russian plutonium in CANDU reactors, however, would require resolving additional transportation issues and additional questions relating to the likely Russian desire for compensation for the energy value of the plutonium.

• The immobilization options have the potential to be implemented more quickly than the reactor options. They face somewhat less political uncertainty but somewhat more technical uncertainty than the reactor options.

• The likelihood of very long delays in gaining approval for siting and construction of deep borehole sites represents a very serious arms reduction and nonproliferation disadvantage of the borehole option, in either of its variants. While the deep borehole direct-emplacement option requires substantially less bulk processing than the other disposition options, that option may not meet the Spent Fuel Standard for retrievability by the host state, as mentioned above. Any potential

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[17] International shipments would be involved (from the United States to Canada) if the CANDU option were pursued as a result of international agreements among the U.S., Canada, and Russia. Overseas shipments would be involved if European MOX fuel fabrication were utilized in the interim before a domestic MOX fabrication facility were completed. The Preferred Alternative and the decisions in this ROD do not involve European MOX fuel fabrication.

[18] The term "homogeneous immobilization" refers to mixing of solutions of plutonium and either HLW or cesium in liquid form, followed by solidification of the mixture in either glass or ceramic matrices. This contrasts with the "can-in-canister" variant, in which the plutonium and HLW or cesium materials are never actually mixed together.

advantage from the reduced processing is small compared to the large timing uncertainty and the potential retrievability disadvantage.

• Similarly, the electrometallurgical treatment option, because it is less developed than the other immobilization options, involves more uncertainty in when it could be implemented, which represents a significant arms reduction and nonproliferation disadvantage. It does not appear to have major compensating advantages compared to the other immobilization options.

• The "can-in-canister" immobilization options have a timing advantage over the homogeneous immobilization options, in that, by potentially relying on existing facilities, they could begin several years sooner. As noted above, however, modified systems intended to allow this option to meet the Spent Fuel Standard are still being designed.

C. Comments on the S&D Final PEIS

After issuing the Final PEIS, DOE received approximately 100 letters from organizations and individuals commenting on the alternatives addressed in the PEIS. Many of these letters expressed opposition to the MOX fuel approach for surplus plutonium disposition. The major concern raised in these letters was the contention that the use of MOX fuel is associated with proliferation risk as well as additional delays, costs, and safety and environmental risks. One of these letters was from a coalition of 14 national organizations recommending that the Department decide to utilize immobilization for the disposition of all surplus plutonium and that MOX be retained for use, if at all, only as an "insurance policy" if immobilization should prove infeasible. Several of those 14 organizations also wrote separately making similar points. Conversely, many of the letters provided comments in support of the use of MOX fuel and/or a dual path, while a few expressed opposition to the immobilization alternatives.

Seven of the letters received suggested the use of disposition approaches that were not analyzed in the PEIS. Three of these approaches (dropping plutonium into volcanoes, burying it in the sea at the base of a volcano, and storing it in large granite or marble structures) are similar to options that were either considered (but found to be unreasonable) in a screening process that preceded the PEIS, or were addressed in the PEIS Comment Response Document. These approaches were considered to be potentially damaging to the environment, among other things, and were therefore dismissed as unreasonable. Three other alternatives (plasma technology, binding and neutralizing plutonium with a new organic material, and use in rocket engines) recommended in these letters would require a substantial amount of development and could not be accomplished in the same time frame as alternatives analyzed in the PEIS. One commentor suggested adding the plutonium to the radioactive sludge being stored at Hanford for eventual disposal. The Department views this as unreasonable because of delays and increased costs that would be incurred in the program to manage the wastes in the Hanford tanks. One commentor was opposed to the utilization of Hanford's Fuels and Materials Examination Facility for MOX fuel fabrication and the Fast Flux Test Facility for MOX fuel burning.

All of the issues raised in these letters are covered in the body of the Final PEIS, in the Comment Response Document, the Summary Report of the Screening Process (DOE/MD-0002, March 19, 1995), the Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition, or the Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives, which have each been considered in reaching this ROD.

The Department's decision for surplus plutonium disposition is to pursue both the existing LWR (MOX fuel) and immobilization approaches. DOE recognizes that the estimated life-cycle cost of immobilization alone would be less than that of the hybrid approach (pursuing both), but the additional expense would be warranted by the increased flexibility should one of the approaches ultimately fail, and the increased ability to influence Russian plutonium disposition actions. (The lowest cost approach would be the No Disposition Action alternative; however, as noted in section III.F, above, that option would not satisfy the purpose and need for this program.) DOE also recognizes that analyses in the PEIS indicated that, for normal operation, the environmental and health impacts would be somewhat lower for immobilization, although, with the exception of waste generation, impacts for the preferred, immobilization, and existing LWR (MOX) alternatives would be essentially comparable (see prior discussion).

Potential latent cancer fatalities for members of the public under the MOX approach would be significantly higher than under the immobilization approach only under highly unlikely facility accident scenarios; the risk (taking into account accident probabilities) to the public of latent cancer fatalities from accidents would be fairly low for both approaches.

From the nonproliferation standpoint, results of the Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives (see section IV.B) indicated that each of the options under consideration for plutonium disposition has its own advantages and disadvantages, and each can potentially provide high levels of security and safeguards for nuclear materials during the disposition process, mitigating the risk of theft of nuclear materials. Initial processing of plutonium pits and other forms is among the most proliferation-sensitive stages of the disposition process, but is largely common to all the options. Although the Assessment also concluded that none of the approaches is clearly superior to the others, both the Nonproliferation Assessment and a letter from the Secretary of Energy Advisory Board Task Force on the Non-proliferation and Arms Control Implications of Weapons-Usable Fissile Materials Disposition Alternatives (included as Appendix B to the Nonproliferation Assessment) concluded that the hybrid approach (both reactors/MOX and immobilization) is preferable because of uncertainties in each approach and because it would minimize potential delays should problems develop with either approach. Numerous comment letters have made similar points.

One such letter was received from five individuals who were the U.S. participants on the U.S.-Russian Independent Scientific Commission on Disposition of Excess Weapons Plutonium. This letter supported the dual-track approach on the grounds that "ruling out reactors and thus depending solely on vitrification as the only approach to plutonium disposition that might be implementable anytime soon, would have far bigger nonproliferation liabilities then would the two-track approach." These commentors argued that designating only immobilization as the preferred approach, with MOX as a back-up, would have essentially all the nonproliferation and arms reduction liabilities of a one-track approach, which would weaken the U.S. position and have severe consequences for the likely success of programs to carry out permanent disposition of weapons plutonium in Russia, and therefore jeopardize the success of programs to carry out U.S. disposition. These commentors stated that without the dual-track approach, the U.S. will lose any leverage it might have over the conditions and safeguards accompanying the use of Russian plutonium in their reactors. They also pointed out that pursuing both the MOX option and immobilization in the U.S. may be the best way to convince Russia, which currently favors converting its own plutonium to MOX fuel, of the value of immobilization for a portion of its excess plutonium. These commentors argued that the dual-track approach would not undermine U.S. nonproliferation policy, would not increase the risk of nuclear theft and terrorism, and would not lead to a new domestic plutonium recycle industry since it would not significantly affect the huge economic barriers to using MOX fuel on a commercial basis.

Two commentors expressed opposition to plutonium recycling (reprocessing), citing the Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors (GESMO), NUREG–0002, which was issued by the NRC in 1976, and President Carter's decision to ban plutonium recycling. DOE notes that plutonium recycling is not part of the plutonium disposition program or the decisions in this ROD; on the contrary, this ROD includes conditions on the use of MOX fuel that are intended to prevent the use of recycled plutonium.

The use of MOX fuel in existing reactors would be undertaken in a manner that is consistent with the United States' policy objective on the irreversibility of the nuclear disarmament process and the United States' policy discouraging the use of plutonium for civil purposes. To this end, implementing the MOX alternative would include government ownership and control of the MOX fuel fabrication facility at a DOE site, and use of the facility only for the surplus plutonium disposition program. There would be no reprocessing or subsequent reuse of spent MOX fuel. The MOX fuel would be used in a once-through fuel cycle in existing reactors, with appropriate arrangements, including contractual or licensing provisions, limiting use of MOX fuel to surplus plutonium disposition.

One commentor, who opposed MOX fuel use, urged DOE not to use European MOX fuel fabrication capability if the MOX approach is pursued. In this ROD, DOE has not decided to use European MOX fuel fabrication.

V. Decisions

A. Storage of Weapons-Usable Fissile Materials

Consistent with the Preferred Alternative in the S&D Final PEIS, the Department has decided to reduce, over time, the number of locations where the various forms of plutonium are stored, through a combination of storage alternatives in conjunction with a combination of disposition alternatives. DOE will begin implementing this decision by moving surplus plutonium from RFETS as soon as possible, transporting the pits to Pantex beginning in 1997, and non-pit plutonium materials to SRS upon completion of the expanded Actinide Packing and Storage Facility (APSF), anticipated in 2001. Over time, DOE will store this plutonium in upgraded facilities at Pantex and in the expanded APSF. Surplus and non-surplus HEU will be stored in upgraded facilities at ORR. Storage facilities for the surplus HEU will also be modified, as needed, to accommodate international inspection requirements consistent with the President's Nonproliferation and Export Control Policy. Accordingly, DOE has decided to pursue the following actions for storage:

- Phase out storage of all weapons-usable plutonium at RFETS beginning in 1997; move pits to Pantex, and non-pit materials to SRS upon completion of the expanded APSF. At Pantex, DOE will repackage pits from RFETS in Zone 12, then place them in existing storage facilities in Zone 4, pending completion of facility upgrades in Zone 12. At SRS, DOE will expand the planned new APSF, and move separated and stabilized non-pit plutonium materials from RFETS to the expanded APSF upon completion. The small number of pits currently at RFETS that are not in shippable form will be placed in a shippable condition in accordance with existing procedures prior to shipment to Pantex. Additionally, some pits and non-pit plutonium materials from RFETS could be used at SRS, LANL, and Lawrence Livermore National Laboratory (LLNL) for tests and demonstrations of aspects of disposition technologies (see disposition decision, below). All non-pit weapons-usable plutonium materials currently stored at RFETS are surplus.

The Department's decision to remove plutonium from RFETS is based on the cleanup agreement among DOE, EPA, and the State of Colorado for RFETS, the proximity of RFETS to the Denver metropolitan area, and the fact that some of the RFETS plutonium is currently stored in buildings 371 and 376, two of the most vulnerable facilities as defined by and identified in DOE's Plutonium Working Group Report on Environmental, Safety, and Health Vulnerabilities Associated With the Department's Plutonium Storage (DOE/EH–0414, November, 1994).

- Upgrade storage facilities at Zone 12 South (to be completed by 2004) at Pantex to store those surplus pits currently stored at Pantex, and surplus pits from RFETS, pending disposition. Storage facilities at Zone 4 will continue to be used for these pits prior to completion of the upgrade.
- In accordance with the preferred alternative in the Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (Stockpile Stewardship and Management PEIS), store Strategic Reserve pits at Pantex in other upgraded facilities in Zone 12.

The Department's decision to consolidate pit storage at Pantex places the pits at a central location where most of the pits already reside and where the expertise and infrastructure are already in place to accommodate pit storage.[19] Pantex has more than 40 years of experience with the handling of pits. Zone 12 facilities would be modified for long-term storage of the Pantex plutonium inventory and the small number of pits transferred from RFETS and SRS for a modest cost (about $10 million capital cost). Pursuant to the Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components (DOE/EIS–0225), DOE is proposing to continue nuclear weapons stockpile management operations and related activities at the Pantex Plant, including interim storage of up to 20,000 pits.[20] Consequently, the storage of surplus pits at Pantex would offer the opportunity to share trained people and other resources, and a decreased cost could be realized over other sites without similar experience. Using the Pantex Plant for pit storage would also involve the lowest cost and the least new construction relative to other sites.

- Expand the planned APSF at SRS (Upgrade Alternative) to store those surplus, non-pit plutonium materials currently at SRS and surplus non-pit plutonium materials from RFETS, pending disposition (see disposition decision, below). DOE analyzed the

[19] A small number of research and development pits located at RFETS that have been and will continue to be packaged and returned to LANL and LLNL are outside the scope of the S&D PEIS and this ROD.

[20] The pits that are to be moved to Pantex pursuant to this ROD fall within the 20,000 pit limit.

potential impacts of constructing and operating the APSF in the Final Environmental Impact Statement, Interim Management of Nuclear Materials (DOE/EIS–0220) and announced the decision to build the facility in the associated ROD (60 FR 65300, December 19, 1995). DOE, pursuant to the decisions announced here to store surplus non-pit plutonium at SRS, will likely design and build the APSF and the expanded space to accommodate the RFETS material as one building,[21] which DOE plans to complete in 2001. The RFETS surplus non-pit plutonium materials[22] will be moved to SRS after stabilization is performed at RFETS under corrective actions in response to Defense Nuclear Facilities Safety Board Recommendation 94–1; and after the material is packaged in DOE-approved storage and shipping containers pursuant to existing procedures. The surplus plutonium already on-site at SRS and the movement of separated and stabilized non-pit plutonium from RFETS would result in the storage of a maximum of 10 metric tons of surplus plutonium in the new, expanded APSF at SRS. In addition, shipment of the non-pit plutonium from RFETS to SRS, after stabilization, would only be implemented if the subsequent ROD for a plutonium disposition site (see Section V.B., below) calls for immobilization of plutonium at SRS. Placement of surplus, non-pit plutonium materials in a new storage facility at SRS will allow utilization of existing expertise and plutonium handling capabilities in a location where disposition activities could occur (see disposition decision, below). The decision to store non-pit plutonium from RFETS at SRS places most non-pit material at a plutonium-competent site with the most modern, state-of-the-art storage and processing facilities, and at a site with the only remaining large-scale chemical separation and processing capability in the DOE complex.[23] Pits currently located at SRS will be moved to Pantex for storage consistent with the Preferred Alternative in the Stockpile Stewardship and Management PEIS. There are no strategic non-pit materials currently located at SRS.

- Continue current storage (No Action) of surplus plutonium at Hanford and INEL, pending disposition (or movement to lag storage[24] at disposition facilities when selected).[25] This action will allow surplus plutonium to remain at the sites with existing expertise and plutonium handling capabilities, and where potential disposition activities could occur (see disposition decision, below). There are no non-surplus weapons-usable plutonium materials currently stored at either site.
- Continue current storage (No Action) of plutonium at LANL, pending disposition (or movement to lag storage at the disposition facilities). This plutonium will be stored in stabilized form with the non-surplus plutonium in the upgraded Nuclear Material Storage Facility pursuant to the No Action alternative for the site.
- Take No Action at the NTS. DOE will not introduce plutonium to sites that do not currently have plutonium in storage.
- Upgrade storage facilities at the Y–12 Plant (Y–12) (to be completed by 2004 or earlier) at ORR to store non-surplus HEU and surplus HEU pending disposition. Existing storage facilities at Y–12 will be modified to meet natural phenomena requirements, as documented in Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities (Y/EN–5080, 1994). Storage facilities will be consolidated, and the storage footprint will be reduced, as surplus HEU is dispositioned and blended to low-enriched uranium, pursuant to the ROD for the Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement (61 FR 40619, August 5, 1996). Consistent with the Preferred Alternative in the Stockpile Stewardship and Management PEIS, HEU strategic reserves will be stored at the Y–12 Plant.

B. Plutonium Disposition

Consistent with the Preferred Alternative in the S&D Final PEIS, DOE has decided to pursue a strategy for plutonium disposition that allows for immobilization of surplus weapons plutonium in glass or ceramic forms and burning of the surplus plutonium as mixed oxide fuel (MOX) in existing reactors. The decision to pursue disposition of the surplus plutonium using these approaches is supported by the analyses in the Disposition Technical Summary Report (section IV.A.2 above) and the Nonproliferation Assessment (section IV.B above), as well as the S&D Final PEIS. The results of additional technology development and demonstrations, site-specific environmental review, detailed cost proposals, nonproliferation considerations, and negotiations with Russia and other nations will ultimately determine the timing and extent to which MOX as well as immobilization is deployed. These efforts will provide the basis and flexibility for the United States to initiate disposition efforts either multilaterally or bilaterally through negotiations with other nations, or unilaterally as an example to Russia and other nations.

Pursuant to this decision, the United States policy not to encourage the civil use of plutonium and, accordingly, not to itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes, does not change. Although under this decision some plutonium may ultimately be burned in existing reactors, extensive measures will be pursued (see below) to ensure that federal support for this unique disposition mission does not encourage other civil uses of plutonium or plutonium reprocessing. The United States will maintain its commitments regarding the use of plutonium in civil nuclear programs in western Europe and Japan.

The Disposition Technical Summary Report (section IV.A.2 above) concluded that the lowest cost option for plutonium disposition would be immobilization using the can-in-canister variant and existing facilities to the maximum extent possible, with a net life-cycle cost of about $1.8 billion. The Disposition Technical Summary Report also estimated that the net life-cycle cost of the hybrid immobilization/MOX approach would be about $2.2 billion. The additional expense of pursuing the hybrid approach would be warranted by

[21] Building the APSF in this way, rather than as originally configured plus an expansion, will not increase the potential impacts of constructing and operating the facility beyond those analyzed in the S&D Final PEIS in conjunction with the analyses in the Final Environmental Impact Statement, Interim Management of Nuclear Materials.

[22] This decision does not include residues at RFETS that are less than 50-percent plutonium by weight, or scrub alloys. The management and disposition of those materials has been or is being considered in separate NEPA reviews. See Environmental Assessment for Solid Residue Treatment, Repackaging, and Storage (DOE/EA–1120, April 1996); Notice of Intent to Prepare an EIS on the Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site (61 FR 58866, November 19, 1996).

[23] SRS is one of the preferred candidate sites for plutonium disposition facilities, including the potential for the early start of disposition by immobilization using the can-in-canister option at the DWPF.

[24] Lag storage is temporary storage at the applicable disposition facility.

[25] Lawrence Livermore National Laboratory (LLNL) currently stores 0.3 metric tons of plutonium, which are primarily research and development and operational feedstock materials not surplus to government needs. Adequate storage facilities for this material currently exist at LLNL, where it will be stored and used for research and development activities. None of the plutonium stored at LLNL falls within the scope of the disposition alternatives in the S&D Final PEIS or the disposition decisions in this ROD.

the increased flexibility it would provide, as noted in the Nonproliferation Assessment, to ensure that plutonium disposition could be initiated promptly should one of the approaches ultimately fail or be delayed. Establishing the means for expeditious plutonium disposition will also help provide the basis for an international cooperative effort that can result in reciprocal, irreversible plutonium disposition actions by Russia. This disposition strategy signals a strong U.S. commitment to reducing its stockpile of surplus plutonium, thereby effectively meeting the purpose of and need for the Proposed Action.

To accomplish the plutonium disposition mission, DOE will use, to the extent practical, new as well as modified existing buildings and facilities for portions of the disposition mission. DOE will analyze and compare existing and new buildings and facilities, and technology variations, in a subsequent, site-specific EIS. In addition, all disposition facilities will be designed or modified, as needed, to accommodate international inspection requirements consistent with the President's Nonproliferation and Export Control Policy. Accordingly, DOE has decided to pursue the following strategy and supporting actions for plutonium disposition:

• Immobilize plutonium materials using vitrification or ceramic immobilization at either Hanford or SRS, in new or existing facilities. Immobilization could be used for pure or impure forms of plutonium. In the subsequent EIS (referenced above), DOE anticipates that the preferred alternative for vitrification or ceramic immobilization will include the can-in-canister variant, utilizing the existing HLW and the DWPF at SRS (see below). Alternatively, new immobilization facilities could be built at Hanford or SRS. The immobilized material would be disposed of in a geologic repository. Pursuant to appropriate NEPA review, DOE will continue the research and development leading to the demonstration of the can-in-canister variant at the DWPF using surplus plutonium and the development of vitrification and ceramic formulations.

• Convert surplus plutonium materials into mixed oxide (MOX) fuel for use in existing reactors. Pure surplus plutonium materials including pits, pure metal, and oxides could be converted without extensive processing into MOX fuel for use in existing commercial reactors. Other, already separated forms of surplus plutonium would require additional purification. (This purification would not involve reprocessing of spent nuclear fuel.) The Government-produced MOX fuel (from plutonium declared surplus to defense needs) would be used in existing LWRs with a once-through fuel cycle, with no reprocessing or subsequent reuse of the spent fuel. In addition, DOE will explore appropriate contractual limits to ensure that any reactor license modification for use of the MOX fuel is limited to governmental purposes involving the disposition of surplus, weapons-usable plutonium, so as to discourage general civil use of plutonium-based fuel. The spent MOX fuel would be disposed of in a geologic repository. If partially completed LWRs were to be completed by other parties, they would be considered for this mission. The MOX fuel would be fabricated in a domestic, government-owned facility at one of four DOE sites (SRS, Hanford, INEL, or Pantex).

The Department reserves as an option the potential use of some MOX fuel in CANDU reactors in Canada in the event that a multilateral agreement to deploy this option is negotiated among Russia, Canada, and the United States. DOE will engage in a test and demonstration program for CANDU MOX fuel consistent with ongoing and potential future cooperative efforts with Russia and Canada.

The test and demonstration activities could occur at LANL and at sites in Canada, potentially beginning in 1997, and will be based on appropriate NEPA review. Fabrication of MOX fuel for CANDU reactors would occur in a DOE facility, as would be true in the case of domestic LWRs. Strict security and safeguards would be employed in the fabrication and transport of MOX fuel to CANDU reactors, as well as domestic reactors. Whether, and the extent to which, the CANDU option is implemented will depend on multi-national agreements and the results of the test and demonstration activities.

Due to technology, complexity, timing, cost, and other factors that would be involved in purifying certain plutonium materials to make them suitable for potential use in MOX fuel, approximately 30 percent of the total quantity of plutonium that has been or may be declared surplus to defense needs would require extensive purification for use in MOX fuel, and therefore will likely be immobilized. Of the plutonium that is currently surplus, DOE will immobilize at least 8 metric tons that it has determined are not suitable for use in MOX fuel.[26] DOE reserves the option of using the immobilization approach for all of the surplus plutonium.

The timing and extent to which either option is ultimately utilized will depend on the results of international agreements, future technology development and demonstrations, site-specific environmental review, detailed cost proposals, and negotiations with Russia and other nations. In the event both technologies are utilized, because the time required for plutonium disposition using reactors would be longer than that for immobilization, it is probable that some surplus plutonium would be immobilized initially, prior to completion of reactor irradiation for other surplus plutonium. Implementation of this strategy will involve some or all of the following supporting actions:

• Construct and operate a plutonium vitrification facility or ceramic immobilization facility at either Hanford or SRS. DOE will analyze alternative locations at these two sites for constructing new buildings or using modified existing buildings in subsequent, site-specific NEPA review. SRS has existing facilities (the DWPF) and infrastructure to support an immobilization mission, and at Hanford, DOE has proposed constructing and operating immobilization facilities for the wastes in Hanford tanks.[27] DOE will not create new infrastructure for immobilizing plutonium with HLW or cesium at INEL, NTS, ORR, or Pantex. Due to the substantial timing and cost advantages associated with the can-in-canister option, as discussed in the Technical Summary Report For Surplus Weapons-Usable Plutonium Disposition and summarized in section IV.A.2, above, DOE anticipates that the proposed action for immobilization in the follow-on plutonium disposition EIS will include the use of the can-in-canister option at the DWPF at SRS for immobilizing a portion of the surplus, non-pit plutonium material.[28]

[26] The S&D Final PEIS, for purposes of analysis of impacts of the preferred alternative (using both reactors and immobilization), assumed that about 30 percent (approximately 17 MT) of the surplus plutonium materials might be immobilized because they are impure. DOE's decision here that immobilization will be used for at least 8 MT currently located at SRS and RFETS is based on DOE's current assessment that that quantity of material is so low in quality that its purification for use in MOX fuel would not be cost-effective. This decision does not preclude immobilizing all of the surplus plutonium, but it does preclude using the MOX/reactor approach for all of the material.

[27] See Final Environmental Impact Statement for the Tank Waste Remediation System, Hanford Site, Richland, Washington (DOE/EIS-0189, August 1996); ROD expected early in 1997.

[28] DOE expects to issue a Notice of Intent to prepare the follow-on EIS shortly following this ROD. Reasonable alternatives for the proposed

• Construct and operate a plutonium conversion facility for non-pit plutonium materials at either Hanford or SRS. DOE will collocate the plutonium conversion facility with the vitrification or ceramic immobilization facility discussed above. In subsequent, site-specific NEPA review, DOE will analyze alternative locations at Hanford and SRS for constructing new buildings or using modified existing buildings for the plutonium conversion facility.

• Construct and operate a pit disassembly/conversion facility at Hanford, INEL, Pantex, or SRS (only one site). DOE will not introduce plutonium to sites that do not currently have plutonium in storage. Therefore, two sites analyzed in the S&D PEIS, NTS and ORR, will not be considered further for plutonium disposition activities. DOE will analyze alternative locations at Hanford, INEL, Pantex, and SRS for constructing new buildings or using modified existing buildings in subsequent, site-specific NEPA review. Based on appropriate NEPA review, DOE anticipates demonstrating the Advanced Recovery and Integrated Extraction System (ARIES) concept at LANL for pit disassembly/conversion beginning in fiscal year 1997.

• Construct and operate a domestic, government-owned, limited-purpose MOX fuel fabrication facility at Hanford, INEL, Pantex, or SRS (only one site). As noted above, NTS and ORR will not be considered further for plutonium disposition activities. In follow-on NEPA review, DOE will analyze alternative locations at Hanford, INEL, Pantex, and SRS, for constructing new buildings or using modified existing buildings. The MOX fuel fabrication facility will serve only the limited mission of fabricating MOX fuel from plutonium declared surplus to U.S. defense needs, with shut-down and decontamination and decommissioning of the facility upon completion of this mission.[29]

DOE's program for surplus plutonium disposition will be subject to the highest standards of safeguards and security for storage, transportation, and processing (particularly during operations that involve the greatest proliferation vulnerability, such as during MOX fuel preparation and transportation), and will include International Atomic Energy Agency verification as appropriate. Transportation of all plutonium-bearing materials under this program, including the transportation of prepared MOX fuel to reactors, will be accomplished using the DOE Transportation Safeguards Division's "Safe Secure Transports" (SSTs), which affords these materials the same level of transportation safety, security, and safeguards as is used for nuclear weapons.

Pursuant to appropriate NEPA review(s), DOE will continue research and development and engage in further testing and demonstrations of plutonium disposition technologies which may include: dissolution of small quantities of plutonium in both glass and ceramic formulation; experiments with immobilization equipment and systems; fabrication of MOX fuel pellets for demonstrations of reactor irradiation at INEL; mechanical milling and mixing of plutonium and uranium feed; and testing of shipping and storage containers for certification, in addition to the testing and demonstrations previously described for the can-in-canister immobilization variant, the ARIES system, and other plutonium processes.

DOE has decided not to pursue several disposition alternatives that were evaluated in the S&D PEIS: two deep borehole alternatives, electrometallurgical treatment, evolutionary reactors, and partially-completed reactors (unless they were completed by others, in which case they would qualify as existing reactors). Although the deep borehole options are technically attractive, the institutional uncertainties associated with siting of borehole facilities make timely implementation of this alternative unlikely. To implement the borehole alternatives, new legislation and regulations, or clarification of existing regulations, may be necessary. DOE has decided not to pursue the electrometallurgical treatment option for immobilization because its technology is less mature than vitrification or ceramic immobilization.[30] DOE has decided not to pursue evolutionary reactors or partially-completed reactors because they offer no advantages over existing reactors for plutonium disposition and would involve higher costs, greater regulatory uncertainties, higher environmental impacts from construction, and less timely commencement of disposition actions.

VI. Conclusion

DOE has decided to implement a program to provide for safe and secure storage of weapons-usable fissile materials and for disposition of weapons-usable plutonium that is declared excess to national security needs (now or in the future), as specified in the Preferred Alternative in the S&D Final PEIS. DOE will consolidate the storage of weapons-usable plutonium by upgrading and expanding existing facilities at the Pantex Plant in Texas and SRS in South Carolina, continuing storage of surplus plutonium currently onsite at Hanford, LANL, and INEL pending disposition, and continuing storage of weapons-usable HEU at DOE's Y-12 Plant in Tennessee, in upgraded and, as surplus HEU is down-blended under the ROD for Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement, consolidated facilities. DOE will provide for disposition of surplus plutonium by pursuing a strategy that allows: (1) Immobilization of surplus plutonium for disposal in a repository pursuant to the Nuclear Waste Policy Act, and (2) fabrication of surplus plutonium into MOX fuel, for use in existing domestic commercial reactors (and potentially CANDU reactors, depending on future agreements with Russia and Canada). The timing and extent to which each of these disposition technologies is deployed will depend upon the results of future technology development and demonstrations, site-specific environmental review, detailed cost proposals, and the results of negotiations with Russia, Canada, and other nations. This programmatic decision is effective upon being made public, in accordance with DOE's regulations implementing NEPA (10 CFR 1021.315). The goals of this program are to support U.S. nuclear weapons nonproliferation policy by reducing global stockpiles of excess fissile materials so that they may never be used in weapons again. This program will demonstrate the United States' commitment to its nonproliferation goals, as specified in the President's Nonproliferation and Export Control Policy of 1993, and provide an example for other nations, where stockpiles of surplus weapons-usable fissile materials may be less secure from potential theft or diversion than those in the United

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action will be considered in the follow-on disposition EIS.

[29] DOE supports external regulation of its facilities, and in the Report of Department of Energy Working Group on External Regulation (DOE/UF-0001, December 1996), DOE proposed to seek legislation that would generally require NRC licenses for new DOE facilities. Therefore, DOE anticipates seeking an NRC license for the MOX fuel fabrication facility, which would be limited to a license to fabricate MOX fuel from plutonium declared surplus to defense needs. DOE may also seek legislation that would by statute limit the MOX fuel fabrication facility to disposition of surplus plutonium.

[30] An evaluation by the National Research Council in a recent report (see footnote 12, above) concluded that the electrometallurgical treatment process is not sufficiently mature to provide a reliable basis for timely plutonium disposition.

States, to encourage them to take similar actions.

The decision process reflected in this Notice complies with the requirements of the National Environmental Policy Act (42 U.S.C. §4321 et seq.) and its implementing regulations at 40 CFR Parts 1500–1508 and 10 CFR Part 1021.

Issued in Washington, D.C., January 14, 1997.

Hazel R. O'Leary,

Secretary.

[FR Doc. 97–1355 Filed 1–17–97; 8:45 am]

BILLING CODE 6450–01–P

Energy Information Administration

Agency Information Collection Activities: Proposed Collection; Comment Request

SUMMARY: The Energy Information Administration (EIA) is soliciting comments concerning the proposed three-year extension of existing form DOE–887, "Department of Energy Customer Surveys."

DATES: Written comments must be submitted on or before March 24, 1997. If you anticipate that you will be submitting comments, but find it difficult to do so within the period of time allowed by this notice, you should advise the contact listed below of your intention to do so as soon as possible.

ADDRESSES: Send comments to Herbert T. Miller, Office of Statistical Standards, EI–73, Forrestal Building, U.S. Department of Energy, Washington, D.C. 20585, (Phone 202–426–1103, FAX 202-426–1081, or e-mail hmiller@eia.doe.gov).

FOR FURTHER INFORMATION: Requests for additional information should be directed to Herbert Miller at the address listed above.

SUPPLEMENTARY INFORMATION:

I. Background
II. Current Actions
III. Request for Comments

I. Background

In order to fulfill its responsibilities under the Federal Energy Administration Act of 1974 (Pub. L. No. 93–275) and the Department of Energy Organization Act (Pub. L. No. 95–91), the Energy Information Administration is obliged to carry out a central, comprehensive, and unified energy data and information program. As part of this program, EIA collects, evaluates, assembles, analyzes, and disseminates data and information related to energy resource reserves, production, demand, and technology, and related economic and statistical information relevant to the adequacy of energy resources to meet demands in the near and longer term future for the Nation's economic and social needs.

The Energy Information Administration, as part of its continuing effort to reduce paperwork and respondent burden (required by the Paperwork Reduction Act of 1995 (Pub. L. 104–13)), conducts a presurvey consultation program to provide the general public and other Federal agencies with an opportunity to comment on proposed and/or continuing reporting forms. This program helps to ensure that requested data can be provided in the desired format, reporting burden is minimized, reporting forms are clearly understood, and the impact of collection requirements on respondents can be properly assessed. Also, EIA will later seek approval by the Office of Management and Budget (OMB) for the collections under Section 3507(h) of the Paperwork Reduction Act of 1995 (Pub. L. No. 104–13, Title 44, U.S.C. Chapter 35).

On September 11, 1993, the President signed Executive Order No. 12862 aimed at "* * * ensuring the Federal government provides the highest quality service possible to the American people." The Order discusses surveys as a means for determining the kinds and qualities of service desired by Federal Government customers and for determining satisfaction levels for existing services. These voluntary customer surveys will be used to ascertain customer satisfaction with the Department of Energy in terms of services and products. Respondents will be individuals and organizations that are the recipients of the Department's services and products. Previous customer surveys have provided useful information to the Department for assessing how well the Department is delivering its services and products and for making improvements. The results are used internally and summaries are provided to the Office of Management and Budget on an annual basis, and are used to satisfy the requirements and the spirit of Executive Order No. 12862.

II. Current Actions

The request to OMB will be for a three-year extension of the expiration date of approval for DOE to conduct customer surveys. During the past clearance cycle, over 20 customer surveys have been conducted by telephone and mail. (Examples of previously conducted customer surveys are available upon request.) Our planned activities in the next 3 fiscal years reflect our increased emphasis on and expansion of these activities, including an increased use of electronic means for obtaining customer input (CD–ROM and World Wide Web).

III. Request for Comments

Prospective respondents and other interested parties should comment on the actions discussed in item II. The following guidelines are provided to assist in the preparation of responses.

General Issues

A. Is the proposed collection of information necessary, taking into account its accuracy, adequacy, and reliability, and the agency's ability to process the information it collects in a useful and timely fashion?

B. What enhancements can EIA make to the quality, utility, and clarity of the information to be collected?

As a Potential Respondent

A. Average public reporting burden for a customer survey is estimated to be .25 hours per response (8,333 respondents per year x 15 minutes per response = 2,083 hours annually). Burden includes the total time, effort, or financial resources expended to generate, maintain, retain, or disclose or provide the information including: (1) reviewing instructions; (2) developing, acquiring, installing, and utilizing technology and systems for the purposes of collecting, validating, verifying, processing, maintaining, disclosing and providing information; (3) adjusting the existing ways to comply with any previously applicable instructions and requirements; (4) training personnel to respond to a collection of information; (5) searching data sources; (6) completing and reviewing the collection of information; and (7) transmitting, or otherwise disclosing the information.

Please comment on (1) the accuracy of our estimate and (2) how the agency could minimize the burden of the collection of information, including the use of automated collection techniques or other forms of information technology.

B. EIA estimates that respondents will incur no additional costs for reporting other than the hours required to complete the collection. What is the estimated (1) total dollar amount annualized for capital and start-up costs and (2) recurring annual dollar amount of operation and maintenance and purchase of services costs associated with this data collection? The estimates should take into account the costs associated with generating, maintaining, and disclosing or providing the information.

A.2 NOTICE OF INTENT - SURPLUS PLUTONIUM DISPOSITION ENVIRONMENTAL IMPACT STATEMENT

collection on the respondents, including through the use of information technology.

Dated: May 16, 1997.

Gloria Parker,

Director, Information Resources Management Group.

Office of Management

Type of Review: New.

Title: Department of Education Federal Cash Award Certification Statement and Department of Education Federal Cash Quarterly Confirmation Statement.

Frequency: Annually.

Affected Public: Business or other for-profit; Not for Profit institutions; Federal Government; State, Local or Tribal Government, SEAs or LEAs.

Annual Reporting and Recordkeeping Hour Burden:

Responses: 12,000.

Burden Hours: 38,160.

Abstract: The collection of the Federal Cash Award Statement is necessary for the Agency to monitor cash advanced to grantees and to obtain expenditure information for each grant from grantees. Information collection is used to report total outlays to the Office of Management and Budget and the Department of the Treasury and is used to project the Federal government's and the Department's financial condition. This information collection also enables the Department to provide Treasury with outlay information to facilitate Treasury's estimation of future borrowing requirements. Respondents include over 12,000 State, local, college, university, proprietary school and non-profit grantees who draw funds from the Department.

The collection of Federal cash quarterly confirmation statement enables grantees to identify discrepancies in grant authorizations, and funds drawn and funds refunded. Action is required only if a grantee's records do not agree with the information contained on the statement. This information will be used to help grantees report and initiate resolution of discrepancies. Respondents include over 12,000 State, local, college, university, proprietary school and non-profit grantees who draw funds from the Department.

Office of Special Education and Rehabilitative Services

Type of Review: New.

Title: Grantee Reporting Form.

Frequency: Annually.

Affected Public: Business or other for-profit; Not-for-profit institutions; State, local or Tribal Gov't, SEAs or LEAs.

Annual Reporting and Recordkeeping Hour Burden:

Responses: 165.

Burden Hours: 330.

Abstract: Rehabilitation Services Administration (RSA) training grants provide stipends to "RSA Scholars" in order to train skilled rehabilitation personnel. Grantees are required to "track" scholars, relative to the "payback" provision in the Rehabilitation Act. Data collection is reported annually to RSA in order to monitor performance and report progress to Congress.

[FR Doc. 97-13413 Filed 5-21-97; 8:45 am]

BILLING CODE 4000-01-M

DEPARTMENT OF ENERGY

Surplus Plutonium Disposition Environmental Impact Statement

AGENCY: Department of Energy

ACTION: Notice of intent

SUMMARY: The Department of Energy (DOE) announces its intent to prepare an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA) on the disposition of United States' weapons-usable surplus plutonium. This EIS is tiered from the Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement (Storage and Disposition PEIS) (DOE/EIS-0229), issued in December 1996, and the associated Record of Decision (62 FR 3014), issued on January 14, 1997.

The EIS will examine reasonable alternatives and potential environmental impacts for the proposed siting, construction, and operation of three types of facilities for plutonium disposition. The first is a facility to disassemble and convert pits (a nuclear weapons component) into plutonium oxide suitable for disposition. As explained in the January 1997 Record of Decision, this pit disassembly and conversion facility will be located at either DOE's Hanford Site, Idaho National Engineering and Environmental Laboratory (INEEL), Pantex Plant, or Savannah River Site (SRS). The second is a facility to immobilize surplus plutonium in a glass or ceramic form for disposition in a geologic repository pursuant to the Nuclear Waste Policy Act. This second facility will be located at either Hanford or SRS, and include a collocated capability to convert non-pit plutonium materials into a form suitable for immobilization. The EIS will discuss various technologies for immobilization. The third type of facility would fabricate plutonium oxide into mixed oxide (MOX) fuel. The MOX fuel fabrication facility would be located at either Hanford, INEEL, Pantex or SRS. MOX fuel would be used in existing commercial light water reactors in the United States, with subsequent disposal of the spent fuel in accordance with the Nuclear Waste Policy Act. Some MOX fuel could also be used in Canadian deuterium uranium (CANDU) reactors depending upon negotiation of a future international agreement between Canada, Russia, and the United States. The EIS will also discuss decommissioning and decontamination (D&D) of the three facilities.

This Notice of Intent describes the Department's proposed action, solicits public input, and announces the schedule for the public scoping meetings.

DATES: Comments on the proposed scope of the Surplus Plutonium Disposition EIS (SPD EIS) are invited from the public. To ensure consideration in the draft EIS, written comments should be postmarked by July 18, 1997. Comments received after that date will be considered to the extent practicable. DOE will hold interactive scoping meetings near sites that may be affected by the proposed action to discuss issues and receive oral and written comments on the scope of the EIS. The locations, dates and times for these public meetings are included in the Supplementary Information section of this notice and will be announced by additional appropriate means.

ADDRESSES: Comments and questions concerning the plutonium disposition program can be submitted by calling (answering machine) or faxing them to the toll free number 1-800-820-5156, or by mailing them to: Bert Stevenson, NEPA Compliance Officer, Office of Fissile Materials Disposition, U.S. Department of Energy, Post Office Box 23786, Washington, DC 20026-3786.

Comments may also be submitted electronically by using the Office of Fissile Materials Disposition's web site. The address is http://web.fie.com/fedix/fisl.html.

FOR FURTHER INFORMATION CONTACT: For general information on the DOE NEPA process, please contact: Carol Borgstrom, Director, Office of NEPA Policy and Assistance, U.S. Department of Energy 1000, Independence Avenue, S.W., Washington, DC 20585, 202-586-4600 or 1-800-472-2756.

SUPPLEMENTARY INFORMATION:

Background

The Storage and Disposition Programmatic Environmental Impact Statement (PEIS) analyzed the potential environmental consequences of alternatives for the long-term storage (up to 50 years) of weapons-usable fissile materials and the disposition of surplus plutonium. Surplus plutonium for disposition refers to that weapons-usable plutonium that the President has declared surplus to national security needs, as well as such plutonium that may be declared surplus in the future. As stated in the Record of Decision for the Storage and Disposition PEIS, the Department decided to pursue a hybrid approach that allows immobilization of surplus plutonium in glass or ceramic form and burning of some of the surplus plutonium as MOX fuel in existing, commercial light water reactors in the United States (and potentially in Canadian Deuterium Uranium (CANDU) reactors in Canada depending on future international agreement). The Department decided that the extent to which either or both of these disposition approaches would ultimately be deployed would depend in part upon future NEPA review, although the Department committed to immobilize at least 8 metric tons (tonnes) of currently declared surplus plutonium and reserved the option of immobilizing all surplus weapons plutonium. In the Record of Decision for the Storage and Disposition PEIS, the Department further decided to: (1) locate the immobilization facility (collocated with a plutonium conversion facility) at either Hanford or SRS; (2) locate a potential MOX fuel fabrication facility at either Hanford, INEEL, Pantex, or SRS; (3) locate a pit disassembly and conversion facility at either Hanford, INEEL, Pantex, or SRS; and (4) determine the specific technology for immobilization based in part on this follow-on disposition EIS.

The processes, materials and technologies involved in surplus plutonium disposition are depicted in Figure 1.

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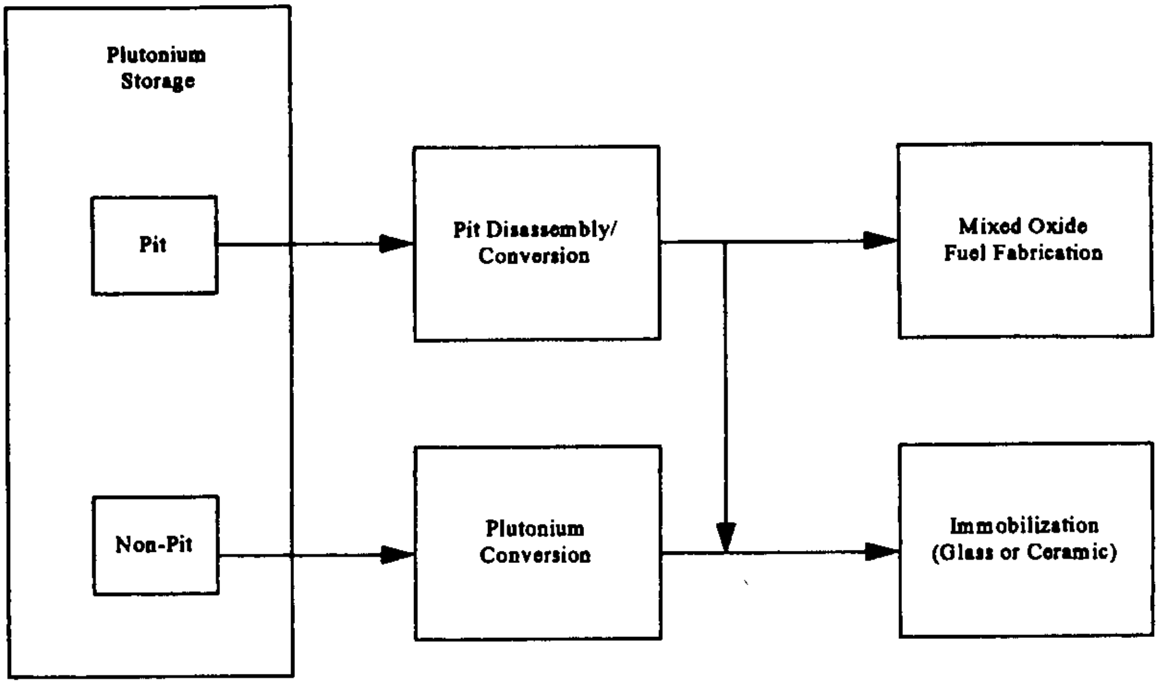

Figure 1. Plutonium Disposition Processes in DOE's Proposed Action

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Proposed Action

The Department proposes to determine whether to continue with both the immobilization and MOX approaches for surplus plutonium disposition and if so, to site, construct, and operate and ultimately D&D three types of facilities for plutonium disposition at one or more of four DOE sites, as follows:

- A collocated non-pit plutonium conversion and immobilization facility at either Hanford, near Richland, Washington, or SRS, near Aiken, South Carolina, with sub-alternatives for the technology and facilities used to form the immobilized plutonium.
- A pit disassembly/conversion facility at either Hanford; SRS; INEEL, near Idaho Falls, Idaho; or the Pantex Plant, near Amarillo, Texas.
- A MOX fuel fabrication facility at either Hanford, INEEL, Pantex, or SRS, with sub-alternatives for fabrication of Lead Test Assemblies for use in fuel qualification demonstrations.

Construction of these facilities would be on previously disturbed land and could include the modification of existing facilities where practicable, to reduce local environmental impacts, reduce costs, and shorten schedules. In the pit disassembly and conversion facility, the Department proposes to disassemble surplus pits and convert the plutonium in them to an unclassified oxide form suitable for disposition. The Department also proposes to convert most non-pit plutonium materials to plutonium oxide at the plutonium conversion facility, which will be collocated with the immobilization facility.

Plutonium Disposition Decisions

The Department expects to make the following decisions based upon the results of this EIS and other information and considerations:

- Whether to construct and operate collocated plutonium conversion and immobilization facilities, and if so, where (including selection of the specific immobilization technology).
- Whether to construct and operate a pit disassembly/conversion facility, and if so, where.
- Whether to construct and operate a MOX fuel fabrication facility, and if so, where (including selection of the site for fabrication of Lead Test Assemblies).

The exact extent to which the MOX approach would ultimately be deployed will depend on a number of factors, in addition to environmental impacts. These are likely to include cost, contract negotiations, and international agreements.

Alternatives

No Action

A No Action alternative will be analyzed (Alternative 1) in the SPD EIS. Implementation of the No Action alternative would mean that disposition would not occur, and surplus weapons-usable plutonium, including pits, metals and oxides, would remain in storage in accordance with the Storage and Disposition PEIS Record of Decision.

Plutonium Disposition Alternatives

The SPD EIS will analyze alternatives for the siting, construction and operation of the three facilities at various candidate sites as described in the Proposed Action. These facilities would be designed so that they could collectively disposition surplus plutonium (existing and future) over their operating lives. Although the exact quantity of plutonium that may be declared surplus over time is not known, for purposes of analysis a nominal 50 tonnes of surplus plutonium will be used for assessing the environmental impacts of plutonium disposition activities at the various candidate sites. Under alternatives involving the "hybrid" (immobilization and MOX) approach selected in the Storage and Disposition Record of Decision, the SPD EIS will analyze the same distribution of surplus plutonium that was analyzed in the Storage and Disposition PEIS, which is fabrication of pits and pure plutonium metal or oxide (approximately 33 tonnes) into MOX fuel, and immobilization of the remaining non-pit plutonium (approximately 17 tonnes). The Record of Decision on the Storage and Disposition PEIS states, "DOE will immobilize at least eight tonnes of currently declared surplus plutonium materials that DOE has already determined are not suitable for use in MOX fuel." Since the issuance of that decision, the Department has further determined that a total of about 17 tonnes of surplus plutonium is not suitable for use in MOX fuel without extensive processing. Thus, an alternative for fabricating all surplus plutonium into MOX fuel will not be analyzed. However, converting the full 50 tonnes of surplus plutonium into an immobilized form will be analyzed as a reasonable alternative.

Under each disposition approach, DOE could in principle locate one, two, or all three facilities at a candidate site. However, locating one facility at each of three sites would mean conducting disposition activities at three widely separated locations around the country. This would substantially increase transportation cost, unnecessarily increase exposure of workers and the public, and increase transportation risks, without any apparent compensating benefit. Therefore, the Department is proposing to consider only alternatives that locate two or more facilities at one site, with the possibility of one facility at a separate site. Further, certain combinations of facilities and sites are not being considered as reasonable alternatives, because they would also substantially increase transportation cost, unnecessarily increase exposure to workers and the public, and increase transportation risks, without any apparent compensating benefit.

Based on the above considerations and the candidate site selections in the Storage and Disposition Record of Decision, the following alternatives have been developed in addition to the No Action alternative. Table 1 summarizes the alternatives by site. Alternatives 2 through 10 (see Table 1) would involve immobilization of approximately 17 tonnes of low purity (non-pit) plutonium, and fabrication of approximately 33 tonnes of high purity plutonium (pits and plutonium metal) into MOX fuel. The differences among alternatives 2 through 10 are the locations of the proposed facilities. Alternatives 11 and 12 would involve immobilization of all 50 tonnes of plutonium at either Hanford or SRS.

The Department has identified existing facilities that can be modified for use in plutonium disposition at various candidate sites. A summary of the existing and new facilities (shown in the parentheses in Table 1) to be used in the SPD EIS analyses is given in Table 1, where FMEF is the Fuel and Materials Examination Facility, FPF is the Fuel Processing Facility, and DWPF is the Defense Waste Processing Facility.

Lead Test Assemblies

With respect to the MOX alternatives, the Department would qualify MOX fuel forms for use in existing commercial reactors. DOE will analyze two sub-alternatives for the fabrication of the lead test assemblies needed to qualify the fuel. In one sub-alternative, the lead test assemblies would be fabricated in the United States. Fabrication in the United States would involve constructing a pilot capability in conjunction with the fuel fabrication facility. Therefore, the potential sites include the candidate sites for the fuel fabrication facility (i.e., Hanford, INEEL, Pantex, and SRS). The pilot capability could also be located in an existing small facility at the Los Alamos National Laboratory (LANL). The second alternative would be for fabrication in existing European facilities; three potential fabrication sites exist (Belgium, France, and the United Kingdom) that would allow fabrication of the Lead Test Assemblies sooner than with any facility under the United States alternative.

TABLE 1.—DISPOSITION ALTERNATIVES

Alt. No.	Alternative/Site/Disposition Facility			
	Pit disassembly	MOX plant	Plutonium conversion and immobilization	Amounts of plutonium
1	No Action			
2	Hanford (FMEF)	Hanford (FMEF)	Hanford (FMEF)	17t Immobilization / 33t MOX.
3	SRS (New)	SRS (New)	SRS (New, or Bldg 221F, and DWPF)	17t Immobilization / 33t MOX.
4	Pantex (New)	Hanford (FMEF)	Hanford (FMEF)	17t Immobilization / 33t MOX.
5	Pantex (New)	SRS (New)	SRS (New, or Bldg 221F, and DWPF)	17t Immobilization / 33t MOX.
6	Hanford (FMEF)	Hanford (FMEF)	SRS (New, or Bldg 221F, and DWPF)	17t Immobilization / 33t MOX.
7	INEEL (FPF)	INEEL (New)	SRS (New, or Bldg 221F, and DWPF)	17t Immobilization / 33t MOX.
8	INEEL (FPF)	INEEL (New)	Hanford (FMEF)	17t Immobilization / 33t MOX.
9	Pantex (New)	Pantex (New)	SRS (New, or Bldg 221F, and DWPF)	17t Immobilization / 33t MOX.
10	Pantex (New)	Pantex (New)	Hanford (FMEF)	17t Immobilization / 33t MOX.
11	Hanford (FMEF)	N/A	Hanford (FMEF)	50t Immobilization / 0t MOX.
12	SRS (New)	N/A	SRS (New, or Bldg 221F, and DWPF)	50t Immobilization / 0t MOX.

Immobilization Technology

The Record of Decision on the Storage and Disposition PEIS stated, "Because there are a number of technology variations that could be used for immobilization, DOE will also determine the specific immobilization technology based upon the follow-on EIS * * *" (i.e., the SPD EIS). The technologies to be considered are those identified as variants in the Storage and Disposition PEIS.

Preferred Alternative

For immobilization, the Department prefers to use the "can-in-canister" technology at the DWPF at SRS. Under the can-in-canister approach, cans containing plutonium in glass or ceramic form would be placed in DWPF canisters, which would be filled with borosilicate glass containing high-level waste.

Classified Information

The Department plans to prepare the SPD EIS as an unclassified document with a classified appendix. The classified information in the SPD EIS will not be available for public review. However, the classified information will be considered by DOE in reaching a decision on the disposition of surplus plutonium. DOE will provide as much information as possible in unclassified form to assist public understanding and comment.

Research and Development Activities

The Department recently announced its intent to prepare two environmental assessments (EAs) for proposed research and development activities that DOE would conduct prior to completion of the SPD EIS and ROD. One EA will analyze the potential environmental impacts of a proposed pit disassembly and conversion integrated systems test at LANL. In addition, to further the purposes of NEPA, this EA will describe other research and development activities currently on-going at various sites, including work related to immobilization and to MOX fuel fabrication. The other EA will be prepared for the proposed shipment of special MOX fuel to Canada for an experiment involving the use of United States and Russian fuel in a Canadian test reactor, for development of fuel for the CANDU reactors. This EA will analyze the prior and future fabrication and proposed shipment of the fuel pellets needed for the experiment.

Relationships With Other DOE NEPA Activities

In addition to the SPD EIS and the EAs discussed above, the Department is currently conducting NEPA reviews of other activities that have a potential relationship with the SPD EIS. They include:

1. *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage and Disposal of Radioactive and Hazardous Waste* (DOE/EIS-0200D) (Draft issued: September 22, 1995; 60 FR 49264).

2. *Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site EIS* (Notice of Intent to Prepare an Environmental Impact Statement: November 19, 1996; 61 FR 58866).

Invitation To Comment

DOE invites comments on the scope of this EIS from all interested parties, including potentially affected Federal, State, and local agencies, and Indian tribes. Comments can be provided by any of the means listed in the Address Section of this notice and by providing oral and written comments at the scoping meetings.

The Department is requesting, by separate correspondence, that Federal agencies[1] desiring to be designated as cooperating agencies on the SPD EIS inform DOE by July 18, 1997.

Scoping Meetings

Public scoping meetings will be held near each site that may be affected by the proposed action. The interactive scoping meetings will provide the public with the opportunity to present comments, ask questions, and discuss concerns regarding plutonium disposition activities with DOE officials, and for the Department to receive oral and written comments on the scope of the EIS. Written and oral comments will be given equal weight in the scoping process. Input from the scoping meetings along with comments received by other means (phone, mail, fax, website) will be used by the Department in refining the scope of the EIS. The locations and dates for these public meetings are as shown below. All meetings will consist of two sessions (1:00 pm to 4:00 pm and 6:00 pm to 9:00 pm).

Hanford Site:

July 1, 1997
Shilo Inn
50 Comstock
Richland, WA 99352
509-946-4661

[1] Arms Control and Disarmament Agency; Department of Defense; Department of State; Environmental Protection Agency; and Nuclear Regulatory Commission.

Idaho National Engineering and Environmental Laboratory

June 10, 1997
Shilo Inn
780 Lindsay Boulevard
Idaho Fall, ID 83402
208-523-0088

Pantex Plant

June 12, 1997
Radisson Inn Airport
7909 I-40 East at Lakeside
Amarillo, TX 79104
806-373-3303

Savannah River Site

June 19, 1997
North Augusta Community Center
495 Brookside Avenue
North Augusta, SC 29841
803-441-4290

Advanced registration for the public meetings is requested but not required. Please call 1-800-820-5134 and leave your name and the location of the meeting(s) you plan to attend. This information will be used to determine the size and number of rooms needed for the meeting.

Scoping Meeting Format:

The Department intends to hold a plenary session at the beginning of each scoping meeting in which DOE officials will more fully explain the framework for the plutonium disposition program, the proposed action, preliminary alternatives for accomplishing the proposed action and public participation in the NEPA process. Following the plenary session, the Department intends to discuss relevant issues in more detail, answer questions, and receive comments. Each scoping meeting for the Surplus Plutonium Disposition EIS will have two sessions, with each session lasting approximately three to four hours.

Issued in Washington, DC this 16 day of May, 1997, for the United States Department of Energy.

Peter N. Brush,

Principal Deputy Assistant Secretary, Environment, Safety and Health.

[FR Doc. 97-13494 Filed 5-21-97; 8:45 am]

BILLING CODE 6450-01-P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket No. RP97-165-003]

Alabama-Tennessee Natural Gas Company; Notice of Compliance Filing

May 16, 1997.

Take notice that on May 12, 1997, Alabama-Tennessee Natural Gas Company (Alabama-Tennessee) tendered for filing the tariff sheets listed in Appendix A to the filing, to be effective June 1, 1997.

Alabama-Tennessee states that the tariff sheets are submitted in compliance with Order No. 587 and the Commission's order issued on May 1, 1997 FERC ¶ 61,117).

Any person desiring to protest said filing should file a protest with the Federal Energy Regulatory Commission, 888 First Street, NE., Washington, DC 20426, in accordance with Section 385.211 of the Commission's Regulations. All such protests must be filed as provided in Section 154.210 of the Commission's Regulations. Protests will be considered by the Commission in determining appropriate action to be taken, but will not serve to make protestants parties to the proceedings. Copies of this filing are on file with the Commission and are available for public inspection.

Lois D. Cashell,

Secretary.

[FR Doc. 97-13441 Filed 5-21-97; 8:45 am]

BILLING CODE 6717-01-M

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket No. ES97-32-000]

Citizens Utilities Company; Notice of Application

May 16, 1997.

Take notice that on May 9, 1997, Citizens Utilities Company (Applicant) filed an application with the Federal Energy Regulatory Commission under § 204 of the Federal Power Act requesting orders (a) extending the effectiveness of the order in Docket No. ES95-34-000 until the close of business on June 30, 1997, and (b) authorizing the issuance, from time to time, of up to 50,000,000 shares of common stock as stock dividends on shares of its outstanding common stock during a two-year period ending July 1, 1999.

Any person desiring to be heard or to protest said application should file a motion to intervene or protest with the Federal Energy Regulatory Commission, 888 1st Street, NE, Washington, D.C. 20426 in accordance with Rules 211 and 214 of the Commission's Rules of Practice and Procedure (18 CFR 385.211 and 385.214). All such motions or protests should be filed on or before May 20, 1997. Protests will be considered by the Commission in determining the appropriate action to be taken, but will not serve to make the protestants parties to the proceeding. Any person wishing to become a party must file a motion to intervene. Copies of this filing are on file with the Commission and are available for public inspection.

Lois D. Cashell,

Secretary.

[FR Doc. 97-13437 Filed 5-21-97; 8:45 am]

BILLING CODE 6717-01-M

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket No. CP96-712-000]

Discovery Gas Transmission LLC; Notice of Site Visit

May 16, 1997.

On May 22, 1997, beginning at 9:30 a.m., the Office of Pipeline Regulation (OPR) staff will conduct a compliance inspection of the onshore facilities of the Discovery Gas Transmission LLC Pipeline Construction Project in Lafourche Parish, Louisiana, beginning at the Larose Gas Processing Plant site (off state highway 24) in Larose.

All parties may attend. Those planning to attend must provide their own transportation (an air boat is required for most of the pipeline route).

For further information, please contact Paul McKee at (202) 208-1088.

Warren C. Edmunds,

Acting Director, Office of Pipeline Regulation.

[FR Doc. 97-13434 Filed 5-21-97; 8:45 am]

BILLING CODE 6717-01-M

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket No. ER97-2846-000]

Florida Power Corporation; Notice of Filing

May 16, 1997.

Take notice that on May 5, 1997, Florida Power Corporation (Florida Power) filed an Application for an Order Approving Market-Based Rates for Sales Outside of Florida. In its Application, Florida Power requests authorization to engage in wholesale, bulk power sales outside of Florida at market-determined prices, including sales not involving Florida Power's generation or transmission. Florida Power requests an effective date of 60 days after this filing, or the date on which the Commission issues an order approving Florida Power's application for market-based rates, whichever is earlier.

Next Section

Appendix B
CONTRACTOR NONDISCLOSURE STATEMENT

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF EIS FOR DOE SURPLUS PLUTONIUM DISPOSITION

The Council on Environmental Quality (CEQ) Regulations at 40 CFR 1506.5(c), which have been adopted by the the U.S. Department of Energy (DOE) (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)." 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offerer and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure of your proposal).

(a) X Offerer and any proposed subcontractors have no financial or other interest in the outcome of the project.

(b) ___ Offerer and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests

1.
2.
3.

Certified by:

[signature]
Signature

Casey Koontz
Name

Contract Representative
Title

August 14, 1997
Date

Appendix C
Adjunct Melter Vitrification Process

C.1 ADJUNCT MELTER AS AN IMMOBILIZATION TECHNOLOGY VARIANT

The adjunct melter vitrification process was identified in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition Final PEIS)* (DOE 1996) as a possible technology variant for immobilizing surplus plutonium. It is a homogenous immobilization approach similar to the new, stand-alone vitrification facility evaluated in the *Storage and Disposition Final PEIS,* except that the approach would use some existing facilities and infrastructure at the Savannah River Site (SRS).

In the adjunct melter approach, plutonium would be immobilized, using modified facilities in Building 221–F, into a borosilicate glass frit that would be temporarily stored in individual cans. This frit would be mixed in the new adjunct melter facility with high-level waste (HLW) supplied from the Defense Waste Processing Facility (DWPF). The blended feed would be melted and poured into DWPF canisters to produce a radiation field in the final product that would meet the Spent Fuel Standard (UC 1996).

C.2 EVALUATION OF IMMOBILIZATION TECHNOLOGY VARIANTS

The U.S. Department of Energy (DOE) examined six immobilization technology variants to determine the more promising variants for further development. The six variants were divided into two categories—the external radiation barrier approach and internal radiation barrier approach—as follows:

I. External barrier (Can-in-canister variants)	1. Ceramic immobilization in existing facilities 2. Glass immobilization in existing facilities
II. Internal barrier (Homogenous variants)	3. Vitrification in new, stand-alone facilities 4. Vitrification with an adjunct melter in existing (DWPF at SRS) and new facilities 5. Ceramic immobilization in new, stand-alone facilities 6. Electrometallurgical treatment in existing and new facilities

Nine evaluation criteria, similar to those used in the screening of alternatives for analysis in the *Storage and Disposition PEIS,* were used to qualitatively evaluate the six immobilization technology variants:

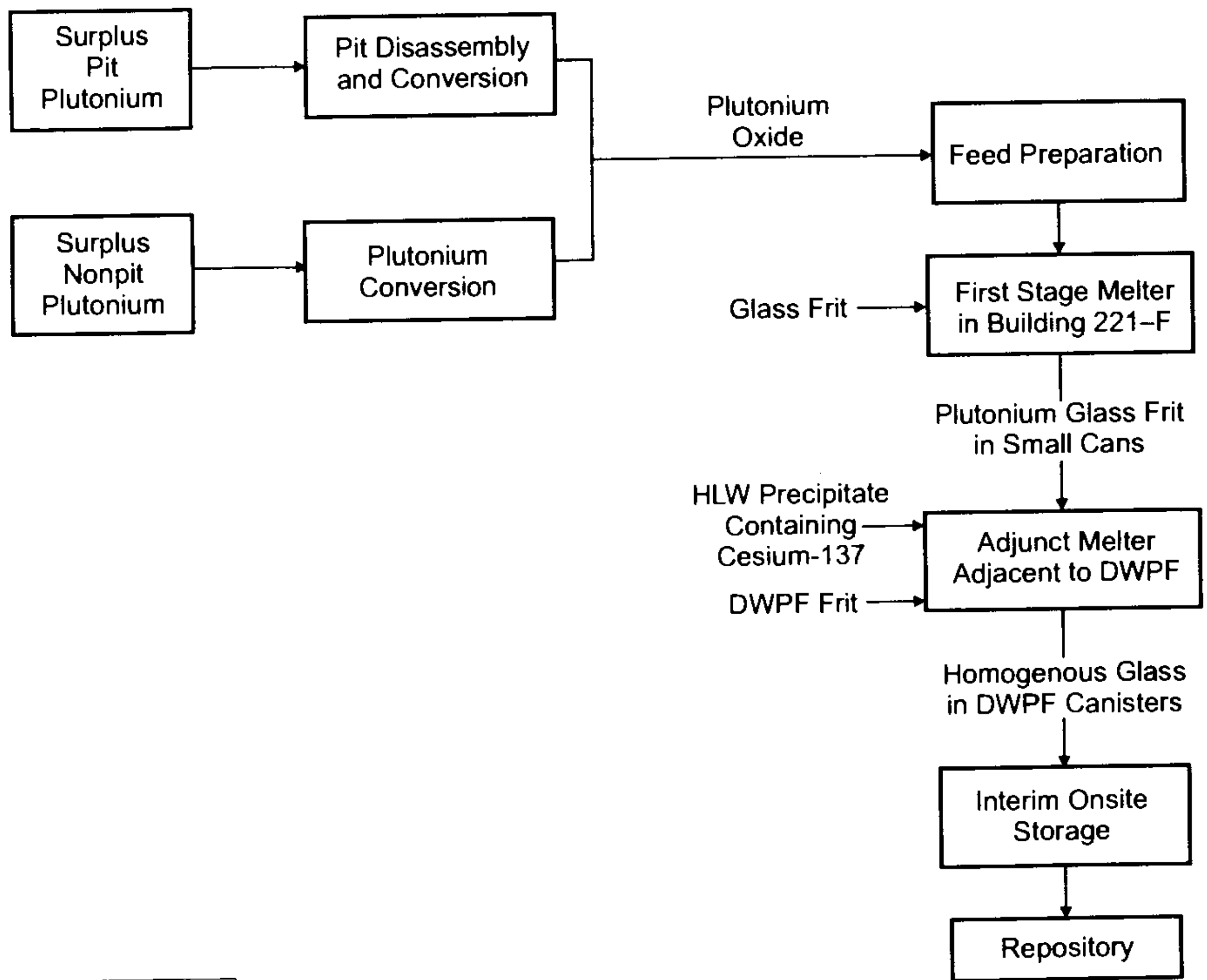
1. Resistance to theft and diversion by unauthorized parties
2. Resistance to retrieval, extraction, and reuse by host nation
3. Technical viability
4. Environmental, safety, and health compliance
5. Cost effectiveness
6. Timeliness
7. Fostering progress and cooperation with Russia and other countries
8. Public and institutional acceptance
9. Additional benefits

The evaluation concluded that the external barrier variants would be superior to the internal barrier variants in terms of timeliness, higher technical viability, much lower costs, and, to a lesser extent, slightly lower environmental and health risks (UC 1997). As a result of this evaluation, the can-in-canister variants (1 and 2) were considered reasonable alternatives for analysis in the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) and are compared with the homogenous vitrification and ceramic immobilization facilities (3 and 5) evaluated in the *Storage and Disposition PEIS*. DOE decided, in the Record of Decision for the *Storage and Disposition PEIS*, not to pursue the electrometallurgical treatment option (6) because its technology is less mature than vitrification or ceramic immobilization. Although use of the adjunct melter (4) may be viable from a technical standpoint, it would cost twice as much as the can-in-canister approach and would take 1 to 5 years longer to implement. Based on the relative sizes of the facilities, their use of existing facilities and infrastructure, and the processing steps associated with their operation, specific environmental impacts associated with the adjunct melter approach would be expected to result in environmental impacts ranging between those of the new facility (homogenous) variants and the two can-in-canister variants. The adjunct melter's lack of an environmental advantage combined with its timeliness, cost, and technical shortcomings make it less reasonable than the can-in-canister approach. Thus, it is not included as a reasonable alternative for detailed environmental analysis in the SPD EIS. For completeness, a description of the vitrification process using the adjunct melter with DWPF at SRS is provided below.

C.3 ADJUNCT MELTER VITRIFICATION PROCESS

A simplified flow diagram using a new adjunct melter at SRS is shown in Figure C–1. The disposition process would begin with the conversion of feed materials to plutonium oxide at Building 221–F. This oxide would be blended by a dry feed preparation process to prepare a consistent feedstock and fed into a melter along with glass frit to initiate the first stage of vitrification. The first-stage melter would dissolve the plutonium oxide into the borosilicate glass and convert the mixture to a frit containing about 10 percent plutonium by weight. The assumed nominal feed of plutonium over the life of the adjunct melter vitrification process would be 50 t (55 tons) over a 10-year period.

The plutonium glass frit would then be stored in small steel cans and transported as needed to the new adjunct melter facility adjacent to DWPF. Standard DWPF operations receive two main feedlines from the SRS HLW tank farms to be vitrified—a washed tank sludge and an aqueous HLW precipitate that contains highly radioactive cesium 137. In the adjunct melter process, some of the aqueous HLW precipitate would be diverted from the DWPF, via an interarea pipeline, to the adjunct melter facility. At the adjunct melter facility, the plutonium glass frit would be mixed with DWPF frit and the aqueous HLW precipitate in a melter feed tank, and slurry fed to the melter, producing a homogenous glass melt that would then be poured into DWPF canisters. The surplus plutonium contained in the canisters would be dissolved in the glass and uniformly integrated with fission products. The canisters would then be stored on the site awaiting final disposal at a geologic repository pursuant to the Nuclear Waste Policy Act.



DWPF Defense Waste Processing Facility
HLW High-level waste

Source: UC 1996:1-5

Figure C–1. Adjunct Melter Vitrification Process

C.4 REFERENCES

DOE (U.S. Department of Energy), 1996, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

UC (Regents of the University of California), 1996, *Alternative Technical Summary Report: Vitrification Adjunct Melter to DWPF Variant*, UCRL-ID-122660, L-120217-1, Lawrence Livermore National Laboratory, Livermore, CA, August 26.

UC (Regents of the University of California), 1997, *Immobilization Technology Down-Selection Radiation Barrier Approach*, UCRL-ID-127320, Lawrence Livermore National Laboratory, Livermore, CA, May 23.

Appendix D
Fast Flux Test Facility

D.1 BACKGROUND

During the public scoping period for the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), the U.S. Department of Energy (DOE) received comments on the use of the Fast Flux Test Facility (FFTF) at the Hanford Site (Hanford) for the disposition of surplus plutonium.

FFTF is a 400-MW thermal reactor cooled by liquid sodium. It was built in 1978 to test plant equipment and mixed oxide (MOX) fuel for the U.S. Government's liquid metal reactor development program. After operating successfully from 1982 to 1992, FFTF was transitioned to a safe, standby condition. As part of the process of selecting plutonium disposition technologies for evaluation in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition Final PEIS)*, DOE considered FFTF because it was an existing facility that would not require the large commitment of time and money that a new reactor would require for implementation of the plutonium disposition mission. FFTF, however, was eliminated because it was in a standby status awaiting shutdown and because it could not satisfy the *Storage and Disposition Final PEIS* criterion of completing the disposition mission within 25 years using the historic FFTF plutonium enrichment specifications (DOE 1996).

D.2 RESTART EVALUATION

In December 1995, DOE issued a Record of Decision (ROD) to pursue a dual track for tritium supply based on the two most promising tritium supply alternatives analyzed in the *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (DOE 1995). The dual track alternatives consisted of (1) initiating the purchase of an existing commercial reactor (operating or partially complete) or irradiation services with an option to purchase the reactor for conversion to a defense facility, and (2) designing, building, and testing critical components of an accelerator system for tritium production. DOE's current plans are to select, by the end of 1998, one of these approaches for development as the primary source of tritium supply and to continue to study the other as a potential backup source. The ROD also noted that DOE would evaluate the potential restart and operation of FFTF to determine if it might have a role in meeting future tritium requirements. Accordingly, FFTF has been maintained in standby condition, pending results of the restart evaluation.

FFTF could be used as a dual-purpose reactor, producing tritium and consuming surplus plutonium as fuel. Such use of FFTF, however, would result in a slower plutonium disposition rate than using MOX fuel in commercial reactors.

A number of studies (Drell et al. 1996; PNNL 1997; Putnam, Hayes & Bartlett 1995) have been conducted to date to evaluate the technical feasibility, environmental and safety issues, cost, and schedule associated with the restart and operation of FFTF. The general conclusion was that it is technically feasible for FFTF to be restarted safely to meet commercial or equivalent standards in a relatively short time at a reasonable cost.

Before FFTF could begin to use surplus plutonium from pits or clean metal for the production of tritium, however, 3 to 4 years would be required to develop and test a higher plutonium enriched reactor fuel (the previous FFTF fuel had an enrichment of approximately 35 percent plutonium) and to establish a MOX fuel fabrication capability. Under these conditions, it would take at least 35 years to disposition the surplus weapons-grade plutonium that is suitable for use in reactors. The goal of completing the disposition mission within 25 years of project authorization could only be achieved if additional reactors were to be provided, or if immobilization were used for a portion of the fuel-usable surplus plutonium.

At the time the SPD EIS went to print, DOE had not proposed to use FFTF for tritium production. If DOE proposes to restart FFTF, appropriate National Environmental Policy Act review, including extensive formal public involvement, would be conducted.

If it were determined that MOX fuel (rather than uranium-only fuel) were needed for FFTF operations, the MOX fuel fabrication alternatives may be eliminated, depending on the amount of surplus plutonium that would be required for tritium production. The alternatives immobilizing all 50 t (55 tons) of the surplus plutonium considered in the SPD EIS (Alternatives 11 and 12) would be eliminated for the same reason.

D.3 REFERENCES

DOE (U.S. Department of Energy), 1995, *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling*, DOE/EIS-0161, Washington, DC, October.

DOE (U.S. Department of Energy), 1996, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Washington, DC, December.

Drell, S., et al., 1996, Use of the Fast Flux Test Facility for Tritium Production, JSR-96-325, MITRE Corporation, McLean, VA, October.

PNNL (Pacific Northwest National Laboratory), 1997, FFTF Briefing to the Secretary of Energy, PNNL-11778, FFTF Standby Project Office, Richland, WA, November.

Putnam, Hayes & Bartlett, 1995, *DOE Tritium Production Options: Putnam, Hayes & Bartlett Final Report on Cost Analysis*, September, text revision October 1995, updated version January 1997.

Appendix E
Facility Data

This appendix provides predesign data on the construction and operation requirements for the facilities required to accomplish the surplus plutonium disposition activities. Tables E–1 through E–24 present data on schedule, construction area requirements, operation area requirements, construction employment requirements, major construction resource requirements, operation employment requirements, and operation resource requirements for each of the four candidate sites (Hanford Site [Hanford], Idaho National Engineering and Environmental Laboratory [INEEL], Pantex Plant [Pantex], and Savannah River Site [SRS]). For the candidate lead assembly fabrication facilities at Argonne National Laboratory–West, Hanford, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and SRS, the schedule, operation employment requirements, and operation resource requirements are presented in Tables E–25 through E–28.

The alternatives addressed in the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) provide options for collocation of facilities at Hanford in the Fuels and Materials Examination Facility. Resource requirements for the pit conversion facility are the same whether the facility is collocated with the other facilities or is installed alone. The same applies for the immobilization facility except as indicated in Tables E–9, E–12, and E–15, and for the mixed oxide (MOX) facility except as indicated in Tables E–20 through E–22.

Table E–1. Pit Conversion Facility Schedule

Activity	Calendar Year
Research and development	1995–2001
Integrated-process demonstrations	1998–2001
Facility design	1999–2001
Construction	2001–2003
Permitting and licensing	1999–2004
Startup and operation	2004–2013
Deactiation and stabilization	2015–2017

Note: Schedule dates are approximate based on latest information. Actual timing may cause some activities to start later in the reference year and end sometime past the end year shown here.
Source: UC 1998a, 1998b, 1998c, 1998d.

Table E–2. Pit Conversion Facility Construction Area Requirements

Function	Hanford	INEEL	Pantex	SRS
Laydown area, ha (acres) (including spoils, topsoils, etc.)	2 (4.94)	2 (4.94)	2 (4.94)	2 (4.94)
Warehouse area, ha (acres)	0 (0)	0 (0)	0 (0)	0 (0)
Staging area, ha (acres)	0 (0)	0 (0)	0 (0)	0 (0)
Temporary parking, ha (acres)	0 (0)	0 (0)	0 (0)	0 (0)
New roads, km (mi)	0.13 (0.08)	1.3 (0.81)	3.1 (1.93)	1.8 (1.12)

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.
Source: UC 1998a, 1998b, 1998c, 1998d.

Table E–3. Pit Conversion Facility Operation Area Requirements

Land-Use Area	Hanford	INEEL	Pantex	SRS
New process facilities, ha (acres)	0 (0)	0 (0)	1.1 (2.72)	0.67 (1.66)
New support facilities, ha (acres)	0.06 (0.15)	0.09 (0.23)	1.4 (3.46)	1.1 (2.72)
Security area, ha (acres)	0 (0)	0 (0)	0 (0)	0 (0)
New parking lots, ha (acres)	0.4 (0.99)	0.4 (0.99)	0.4 (0.99)	0.4 (0.99)

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.
Source: UC 1998a, 1998b, 1998c, 1998d.

Table E–4. Pit Conversion Facility Construction Employment Requirements (2001–2003)

Employees	Hanford	INEEL	Pantex	SRS
Craft workers	220	290	853	789
Management and administrative	44	58	171	158
Total employment	264	348	1,024	947

Note: Includes construction staff data provided in the data reports.
Source: UC 1998a, 1998b, 1998c, 1998d.

Table E–5. Pit Conversion Facility Major Construction Resource Requirements (2001–2003)

Resource Requirements	Hanford	INEEL	Pantex	SRS
Electricity (MWh)	5,100	5,100	5,100	5,100
Fuel, l (gal)	260,000 (68,684)	330,000 (87,176)	990,000 (261,528)	930,000 (245,678)
Water, l (gal)	6,000,000 (1,585,020)	12,000,000 (3,170,040)	36,000,000 (9,510,120)	30,000,000 (7,925,100)
Concrete, m^3 (yd^3)	4,200 (5,494)	5,700 (7,456)	18,000 (23,544)	17,000 (22,236)
Steel, t (tons)	140 (154)	190 (209)	1,900 (2,094)	2,300 (2,535)

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.
Source: UC 1998a, 1998b, 1998c, 1998d.

Table E–6. Pit Conversion Facility Annual Employment Operation Requirements

Employees	Hanford	INEEL	Pantex	SRS
Officials and managers	6	6	6	6
Professionals	65	65	65	65
Technicians	179	179	179	179
Office and clerical	14	14	14	14
Craft workers	42	42	42	42
Operatives	22	22	22	22
Laborers	5	5	5	5
Service workers	67	25	67	67
Total employment	400	358	400	400

Source: UC 1998a, 1998b, 1998c, 1998d.

Table E–7. Pit Conversion Facility Annual Operation Resource Requirements

Resource Requirements	Hanford	INEEL	Pantex	SRS
Electricity (MWh)	28,000	15,000	16,000	12,000
Coal, t (tons)	NA	2,100 (2,315)	NA	1,800 (1,984)
Natural gas, m^3 (ft^3)	NA	NA	1,300,000 (45,909,500)	NA
Fuel oil,[a] l (gal)	38,000 (10,038)	38,000 (10,038)	38,000 (10,038)	38,000 (10,038)
Water, l (gal)	62,000,000 (16,378,540)	49,000,000 (12,944,330)	48,000,000 (12,680,160)	48,000,000 (12,680,160)
Hydrogen, m^3 (ft^3)	450 (15,892)	450 (15,892)	450 (15,892)	450 (15,892)
Nitrogen, m^3 (ft^3)	2,200 (77,693)	2,200 (77,693)	2,200 (77,693)	2,200 (77,693)
Oxygen, m^3 (ft^3)	330 (11,654)	330 (11,654)	330 (11,654)	330 (11,654)
Argon, m^3 (ft^3)	14,000 (494,410)	14,000 (494,410)	14,000 (494,410)	13,000 (459,095)
Chlorine, m^3 (ft^3)	62 (2,190)	63 (2,225)	62 (2,190)	60 (2,119)
Helium, m^3 (ft^3)	4,800 (169,512)	4,800 (169,512)	4,800 (169,512)	4,800 (169,512)
Sulfuric acid, kg (lb)	570 (1,257)	100 (220)	470 (1,036)	96 (212)
Phosphoric acid, kg (lb)	240 (529)	240 (529)	240 (529)	240 (529)
Oils and lubricants, kg (lb)	1,600 (3,527)	1,600 (3,527)	1,600 (3,527)	1,600 (3,527)
Cleaning solvents, kg (lb)	140 (309)	140 (309)	140 (309)	140 (309)
Polyphosphate, kg (lb)	67 (148)	0 (0)	70 (154)	0 (0)
Polyelectrolyte, kg (lb)	240 (529)	240 (529)	240 (529)	240 (529)
Liquid nitrogen, kg (lb)	1,100 (2,425)	1,100 (2,425)	1,100 (2,425)	1,100 (2,425)
Aluminum sulfate, kg (lb)	940 (2,072)	970 (2,138)	960 (2,116)	960 (2,116)
Bentonite, kg (lb)	470 (1,036)	490 (1,080)	480 (1,058)	480 (1,058)

[a] Fuel oil includes gasoline, diesel, and lube oil.

Key: NA, not applicable.

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values. Resource requirements less than 50 kg/yr (110 lb/yr) are not listed.

Source: UC 1998a, 1998b, 1998c, 1998d.

Table E–8. Ceramic or Glass Immobilization Facility Schedule

Activity	Calendar Year
Research and development	1995–2002
Integrated-process demonstrations	1997–2003
Design and construction	1999–2004
Permitting and licensing	1999–2004
Startup and operation	2004–2015
Deactivation and stabilization	2016–2019

Note: Schedule dates are approximate based on latest information. Actual timing may cause some activities to start later in the reference year and end sometime past the end year shown here.

Source: UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j.

Table E–9. Ceramic or Glass Immobilization Facility Construction Area Requirements

Function	Hanford Alone	Hanford Collocation	SRS Building 221–F	SRS New
Laydown area, ha (acres) (including spoils, topsoils, etc.)	1.8 (4.45)	1.8 (4.45)	6 (14.83)	9.7 (23.97)
Warehouse area, ha (acres)	0 (0)	0.37 (0.91)	3.3 (8.15)	2.6 (6.42)
Staging area, ha (acres)	0 (0)	0 (0)	0 (0)	0 (0)
Temporary parking, ha (acres)	0 (0)	0 (0)	0 (0)	0 (0)
New roads, km (mi)	0 (0)	0 (0)	0 (0)	0 (0)

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.
Source: UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j.

Table E–10. Ceramic or Glass Immobilization Facility Operation Area Requirements

Land–Use Area	Hanford Alone	Hanford Collocation	SRS Building 221–F	SRS New
New process facilities, ha (acres)	0 (0)	0 (0)	0.05 (0.13)	0.18 (0.45)
New support facilities, ha (acres)	0 (0)	0 (0)	0 (0)	0.19 (0.47)
Security area, ha (acres)	0 (0)	0 (0)	0.81 (2.0)	1 (2.47)
New parking, ha (acres)	0 (0)	0 (0)	1.2 (2.97)	2 (4.94)

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.
Source: UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j.

Table E–11. Ceramic or Glass Immobilization Facility Construction Employment Requirements (2002–2004)

Employees	Hanford	SRS Building 221–F	SRS New
Craft workers	558	810	865
Management and administrative	113	168	177
Total employment	671	978	1,042

Source: UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j.

Table E–12. Ceramic or Glass Immobilization Facility Major Construction Resource Requirements (2002–2004)

	Hanford		SRS	
Resource Requirements	**Alone**	**Collocation**	**Building 221–F**	**New**
Electricity (MWh)	42,000	30,000	33,000	12,000
Fuel, l (gal)	170,000 (44,909)	260,000 (68,684)	230,000 (60,759)	960,000 (253,603)
Coal, t (tons)	NA	NA	1,300 (1,433)	440 (485)
Water, l (gal)	130,000,000 (34,342,100)	140,000,000 (36,983,800)	210,000,000 (55,475,700)	120,000,000 (31,700,400)
Concrete, m^3 (yd^3)	480 (628)	1,200 (1,570)	1,200 (1,570)	53,000 (69,324)
Steel, t (tons)	200 (220)	300 (331)	6,300 (6,944)	17,000 (18,739)

Key: NA, not applicable.
Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.
Source: UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j.

Table E–13. Ceramic or Glass Immobilization Facility Annual Employment Operation Requirements

	Hanford		SRS Building 221–F		SRS New	
Employees	**17 t**	**50 t**	**17 t**	**50 t**	**17 t**	**50 t**
Officials and managers	5	5	5	5	5	5
Professionals	11	11	11	11	11	11
Technicians	180	220	180	220	170	195
Office and clerical	14	14	14	14	14	14
Craft workers	30	30	30	30	30	30
Service workers	24	24	32	32	16	16
Total employment	264	304	272	312	246	271

Source: UC 1998e, 1998f, 1998g, 1998h, 1998i, 1998j.

Table E–14. Immobilization Facility Annual Operation Resource Requirements at Hanford

Resource Requirements	Ceramic 17 t	Ceramic 50 t	Glass 17 t	Glass 50 t
Electricity (MWh)	12,000	16,000	11,000	15,000
Coal, t (tons)	NA	NA	NA	NA
Natural gas, m^3 (ft^3)	NA	NA	NA	NA
Fuel oil,[a] l (gal)	29,000 (7,661)	29,000 (7,661)	29,000 (7,661)	29,000 (7,661)
Water, l (gal)	42,000,000 (11,095,140)	44,000,000 (11,623,480)	39,000,000 (10,302,630)	41,000,000 (10,830,970)
Hydrogen, m^3 (ft^3)	260 (9,182)	290 (10,241)	260 (9,182)	290 (10,241)
Oxygen, m^3 (ft^3)	230 (8,122)	260 (9,182)	230 (8,122)	260 (9,182)
Nitrogen,[b] m^3 (ft^3)	800 (28,252)	2,200 (77,693)	800 (28,252)	2,200 (77,693)
Argon,[b] m^3 (ft^3)	71,000 (2,507,365)	190,000 (6,709,850)	70,000 (2,472,050)	190,000 (6,709,850)
Helium,[b] m^3 (ft^3)	2,300 (81,225)	2,900 (102,414)	2,300 (81,225)	2,900 (102,414)
Carbon monoxide, m^3 (ft^3)	3,000 (105,945)	9,000 (317,835)	NA	NA
Carbon dioxide, m^3 (ft^3)	52,000 (1,836,380)	160,000 (5,650,400)	NA	NA
Process water, l (gal)	110 (29)	110 (29)	110 (29)	110 (29)
Precursor, kg (lb)	11,000 (24,251)	31,000 (68,343)	NA	NA
Binder, kg (lb)	350 (772)	950 (2,094)	NA	NA
Lubricant, kg (lb)	17 (37)	50 (110)	NA	NA
Frit, kg (lb)	NA	NA	29,000 (63,933)	55,000 (121,253)
Stainless steel canisters, kg (lb)	45,000 (99,207)	120,000 (264,552)	55,000 (121,253)	150,000 (330,690)
Absorbents, kg (lb)	1,100 (2,425)	1,100 (2,425)	1,100 (2,425)	1,100 (2,425)
Hydraulic fluid, l (gal)	400 (106)	400 (106)	400 (106)	400 (106)
Oil,[c] l (gal)	1,400 (370)	1,400 (370)	1,400 (370)	1,400 (370)
Sodium hypochlorite, kg (lb)	57 (126)	57 (126)	57 (126)	57 (126)
Polyphosphate, kg (lb)	84 (185)	84 (185)	84 (185)	84 (185)
Corrosion inhibitor, kg (lb)	100 (220)	100 (220)	100 (220)	100 (220)

[a] Fuel oil includes gasoline, diesel, and oil.
[b] Includes process and nonprocess chemicals.
[c] Includes cutting oil and lubricating oil.

Key: NA, not applicable.

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values. Resource requirements less than 50 kg/yr (110 lb/yr) are not listed, except for lubricants.

Source: UC 1998e, 1998f.

Table E–15. Immobilization Facility Annual Operation Resource Requirements Collocated with MOX Facility at Hanford

Resource Requirements	17 t Ceramic	17 t Glass
Electricity (MWh)	13,000	13,000
Coal, t (tons)	NA	NA
Natural gas, m^3 (ft^3)	NA	NA
Fuel oil,[a] l (gal)	29,000 (7,661)	29,000 (7,661)
Water, l (gal)	42,000,000 (11,095,140)	39,000,000 (10,302,630)
Hydrogen, m^3 (ft^3)	260 (9,182)	260 (9,182)
Oxygen, m^3 (ft^3)	230 (8,122)	230 (8,122)
Nitrogen,[b] m^3 (ft^3)	800 (28,252)	800 (28,252)
Argon,[b] m^3 (ft^3)	71,000 (2,507,365)	70,000 (2,472,050)
Helium,[b] m^3 (ft^3)	2,300 (81,225)	2,300 (81,225)
Carbon monoxide, m^3 (ft^3)	3,000 (105,945)	NA
Carbon dioxide, m^3 (ft^3)	52,000 (1,836,380)	NA
Process water, l (gal)	110 (29)	110 (29)
Precursor, kg (lb)	11,000 (24,251)	NA
Binder, kg (lb)	350 (772)	NA
Lubricant, kg (lb)	17 (37)	NA
Frit, kg (lb)	NA	29,000 (63,933)
Stainless steel canisters, kg (lb)	45,000 (99,207)	55,000 (121,253)
Absorbents, kg (lb)	1,100 (2,425)	1,100 (2,425)
Hydraulic fluid, l (gal)	400 (106)	400 (106)
Oil,[c] l (gal)	1,400 (370)	1,400 (370)
Sodium hypochlorite, kg (lb)	57 (126)	57 (126)
Polyphosphate, kg (lb)	84 (185)	84 (185)
Corrosion inhibitor, kg (lb)	100 (220)	100 (220)

[a] Fuel oil includes gasoline, diesel, and oil.
[b] Includes process and nonprocess chemicals.
[c] Includes cutting oil and lubricating oil.

Key: NA, not applicable.

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values. Resource requirements less than 50 kg/yr (110 lb/yr) are not listed, except for lubricants.

Source: UC 1998e, 1998f.

Table E–16. Immobilization (Ceramic) Facility Annual Operation Resource Requirements at SRS

Resource Requirements	Ceramic (Building 221–F) 17 t	Ceramic (Building 221–F) 50 t	Ceramic (New) 17 t	Ceramic (New) 50 t
Electricity (MWh)	12,000	14,000	12,000	14,000
Coal, t (tons)	450 (496)	450 (496)	450 (496)	450 (496)
Natural gas, m^3 (ft^3)	NA	NA	NA	NA
Fuel oil,[a] l (gal)	29,000 (7,661)	29,000 (7,661)	29,000 (7,661)	29,000 (7,661)
Water, l (gal)	50,000,000 (13,208,500)	52,000,000 (13,736,840)	47,000,000 (12,415,990)	49,000,000 (12,944,330)
Hydrogen, m^3 (ft^3)	260 (9,182)	290 (10,241)	260 (9,182)	290 (10,241)
Oxygen, m^3 (ft^3)	230 (8,122)	260 (9,182)	230 (8,122)	260 (9,182)
Nitrogen,[b] m^3 (ft^3)	800 (28,252)	2,200 (77,693)	800 (28,252)	2,200 (77,693)
Argon,[b] m^3 (ft^3)	71,000 (2,507,365)	190,000 (6,709,850)	71,000 (2,507,365)	190,000 (6,709,850)
Helium,[b] m^3 (ft^3)	2,300 (81,225)	2,900 (102,414)	2,300 (81,225)	2,900 (102,414)
Carbon monoxide, m^3 (ft^3)	3,000 (105,945)	9,000 (317,835)	3,000 (105,945)	9,000 (317,835)
Carbon dioxide, m^3 (ft^3)	52,000 (1,836,380)	160,000 (5,650,400)	52,000 (1,836,380)	160,000 (5,650,400)
Process water, l (gal)	110 (29)	110 (29)	110 (29)	110 (29)
Precursor, kg (lb)	11,000 (24,251)	31,000 (68,343)	11,000 (24,251)	31,000 (68,343)
Binder, kg (lb)	350 (772)	950 (2,094)	350 (772)	950 (2,094)
Lubricant, kg (lb)	17 (37)	50 (110)	17 (37)	50 (110)
Frit, kg (lb)	NA	NA	NA	NA
Stainless steel canisters, kg (lb)	45,000 (99,207)	120,000 (264,552)	45,000 (99,207)	120,000 (264,552)
Absorbents, kg (lb)	1,100 (2,425)	1,100 (2,425)	1,100 (2,425)	1,100 (2,425)
Hydraulic fluid, l (gal)	400 (106)	400 (106)	400 (106)	400 (106)
Oil,[c] l (gal)	1,400 (370)	1,400 (370)	1,400 (370)	1,400 (370)
Sodium hypochlorite, kg (lb)	57 (126)	57 (126)	57 (126)	57 (126)
Polyphosphate, kg (lb)	84 (185)	84 (185)	84 (185)	84 (185)
Corrosion inhibitor, kg (lb)	100 (220)	100 (220)	100 (220)	100 (220)

[a] Fuel oil includes gasoline, diesel, and oil.
[b] Includes process and nonprocess chemicals.
[c] Includes cutting oil and lubricating oil.
Key: NA, not applicable.
Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values. Resource requirements less than 50 kg/yr (110 lb/yr) are not listed, except for lubricants.
Source: UC 1998g, 1998h.

Table E–17. Immobilization (Glass) Facility Annual Operation Resource Requirements at SRS

Resource Requirements	Glass (Building 221-F) 17 t	Glass (Building 221-F) 50 t	Glass (New) 17 t	Glass (New) 50 t
Electricity (MWh)	11,000	13,000	11,000	13,000
Coal, t (tons)	450 (496)	450 (496)	450 (496)	450 (496)
Natural gas, m^3 (ft^3)	NA	NA	NA	NA
Fuel oil,[a] l (gal)	29,000 (7,661)	29,000 (7,661)	29,000 (7,661)	29,000 (7,661)
Water, l (gal)	50,000,000 (13,208,500)	52,000,000 (13,736,840)	47,000,000 (12,415,990)	49,000,000 (12,944,330)
Hydrogen, m^3 (ft^3)	260 (9,182)	290 (10,241)	260 (9,182)	290 (10,241)
Oxygen, m^3 (ft^3)	230 (8,122)	260 (9,182)	230 (8,122)	260 (9,182)
Nitrogen,[b] m^3 (ft^3)	800 (28,252)	2,200 (77,693)	800 (28,252)	2,200 (77,693)
Argon,[b] m^3 (ft^3)	70,000 (2,472,050)	190,000 (6,709,850)	70,000 (2,472,050)	190,000 (6,709,850)
Helium,[b] m^3 (ft^3)	2,300 (81,225)	2,900 (102,414)	2,300 (81,225)	2,900 (102,414)
Carbon monoxide, m^3 (ft^3)	NA	NA	NA	NA
Carbon dioxide, m^3 (ft^3)	NA	NA	NA	NA
Process water, l (gal)	110 (29)	110 (29)	110 (29)	110 (29)
Precursor, kg (lb)	NA	NA	NA	NA
Binder, kg (lb)	NA	NA	NA	NA
Lubricant, kg (lb)	NA	NA	NA	NA
Frit, kg (lb)	29,000 (63,933)	55,000 (121,253)	29,000 (63,933)	55,000 (121,253)
Stainless steel canisters, kg (lb)	55,000 (121,253)	150,000 (330,690)	55,000 (121,253)	150,000 (330,690)
Absorbents, kg (lb)	1,100 (2,425)	1,100 (2,425)	1,100 (2,425)	1,100 (2,425)
Hydraulic fluid, l (gal)	400 (106)	400 (106)	400 (106)	400 (106)
Oil,[c] l (gal)	1,400 (370)	1,400 (370)	1,400 (370)	1,400 (370)
Sodium hypochlorite, kg (lb)	57 (126)	57 (126)	57 (126)	57 (126)
Polyphosphate, kg (lb)	84 (185)	84 (185)	84 (185)	84 (185)
Corrosion inhibitor, kg (lb)	100 (220)	100 (220)	100 (220)	100 (220)

[a] Fuel oil includes gasoline, diesel, and oil.
[b] Includes process and nonprocess chemicals.
[c] Includes cutting oil and lubricating oil.
Key: NA, not applicable.
Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values. Resource requirements less than 50 kg/yr (110 lb/yr) are not listed, except for lubricants.
Source: UC 1998i, 1998j.

Table E–18. MOX Facility Schedule

Activity	Calendar Year
MOX team selection and contract negotiation	1999
Design	2000–2001
Permitting and licensing	2000–2006
Construction	2002–2004
Cold startup	2005
Hot startup	2006
Operation	2006–2015
Deactivation and stabilization	2015–2018 (nominal 3 years)

Note: Schedule dates are approximate based on latest information. Actual timing may cause some activities to start later in the reference year and end sometime past the end year shown here.
Source: UC 1998k, 1998l, 1998m, 1998n.

Table E–19. MOX Facility Construction Area Requirements

Function	Hanford		INEEL	Pantex	SRS
	FMEF	New			
Laydown area, ha (acres) (including spoils, topsoils, etc.)	2 (4.94)	2 (4.94)	2 (4.94)	2 (4.94)	2 (4.94)
Warehouse area, ha (acres)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Staging area, ha (acres)	0.65 (1.61)	0.65 (1.61)	0.65 (1.61)	0.65 (1.61)	0.65 (1.61)
Temporary parking, ha (acres)	2 (4.94)	2 (4.94)	2 (4.94)	2 (4.94)	2 (4.94)
New roads, km (mi)	1 (0.62)	1 (0.62)	1 (0.62)	2 (1.24)	2 (1.24)

Key: FMEF, Fuels and Materials Examination Facility.
Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.
Source: UC 1998k, 1998l, 1998m, 1998n.

Table E–20. MOX Facility Operation Area Requirements

Land-Use Area	Hanford		INEEL	Pantex	SRS
	FMEF	New			
New process facilities, ha (acres)	0 (0)	0.65 (1.61)	0.65 (1.61)	0.65 (1.61)	0.65 (1.61)
New support facilities, ha (acres)	0.37 (0.91)	0.37 (0.91)	0.37 (0.91)	0.37 (0.91)	0.37 (0.91)
Security area, ha (acres)	3 (7.41)	3 (7.41)	3 (7.41)	3 (7.41)	3 (7.41)
New parking, ha (acres)	2 (4.94)	2(4.94)	2 (4.94)	2 (4.94)	2 (4.94)

Key: FMEF, Fuels and Materials Examination Facility.
Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.
Source: UC 1998k, 1998l, 1998m, 1998n.

Table E–21. MOX Facility Construction Employment Requirements (2002–2004)

Employees	Hanford FMEF	Hanford New	INEEL	Pantex	SRS
Craft workers	838	999	999	999	999
Management and administrative	434	463	463	463	463
Total employment	1,272	1,462	1,462	1,462	1,462

Key: FMEF, Fuels and Materials Examination Facility.
Note: Total employment includes construction workers during cold and hot startup years.
Source: UC 1998k, 1998l, 1998m, 1998n.

Table E–22. MOX Facility Major Construction Resource Requirements (2002–2004)

Resource Requirements	Hanford FMEF	Hanford New	INEEL	Pantex	SRS
Electricity (MWh)					
3-year period	55,000	2,300	2,300	2,300	2,600
5-year period[a]	97,000	45,000	20,000	20,000	21,000
Fuel, l (gal)	140,000 (36,984)	680,000 (179,636)	680,000 (179,636)	680,000 (179,636)	680,000 (179,636)
Water,[b] l (gal)	41,000,000 (10,830,970)	47,000,000 (12,415,990)	47,000,000 (12,415,990)	47,000,000 (12,415,990)	47,000,000 (12,415,990)
Concrete, m^3 (yd^3)	3,100 (4,055)	10,000 (13,080)	10,000 (13,080)	10,000 (13,080)	9,200 (12,034)
Steel, t (tons)	1,200 (1,323)	4,000 (4,409)	4,000 (4,409)	4,000 (4,409)	3,800 (4,189)

[a] Includes electricity during the cold and hot startup years.
[b] Includes water usage by construction workers during cold and hot startup years.
Key: FMEF, Fuels and Materials Examination Facility.
Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values. Resource requirements less than 50 kg/yr (110 lb/yr) are not listed.
Source: UC 1998k, 1998l, 1998m, 1998n.

Table E–23. MOX Facility Annual Employment Operation Requirements

Employees	Hanford FMEF	Hanford New	INEEL	Pantex	SRS
Officials and managers	10	10	10	10	10
Professionals	75	75	75	75	75
Technicians	67	67	67	67	67
Office and clerical	10	10	10	10	10
Craft workers	30	30	30	30	30
Operatives	102	102	102	102	102
Laborers	4	4	4	4	4
Service workers	52	52	52	52	52
Total employment	350	350	350	350	350

Key: FMEF, Fuels and Materials Examination Facility.
Note: Total employment during normal operation, after cold and hot startup years.
Source: UC 1998k, 1998l, 1998m, 1998n.

Table E–24. MOX Facility Annual Operation Resource Requirements

	Hanford				
Resource Requirements	**FMEF**	**New**	**INEEL**	**Pantex**	**SRS**
Electricity (MWh)	24,000	24,000	12,000	12,000	12,000
Coal, t (tons)	NA	NA	1,600 (1,764)	NA	650 (716)
Natural gas, m^3 (ft^3)	NA	NA	NA	920,000 (32,489,800)	NA
Fuel oil,[a] l (gal)	43,000 (11,359)	43,000 (11,359)	43,000 (11,359)	43,000 (11,359)	43,000 (11,359)
Water, l (gal)	43,000,000 (11,359,310)	43,000,000 (11,359,310)	43,000,000 (11,359,310)	43,000,000 (11,359,310)	43,000,000 (11,359,310)
Hydrogen, m^3 (ft^3)	36,000 (1,271,340)	36,000 (1,271,340)	36,000 (1,271,340)	36,000 (1,271,340)	36,000 (1,271,340)
Nitrogen, m^3 (ft^3)	15 (530)	15 (530)	15 (530)	15 (530)	15 (530)
Oxygen, m^3 (ft^3)	74 (2,613)	74 (2,613)	74 (2,613)	74 (2,613)	74 (2,613)
Argon, m^3 (ft^3)	5,900 (208,359)	5,900 (208,359)	5,900 (208,359)	5,900 (208,359)	5,900 (208,359)
Helium, m^3 (ft^3)	95 (3,355)	95 (3,355)	95 (3,355)	95 (3,355)	95 (3,355)
Phosphoric acid, kg (lb)	100 (220)	100 (220)	100 (220)	100 (220)	100 (220)
Sodium nitrate, kg (lb)	500 (1,102)	500 (1,102)	500 (1,102)	500 (1,102)	500 (1,102)
Sodium hydroxide, kg (lb)	76 (168)	76 (168)	76 (168)	76 (168)	76 (168)
Ethylene glycol, kg (lb)	300 (661)	300 (661)	300 (661)	300 (661)	300 (661)
Lubricant zinc stearate, kg (lb)	300 (661)	300 (661)	300 (661)	300 (661)	300 (661)

[a] Fuel oil includes gasoline and oil.

Key: FMEF, Fuels and Materials Examination Facility; NA, not applicable.

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values.

Source: UC 1998k, 1998l, 1998m, 1998n.

Table E–25. Lead Assembly Fabrication Facility Schedule

Activity	Calendar Year
Equipment procured	2000–2001
Facility design	1999 –2001
Facility permitting	2000–2002
Facility modification	2001–2002
Lead assembly fabrication (operation)	2003–2006
Deactivation and stabilization	2010–2013

Note: Schedule dates are approximate based on latest information. Actual timing may cause some activities to start later in the reference year and end sometime past the end year shown here.

Source: O'Connor et al. 1998a, 1998b, 1998c, 1998d, 1998e.

Table E–26. Lead Assembly Fabrication Annual Employment Operation Requirements

Employees	Number of Employees
Officials and managers	1
Professionals	4
Technicians	31
Office and clerical	2
Craft workers	5
Operatives	8
Service workers	9
Total employment	60

Source: O'Connor et al. 1998a, 1998b, 1998c, 1998d, 1998e.

Table E–27. Lead Assembly Fabrication Construction Resource Requirements

Resource Requirement	ANL–W	Hanford	LLNL	LANL	SRS
Electricity (MWh)	NR	NR	NR	NR	2,800
Fuel oil,[a] l (gal)	NR	NR	NR	NR	45,000 (11,888)
Water, l (gal)	NR	NR	NR	NR	15,000,000 (3,962,550)
Industrial gases, m^3 (ft^3)	NR	NR	NR	NR	57 (2,013)
Concrete, m^3 (yd^3)	NR	NR	NR	NR	19 (25)
Steel, t (tons)	NR	NR	NR	NR	45 (50)

[a] Fuel oil includes gasoline, diesel, and oil.

Key: ANL–W, Argonne National Laboratory–West; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory; NR, not reported.

Note: ANL–W, Hanford, LANL, and LLNL require minor modifications to existing buildings; therefore, no significant construction resource requirements are expected.

Source: O'Connor et al. 1998a, 1998b, 1998c, 1998d, 1998e.

Table E–28. Lead Assembly Fabrication Annual Operation Resource Requirements

Resource Requirement	ANL–W	Hanford	LLNL	LANL	SRS
Electricity (MWh)	720	1,200	720	720	720
Coal, t (tons)	NA	NA	NA	NA	60 (66)
Natural gas, m^3 (ft^3)	NA	NA	55,000 (1,942,325)	55,000 (1,942,325)	NA
Fuel oil,[a] l (gal)	61,000 (16,114)	12,000 (3,170)	12,000 (3,170)	12,000 (3,170)	12,000 (3,170)
Water, l (gal)	1,600,000 (422,672)	1,600,000 (422,672)	1,600,000 (422,672)	1,600,000 (422,672)	1,600,000 (422,672)
Argon, m^3 ft^3	16,000 (565,040)	16,000 (565,040)	16,000 (565,040)	16,000 (565,040)	16,000 (565,040)
Helium, m^3 (ft^3)	10 (353)	10 (353)	10 (353)	10 (353)	10 (353)
Hydrogen, m^3 (ft^3)	1,000 (35,315)	1,000 (35,315)	1,000 (35,315)	1,000 (35,315)	1,000 (35,315)
Nitrogen, m^3 (ft^3)	5,300 (187,170)	5,300 (187,170)	5,300 (187,170)	5,300 (187,170)	5,300 (187,170)
Oxygen, m^3 (ft^3)	5,000 (176,575)	5,000 (176,575)	5,000 (176,575)	5,000 (176,575)	5,000 (176,575)
Sodium nitrate, kg (lb)	85 (187)	85 (187)	85 (187)	85 (187)	85 (187)
Alcohol, l (gal)	230 (61)	230 (61)	230 (61)	230 (61)	230 (61)
General cleaning fluids, l (gal)	230 (61)	230 (61)	230 (61)	230 (61)	230 (61)

[a] Fuel oil includes gasoline, diesel, and oil.

Key: ANL–W, Argonne National Laboratory–West; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory; NA, not applicable.

Note: For purposes of the SPD EIS, metric values provided in the data reports were rounded to two significant digits and converted to the English values. Resource requirements less than 50 kg/yr (110 lb/yr) are not listed.

Source: O'Connor et al. 1998a, 1998b, 1998c, 1998d, 1998e.

REFERENCES

O'Connor, D.G., et al., 1998a, *ANL-W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13478, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998b, *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13481, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998c, *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13482, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998d, *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13480, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998e, *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13483, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

UC (Regents of the University of California), 1998a, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Hanford Site*, LA-UR-97-2907, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998b, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Idaho National Engineering and Environmental Laboratory*, LA-UR-97-2908, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998c, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Pantex Plant*, LA-UR-97-2909, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998d, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Savannah River Site*, LA-UR-97-2910, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998e, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford*, UCRL-ID-128275, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998f, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Hanford*, UCRL-ID-128276, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998g, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in New Facilities at Savannah River Site*, UCRL-ID-128273, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998h, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Savannah River Site*, UCRL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998i, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site*, UCRL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998j, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Savannah River Site*, UCRL-ID-128272, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998k, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Hanford Site*, LA-UR-97-2064, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998l, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Idaho National Engineering and Environmental Laboratory*, LA-UR-97-2065, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998m, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Pantex Plant*, LA-UR-97-2067, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998n, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Savannah River Site*, LA-UR-97-2066, Los Alamos National Laboratory, Los Alamos, NM.

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Appendix F
Impact Assessment Methods

This appendix briefly describes the methods used to evaluate the potential direct, indirect, and cumulative effects of the alternatives for surplus plutonium disposition. Included are impact assessment methods for air quality and noise, geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, infrastructure, waste management, socioeconomics, human health risk, facility accidents, transportation, environmental justice, and cumulative impacts. Each section is organized so that first the affected resource is described and then the impact assessment method is presented. Detailed descriptions of the methods for facility accidents and transportation impacts analysis are presented as Appendixes K and L, respectively.

Although impacts were generally described as either major or minor, this assignment was made in different ways, depending on the resource. For air quality, for example, estimated pollutant emissions from the proposed facilities were compared with the appropriate regulatory standards or guidelines. For human health risk, estimated radionuclide exposure to humans from the proposed facilities were compared with applicable dose limits. Comparison with regulatory standards is a commonly used method for benchmarking environmental impact and is done here to provide perspective on the magnitude of identified impacts.

Other indicators of impact were also established to focus the analysis on impacts that could be major. The analysis of waste management impacts, for example, focused on alternatives where additional waste generation would be a large percentage of current site waste generation, although a major impact was suggested only where waste generation would exceed the capacity of existing waste management facilities. Cumulative impacts were also evaluated with a view to ensuring that actions with minor impacts individually could not have major impacts collectively.

Impacts in all resource areas were analyzed consistently; that is, the impact values were estimated using a consistent set of input variables and computations. Moreover, efforts were made to ensure that calculations in all areas used accepted protocols and up-to-date models. Finally, like presentations were developed to facilitate the comparison of alternatives.

F.1 AIR QUALITY AND NOISE

F.1.1 Description of Affected Resources

F.1.1.1 Air Quality

Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. For purposes of the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), only outdoor air pollutants were addressed. They may be in the form of solid particles, liquid droplets, gases, or a combination of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants or by reaction with normal atmospheric constituents, which may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere with the appropriate standards. Ambient air quality standards have been established by Federal and State agencies, allowing an adequate margin of safety for protection of public health and welfare from the adverse effects of pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; those below such standards, acceptable.

The pollutants of concern are primarily those for which Federal and State ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air compounds. Criteria air pollutants are those listed in 40 CFR 50, *National Primary and Secondary Ambient Air Quality Standards* (EPA 1997a). Hazardous air pollutants and other toxic compounds are those listed in Title I of the 1990 Clean Air Act (CAA) as amended, those regulated by the National Emissions Standards for Hazardous Air Pollutants (NESHAP), and those that have been proposed or adopted for regulation by the respective State or are listed in State guidelines. Also of concern are air pollutant emissions that may contribute to the depletion of stratospheric ozone or global warming. Construction activities, particularly those that involve modification of existing facilities, may be subject to certain NESHAP requirements, for example, the reporting, training, and work practice requirements for asbestos renovation (EPA 1997b). Provisions of other NESHAP requirements, such as those for benzene (EPA 1997c), would likely not apply because the amounts stored and used for construction and operation of these facilities would be small. Provisions of NESHAP for radionuclides are discussed in Chapter 5 and Appendix F.10.

Areas with air quality better than the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants are designated as being in attainment; areas with air quality worse than the NAAQS for such pollutants, as nonattainment areas. Areas may be designated as unclassified when sufficient data for attainment status designation are lacking. Attainment status designations are assigned by county, metropolitan statistical area, consolidated metropolitan statistical area, or portions thereof. Air Quality Control Regions designated by the U.S. Environmental Protection Agency (EPA) are listed in 40 CFR 81, *Designation of Areas for Air Quality Planning Purposes.*

For locations that are in an attainment area for criteria air pollutants, prevention of significant deterioration (PSD) regulations limit pollutant emissions from new sources and establish allowable increments of pollutant concentrations. Three PSD classifications are specified with the criteria established in the CAA amendments. Class I areas include national wilderness areas, memorial parks larger than 2,020 ha (5,000 acres), and national parks larger than 2,430 ha (6,000 acres), and areas that have been redesignated as Class I. Class II areas are all areas not designated as Class I. No Class III areas have been designated.

Designation as a nonattainment area for criteria air pollutants triggers control requirements designated to achieve attainment status by specified dates. In addition, facilities that constitute major new emission sources cannot be constructed in a nonattainment area without permits that impose stringent pollution control requirements to ensure progress toward compliance.

The region of influence (ROI) for air quality is that area around a site potentially affected by air pollutant emissions caused by the surplus plutonium disposition alternatives. The air quality impact area normally evaluated is the area in which concentrations of criteria air pollutants would increase more than a significant amount in a Class II area. Significance varies according to the averaging period: 2,000 $\mu g/m^3$ for 1 hr for carbon monoxide; 25 $\mu g/m^3$ for 3 hr for sulfur dioxide; 5 $\mu g/m^3$ for 24 hr for sulfur dioxide and particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}); and 1 $\mu g/m^3$ annually for sulfur dioxide, PM_{10}, and nitrogen dioxide (EPA 1997d). Generally, this covers a few kilometers downwind from the source. For sources within 100 km (62 mi) of a Class I area, the air quality impact area evaluated would include the Class I area if the average 24-hr increase in concentration were greater than 1 $\mu g/m^3$. The size of the ROI depends on emission source characteristics, pollutant types, emission rates, and meteorological and topographical conditions. For purposes of this analysis, where most of the sites are large, impacts were evaluated at the site boundary, along roads within the sites to which the public has access, and anywhere else the contributions to pollutant concentrations could exceed the established significance levels.

Baseline air quality is typically described in terms of pollutant concentrations modeled for existing sources at each site and background air pollutant concentrations measured near the sites. For this analysis, concentrations for existing sources were obtained from existing source documents or by modeling recent emissions data. Data from the *Storage and Disposition Final PEIS* (DOE 1996a) were incorporated where appropriate.

The maximum concentrations of toxic air pollutants at or beyond the site boundary were compared with Federal and State regulations or limits. To determine human health risk (see Appendix F.10), modeling outputs on chemical concentrations in air were weighed against chemical-specific toxicity values. Emissions of radionuclides to the air (see Appendix F.10) were evaluated in terms of a total dosage standard.

F.1.1.2 Noise

Sound results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. Propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (e.g., hearing, sleep), damage hearing, or diminish the quality of the environment.

Sound-level measurements used to evaluate the effects of nonimpulsive sound on humans are compensated by an A-weighting scale that accounts for the hearing response characteristics (i.e., frequency) of the human ear. Sound levels are expressed in decibels, or in the case of A-weighted measurements, decibels A-weighted. The EPA has developed noise-level guidelines for different land-use classifications. Some States and localities have established noise control regulations or zoning ordinances that specify acceptable noise levels by land-use category.

Noise from facility operations and associated traffic could affect human and animal populations. Because most nontraffic noise associated with construction and operation of the proposed facilities would be distant from offsite noise-sensitive receptors, the contribution to offsite noise levels should be small. Impacts associated with transportation access routes, including noise from increased traffic, could result in small increases in noise along these routes. The ROI for each of the sites includes the site and surrounding areas, including transportation corridors, where proposed activities might increase noise levels. Transportation corridors most likely to experience increased noise levels are those roads within a few miles of the site boundary that carry most of the site's employee and shipping traffic.

Sound-level data representative of site environs were obtained from existing reports and from calculations of the sound levels typical of prevailing traffic volumes along the transportation corridors. The acoustic environment was further described in terms of existing noise sources for each site.

F.1.2 Description of Impact Assessment

F.1.2.1 Air Quality

Potential air quality impacts of pollutant emissions from construction and normal operations were evaluated for each alternative (see Table F–1). That assessment included a comparison of effects of each alternative with applicable Federal and State ambient air quality standards and concentration limits. The more stringent standards, EPA or State, served as the assessment criteria. Criteria for hazardous and toxic air pollutants include those listed in Title III of the 1990 CAA Amendments, the NESHAP, and standards and guidelines adopted by the respective states. The SPD incremental change in concentrations of pollutants was compared with the PSD Class II allowable increments. Impacts on Class I PSD areas were evaluated where there was a Class I area within 100 km (62 mi) of the site.

Table F–1. Impact Assessment Protocol for Air Quality and Noise

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Air quality			
Criteria air pollutants and other regulated pollutants[a]	Ambient concentration ($\mu g/m^3$) of air pollutants, and concentrations of pollutants from existing sources at site	Emission (kg/yr) of air pollutants from facility and facility construction or modification; source characteristics (e.g., stack height and diameter, exit temperature and velocity); shipments and workforce estimates	Contribution of proposed alternative to concentrations of each pollutant at or beyond site boundary; total concentration of each pollutant at or beyond site boundary; percent of applicable standard
Toxic/hazardous air pollutants[b]	Ambient concentrations ($\mu g/m^3$) of toxic air pollutants; concentrations of pollutants from existing sources at site	Emission rate (kg/yr) of toxic air pollutants from facility; source characteristics (e.g., stack height and diameter, exit temperature and velocity)	Contribution of proposed alternative to concentrations of each pollutant at or beyond the site boundary; total concentration of each pollutant at or beyond site boundary; percent of applicable standard
Noise	Sound levels at sensitive offsite receptors (e.g., at nearby residences, along major access routes); sound levels at noise-sensitive wildlife habitat (nearby threatened and endangered wildlife habitat)	Descriptions of major construction and operations sources; shipment and workforce estimates	Increase in day/night average sound level at sensitive receptors

[a] Carbon monoxide; hydrogen fluoride; lead; nitrogen oxides; ozone; particulate matter with an aerodynamic diameter less than or equal to $10 \mu g$; sulfur dioxide; total suspended particulates.
[b] Title III pollutants, pollutants regulated under the National Emissions Standard for Hazardous Air Pollutants, and other State-regulated pollutants.

Operational air pollutant emissions data for each alternative (other than No Action) were based on engineering design reports; construction emissions data for each alternative, on engineering design reports, emission factors for construction equipment listed in *Compilation of Air Pollutant Emission Factors, Vol. II - Mobile Sources* (EPA 1991:vol. II, 7-1–7-7), and emission factors for fugitive dust from construction listed in *Compilation of Air Pollutant Emission Factors* (EPA 1996a:13.2-1; 13.2-2; 13.2.2-1–13.2.2-8; 13.2.3-1–13.2.3-7; 13.2.4-1–13.2.4-9; 13.2.5-1–13.2.5-21). Traffic emissions were estimated using EPA's MOBILE5b and PART 5 emissions calculation models.

For each alternative, contributions to offsite air pollutant concentrations were modeled on the basis of guidance presented in the *Guidelines on Air Quality Models* (EPA 1997e). The EPA-recommended Industrial Source Complex Model, Version 3 (ISC3), was selected as the most appropriate model to perform the air dispersion modeling, because it is designed to support the EPA regulatory modeling program and is capable of handling multiple sources and source types. The short-term version of ISC3, ISCST3, was used to calculate concentrations with averaging times of 1 to 24 hours and annual average concentrations. Concentrations for the No Action Alternative were based on information provided in the *Storage and Disposition Final PEIS* (DOE 1996a).

The modeling analysis incorporated conservative assumptions, which tend to overestimate the pollutant concentrations. The "highest-high" concentration for each pollutant and averaging time was selected for comparison with the applicable assessment criterion, instead of the less conservative EPA-recommended "highest-high" and "highest second-highest" concentration for long-term and short-term averaging times, respectively. The concentrations evaluated were the maximum occurring at or beyond the site boundary or a public access road, and included the contribution of the alternative and that of existing onsite sources. Available monitoring data, which reflect both onsite and offsite sources, were also taken into consideration. Concentrations of the criteria air pollutants, hazardous air pollutants, and toxic air compounds were presented for each alternative. Construction equipment activity emissions were evaluated as a volume source for each alternative using the ISC3 model. The total concentration, including the contribution from each alternative and the percent of the applicable standard, were presented. This percentage reflects the variability of the No Action concentrations, the standards and guidelines among sites and the differences among the alternatives.

The effects of traffic related to construction and operation for each alternative were evaluated by calculating the emissions of criteria pollutants from worker vehicles and shipping activities.

One year of sequential hourly onsite meteorological data from the sites and upper-air data for appropriate locations from the National Climactic Data Center were used in the air quality modeling. For consistency, the data were for the same year considered in the *Storage and Disposition Final PEIS* (DOE 1996a).

Additional assumptions were incorporated in the air quality modeling at each site. For example, to model emissions from a generic process stack for mixed oxide fuel fabrication, a single source within the facility was used, assuming a stack height of 8 m (26 ft), a stack diameter of 0.3 m (1 ft), a stack exit temperature equal to the ambient temperature, and a stack exit velocity of 0.03 m/s (0.1 ft/s). Where they could be obtained, however, actual stack locations and stack parameters were used to model pollutant concentrations.

The analysis tends to overestimate pollutant concentrations, since the location of the maximum site boundary concentrations due to surplus plutonium disposition facilities was assumed to be the same as the location of maximum concentrations of other pollutant sources at the site.

Ozone is typically formed as a secondary pollutant in the ambient air (troposphere). It is formed from such primary pollutants as nitrogen oxides and volatile organic compounds, which emanate from vehicular (mobile), natural, and other stationary sources. It is not emitted directly as a pollutant from the sites. Although ozone may thus be regarded appropriately as a regional issue, specific ozone precursors, notably nitrogen dioxide and volatile organic compounds, were analyzed as applicable to the alternatives under consideration.

The CAA, as amended, required that Federal actions conform to the host State's "State Implementation Plan." A State Implementation Plan provides for the implementation, maintenance, and enforcement of NAAQS for the six criteria pollutants: sulfur dioxide; particulate matter with an aerodynamic diameter smaller than or equal to 10 μm in diameter (PM_{10}); carbon monoxide; ozone; nitrogen dioxide; and lead. Its purpose is to eliminate or reduce the severity and number of violations of NAAQS and to expedite the attainment of these standards. No department, agency, or instrumentality of the Federal Government shall engage in or support in any way (i.e., provide financial assistance for, license or permit, or approve) any activity that does not conform to an applicable implementation plan. The final rule for *Determining Conformity of General Federal Actions to State or Federal Implementation Plans* (EPA 1993) took effect on January 31, 1994. Hanford, Pantex, the Idaho National Engineering and Environmental Laboratory (INEEL), the Savannah River Site

(SRS), Los Alamos National Laboratory (LANL), and Lawrence Livermore National Laboratory (LLNL) are within areas currently designated as attainment for criteria air pollutants. Therefore, the surplus plutonium disposition alternatives being considered at these sites are not affected by the provisions of the conformity rule. Rocky Flats Environmental Technology Site (RFETS) is in an area designated nonattainment for ozone, PM_{10}, and carbon monoxide. Applicability of the conformity rule to the RFETS is discussed in Section 4.2.1.6 on No Action.

Emissions of potential stratospheric ozone-depleting compounds such as chlorofluorocarbons were not evaluated, for no emissions of these pollutants were identified in the engineering design reports.

Emissions of pollutants that are potential contributors to global warming (e.g., carbon dioxide, nitrous oxide chlorofluorocarbons, and methane) were evaluated using emission data in the engineering design reports. These emission were compared with annual releases of these pollutants from other sources.

F.1.2.2 Noise

Also addressed in the SPD EIS assessment were the onsite and offsite acoustic impacts of construction and operation of the proposed facilities (see Table F–1). That analysis drew from available information (e.g., engineering design reports) on the types of noise sources and the locations of the proposed facilities relative to the site boundary and noise-sensitive locations. Its focus was the degree of change in noise levels at sensitive receptors (e.g., residences near the site boundary and along access routes, and schools along access routes) with respect to ambient conditions. (A change in noise level of less than 3 decibels is generally not detectable by the human ear. An increase of 10 decibels is roughly equivalent to a doubling of the perceived sound.) Most nontraffic noise sources associated with construction and operation of the surplus plutonium disposition facilities are far enough from offsite noise-sensitive receptors that the contribution to offsite noise levels should be small. Projections of traffic noise during construction and operations were based on the employment and shipment projections provided in the engineering design reports.

F.2 GEOLOGY AND SOILS

F.2.1 Description of Affected Resources

Geologic resources include consolidated and unconsolidated earth materials, including mineral assets such as ore and aggregate materials, and fossil fuels such as coal, oil, and natural gas. Geologic conditions include hazards such as earthquakes, faults, volcanoes, landslides, and land subsidence. Soil resources include the loose surface materials of the earth in which plants grow, usually consisting of mineral particles from disintegrating rock, organic matter, and soluble salts.

The ROI for geology and soils includes all areas subject to disturbance by construction and operation of surplus plutonium disposition facilities, and those areas beneath these facilities that would remain inaccessible for the life of the facilities.

Geology and soils were considered with respect to natural conditions that could affect the alternative, as well as those portions of the resource that could be affected by the alternative. Geology and soils conditions that could affect the integrity and safety of the surplus plutonium disposition alternatives include large-scale geologic hazards and attributes of the soil beneath the proposed facility. Geology and soils resources that could be affected by the surplus plutonium disposition alternatives include economically valuable mineral resources and prime farmland soils.

F.2.2 Description of Impact Assessment

Facility construction and operations for the surplus plutonium disposition alternatives were considered from the perspective of impacts on specific geologic resources and soil attributes. Construction impacts would predominate in effects on geologic and soil resources; hence, key factors in the analysis were the land area to be disturbed during construction and occupied during operations (see Table F–2). The main objective was avoidance of the siting of facilities over unstable soils—i.e., soils prone to liquefaction, shrink-swell, or erosion.

Table F–2. Impact Assessment Protocol for Geology and Soils

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Soil attributes	Presence of any unstable soils at proposed facility location	Location of proposed facility on the site	Location of facility on unstable soils
Valuable mineral and energy resources	Presence of any valuable mineral or energy resources at proposed facility location	Location of proposed facility on the site	Destruction or rendering inaccessible of valuable mineral or energy resources
Prime farmland soils	Presence of prime farmland soils at proposed facility location	Location of proposed facility on the site	Conversion of prime farmland soils to nonagricultural use

Included in the geology and soils impact analysis was consideration of the risks to the proposed facilities of large-scale geologic hazards such as faulting and earthquakes, lava extrusions and other volcanic activity, landslides, sinkholes, and salt dissolution—i.e., conditions that tend to affect broad expanses of land. While evidence of impacts in facility-specific areas was developed, there was no attempt to revisit the basic conclusion of the *Storage and Disposition Final PEIS* (DOE 1996a:4-45–47, 4-148–150, 4-204–206, 4-309–311) in this regard: that the risks of such hazards to storage and disposition facilities at the candidate sites are acceptable. The findings of that analysis, which focused on the presence of the hazard and the distance of the facilities from it, were accepted as generally applicable to the surplus plutonium disposition facilities. Efforts were also made to determine if locating the surplus plutonium disposition facilities at a specific site could destroy, or preclude the use of, valuable mineral or energy resources.

Pursuant to the Farmland Protection Policy Act (FPPA) (7 USC 4201 et seq.), and the regulations (7 CFR 658) promulgated as result thereof, the presence of prime farmland was also evaluated. This act requires agencies to make FPPA evaluations part of the National Environmental Policy Act (NEPA) process, the main purpose being to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. Prime farmland, as defined in 7 CFR 657, is land that contains the best combination of physical and chemical characteristics for producing crops. It includes cropland, pasture land, rangeland, and forest land. Potential prime farmlands not acquired prior to June 22, 1982, the effective date of the FPPA, are exempt from its provisions (DOE 1996b:4-22).

F.3 WATER RESOURCES

F.3.1 Description of Affected Resources

Water resources are the surface and subsurface waters that are suitable for human consumption, agricultural purposes, or irrigation or industrial/commercial purposes, and that could be impacted by the proposed action.

This analysis involved the review of engineering estimates of expected water use and effluent discharges from proposed construction, operation, maintenance, and decontamination and decommissioning (D&D) of the proposed facilities, and ultimately the impacts of the activities on the local surface water and groundwater.

F.3.2 Description of Impact Assessment

The water resources evaluation for the SPD EIS tiers from the corresponding analysis presented in the *Storage and Disposition Final PEIS* (DOE 1996a). Its purpose was to evaluate the differences in the impacts where changes would be incurred in the assumed water usage to accommodate the facilities involved in the planned disposition activities. Determination of the impacts of the alternatives on water resources (see Table F–3) consisted of a comparison of field-generated data with regulatory standards, design parameters commonly used in the water and wastewater design industry, and accepted industry standards.

Table F–3. Impact Assessment Protocol for Water Resources[a]

	Required Data		
Resource	**Affected Environment**	**Facility Design**	**Measure of Impact**
Surface water quality	Surface waters near the facilities in terms of stream classifications and changes in water quality	Anticipated effluent quantity and quality	Noncompliance of surface water quality with relevant standards of Clean Water Act or with State regulations
Groundwater quality	Groundwater near the facilities in terms of classification, presence of designated sole source aquifers, and changes in quality of groundwater	Quantity and quality of anticipated withdrawals from, or discharges to, groundwater	Concentrations of contaminants in groundwater exceeding standards established in accordance with Safe Drinking Water Act or State regulations
Surface water availability	Surface waters near the facilities, including average flow; 7-day, 10-year low flow; and numbers of downstream users	Volume of withdrawals from, and discharges to, surface waters	Changes in availability to downstream users of water for drinking, irrigation, or animal feeding[b]
Groundwater availability	Groundwater near the facilities, including numbers of all groundwater users, existing water rights for major water users, and contractual agreements for water supply use within impacted area	Volume of withdrawals and discharges to groundwater	Changes in availability of groundwater for human consumption, irrigation, or animal feeding
Flooding impacts	Locations of 100- and 500-year floodplains	Facility location on the site	Construction of facilities in a floodplain[c]

[a] For flows above the design capacity of existing water and sewage treatment systems.
[b] An impact is assumed if withdrawals exceed 10 percent of the 7-day, 10-year low flow of the receiving stream.
[c] A floodplain assessment is a prerequisite to construction on a floodplain.

Certain assumptions were integral to this analysis: (1) that all water and sewage treatment facilities would be approved by the appropriate permitting authority, and thus that the impacts of project-specific withdrawals from the water treatment plants and effluent discharges from the sewage treatment plant would be in accordance with established standards; (2) that the sewage treatment facilities would meet the effluent limitations imposed by their respective National Pollutant Discharge Elimination System (NPDES) permits; and (3) that any stormwater runoff from construction or operations activities would be handled in accordance with the regulations of the appropriate permitting authority. It was also assumed that, during construction, siltation fencing or other erosion control devices would be used to mitigate short-term adverse impacts from siltation, and that as appropriate, stormwater holding ponds would be constructed to lessen the impacts of rainfall events on the receiving streams.

Further assumptions regarding water resources impacts were based in part on results of the analysis. The first step in the analysis was to determine whether any revisions in project water and wastewater flows had occurred between the time of the *Storage and Disposition Final PEIS* (DOE 1996a) and the collection of data for the SPD EIS. If no such determination was made, and if no evidence of an impact on water resources had been presented in the *Storage and Disposition Final PEIS* (DOE 1996a), then it was assumed that no such impact would be incurred. If the analysis reflected a revision downward in the assumed water use for a proposed activity, but there had been no finding of impact for that activity in the *Storage and Disposition Final PEIS* (DOE 1996a), then no impact was attributed to that activity. If the analysis reflected an increase in water use, then an evaluation of the design capacity of the water and wastewater treatment facilities was made to determine whether their design capacity would be exceeded by the additional flows. If the combined flow—i.e., the existing flow plus those from the proposed activities—were less than the design capacity of the water and sewage treatment plants, then it was assumed that there would be no impact on water availability for local users, nor on the receiving stream from sewage treatment plant effluent discharges. If the flows from the proposed facilities were found to exceed the design capacity of the existing water or sewage treatment facilities, then the following extensive analyses of the impact of these flows were conducted.

Surface Water Availability. The analysis of the potential impacts on water availability entailed comparing the rate of surface water use for the specific alternative, the associated effluent discharges, and the use and classification of water in downstream waterways. For facilities intending to use surface water, an evaluation of the total use and the 7-day, 10-year low-flow conditions of the receiving stream was made. Discharges of effluent back into the receiving stream were included in the evaluation. If net losses were found to exceed 10 percent of the 7-day, 10-year low flow, an impact was assumed. Where groundwater was the source of water, discharges to surface water were interpreted as adding to the flow in the receiving stream. If the increases exceeded 200 percent of the 7-day, 10-year low flow, then an impact was assumed.

Surface Water Quality. The evaluation of the service water quality impacts focused on the quality and quantity of the effluent to be discharged and the quality of the receiving stream upstream and downstream from the proposed facilities. The evaluation of effluent quality featured review of the expected design parameters, such as the design average and maximum flows, as well as the effluent parameters reflected in the existing or expected NPDES permit. Those parameters include biochemical oxygen demand, total suspended solids, metals, coliform bacteria, organic and inorganic chemicals, radionuclides, and any other parameters that affect the local environment. Water quality management practices were reviewed to ensure that NPDES permit limitations would be met. Factors that currently degrade water quality were also identified.

During construction, the receiving stream could be affected by construction site runoff and sedimentation. Such impacts relate to the amount of land disturbed, the type of soil at the site, the topography, and weather conditions. They would be minimized by application of standard management practices for storm-water and erosion control.

During operations, receiving waters could be affected by increased runoff from parking lots, buildings, or other cleared areas. Storm water from these areas could be contaminated with materials deposited by airborne pollutants, automobile exhaust and residues, and process effluents. Impacts of storm-water discharges could be highly specific, and mitigation would depend on management practices, the design of holding facilities, the topography, and adjacent land use. Data from the existing water quality database were compared with expected flows from the new facilities to determine the relative impacts on the quality of the water in the receiving stream.

Groundwater Availability. Effects of the proposed action on groundwater supplies were determined by analyzing potential withdrawal rates for the construction and operations phases of the action. Estimates of withdrawal from the affected aquifers were provided. Additionally, instances in which groundwater use could exceed a large portion of the locally developed groundwater supplies were identified.

Groundwater Quality. Potential groundwater quality impacts associated with effluent discharges during the construction and operations phases were examined. The groundwater quality projections were then weighed against federal and state groundwater quality standards, effluent limitations, and drinking water standards to determine the impacts of each alternative. Also evaluated were the effects of construction and operations activities on the movement of existing groundwater contamination plumes, and the consequences thereof for groundwater use in the area.

Floodplain Impacts. Once the regional 100- and 500-year floodplains were identified from maps and other existing documents, the likely impacts thereon of proposed surplus plutonium disposition facility, construction, and operations activities were analyzed. For any facilities proposed for location in a floodplain, a floodplain assessment was prepared. Where possible, the surplus plutonium disposition facilities were sited to ensure compliance with Executive Order 11988, *Floodplain Management*, and 10 CFR 1022, *Compliance With Floodplain/Wetlands Environmental Review Requirements*.

F.4 ECOLOGICAL RESOURCES

F.4.1 Description of Affected Resources

Ecological resources include terrestrial and aquatic resources (plants and animals), wetlands, and threatened and endangered species that could be affected by proposed construction and operations at the proposed surplus plutonium disposition sites. In accord with the *Storage and Disposition Final PEIS* (DOE 1996a), the ROI for habitat impacts from facility construction and operations, is the area within a 1.6-km (1-mi) radius of the proposed facility.

F.4.2 Description of Impact Assessment

The proposed alternatives would involve, at a minimum, land disturbance during modifications to existing facilities and may require site clearing for construction of new facilities (see Table F–4). Accordingly, ecological impacts were assessed in terms of potential disturbances or loss of nonsensitive terrestrial and aquatic habitats and the potential effects on nearby sensitive habitats. For purposes of this SPD EIS, sensitive habitats include those areas occupied by threatened and endangered species, State-protected species, and wetlands.

F.4.2.1 Nonsensitive Habitat Impacts

During the construction phase, ecological resources could be affected through disturbance or loss of habitat resulting from site clearing, land disturbance, human intrusion, and noise. Terrestrial resources could be directly affected through changes in vegetative cover important to individual animals of certain species with limited home ranges, such as small mammals and songbirds. Likely impacts include increased direct mortality and susceptibility to predation. Activities associated with the construction and operation of facilities (e.g., human intrusion and noise) could also compel the migration of the wildlife to adjacent areas with similar

Table F–4. Impact Assessment Protocol for Ecological Resources

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Nonsensitive terrestrial and aquatic habitats	Vegetation and wildlife within a 1.6-km (1-mi) radius of proposed facility locations	Area disturbed by construction of proposed facility	Decrease in acreage of undisturbed local and regional nonsensitive habitats
Sensitive terrestrial and aquatic habitats, including wetlands	Sensitive species habitats within a 1.6-km (1-mi) radius of proposed facility locations	Area disturbed by construction of proposed facility	Decrease in extent of sensitive habitats in ROI Determination by USFWS and State agencies that facility construction could disturb sensitive habitats

Key: ROI, region of influence; USFWS, U.S. Fish and Wildlife Service.

habitat. If the receiving areas were already supporting the maximum sustainable wildlife, competition for limited resources and habitat degradation could be fatal to some species. Therefore, the analysis of impacts on terrestrial wildlife was based largely on the extent of plant community loss or modification.

Construction or modification of facilities, and the operation thereof, could directly affect aquatic resources through increased runoff and sedimentation, increased flows, and the introduction of thermal and chemical changes to the water. However, various mitigation techniques should minimize construction impacts, and discharges of contaminants to surface waters from routine operations are expected to be limited by engineering control practices. Therefore, impacts are expected to be minimal.

F.4.2.2 Sensitive Habitat Impacts

Impacts on threatened and endangered species, State-protected species, and their habitats during construction of the proposed surplus plutonium disposition facilities were determined in a manner similar to that for nonsensitive habitats. A list of sensitive species that could be present at each site was compiled. Plans were developed for preconstruction surveys, as necessary, to determine the presence of any Federal- or State-listed species within the ROI. Those plans call for consulting the U.S. Fish and Wildlife Service and various State agencies to confirm that potential impacts on sensitive habitats are acceptable or can be mitigated.

Most construction impacts on wetlands are related to the displacement of wetlands by filling, draining, or dredging activities. Operational impacts thereon could result from effluents, surface water or groundwater withdrawals, or the creation of new wetlands. Loss of wetlands resulting from construction and operation of the surplus plutonium disposition facilities was addressed by comparing data on the location and areal extent of wetlands in the ROI with the land area requirements for the proposed facilities.

F.5 CULTURAL AND PALEONTOLOGICAL RESOURCES

F.5.1 Description of Affected Resources

Cultural resources are the indications of human occupation and use of the landscape as defined and protected by a series of Federal laws, regulations, and guidelines. For the SPD EIS, the potential impacts of proposed surplus plutonium disposition activities were assessed separately for each of the three general categories of cultural resources: prehistoric, historic, and Native American. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age, and may be sources of information on paleoenvironments and the evolutionary development of plants and animals. Although not governed by the same historic preservation laws as cultural resources, they could be affected by the proposed surplus plutonium disposition activities in much the same manner.

Prehistoric resources are physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past. Historic resources consist of physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492 and later. Ordinarily, sites less than 50 years old are not considered historic, but exceptions can be made for such properties if they are of particular importance, such as structures associated with Cold War themes. Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. Such resources may include geographical features, plants, animals, cemeteries, battlefields, trails, and environmental features.

The primary ROI used for the cultural and paleontological resource analyses encompasses the land areas directly disturbed by construction and operation of the proposed facilities. The natural setting of those resources was considered a contextual component thereof.

F.5.2 Description of Impact Assessment

The SPD EIS study addressed the potential direct and indirect impacts on cultural resources at each of the candidate sites from the proposed action and alternatives (see Table F–5). The assessment of direct impacts focused on ground-disturbing activities and alterations to existing resources, particularly those listed or eligible for listing on the National Register of Historic Places (National Register), and those considered important to Native Americans. Potential indirect impacts of surplus plutonium disposition activities were also assessed—impacts associated with reduced access to a resource site, as well as impacts associated with increased traffic and visitation in sensitive areas.

For specific sites, depending on the alternative, more detailed information was required—e.g., file investigations, Native American consultation, implementation of the American Indian Policy of the DOE, predictive modeling—to determine the types, numbers, and locations, as well as the National Register eligibility or importance in other respects of resources in the proposed project area.

Plans were drawn up for consultation with each State Historic Preservation Officer and reviews of existing DOE site cultural resource surveys and management plans to determine the National Register eligibility and importance of the resources, and to assess measures designed to mitigate the impacts of the proposed actions.

The measure of impact on a particular resource will depend largely on specific cultural resource management agreements with the candidate sites, the consultations with project-specific State Historic Preservation Officers and affected Native American tribes, and overall compliance with Section 106 of the National Historic Preservation Act.

F.6 LAND RESOURCES

F.6.1 Description of Affected Resources

Land resources include the land on and contiguous to each candidate site; the physical features that influence current or proposed uses; local urban and rural population density; pertinent State, county, and municipal land-use plans and regulations; land ownership and availability; and the aesthetic characteristics of the site and surrounding areas.

Table F–5. Impact Assessment Protocol for Cultural and Paleontological Resources

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Prehistoric resources	Site cultural resource inventory/management plan reflecting listing or eligibility for listing on National Register Existing programmatic agreements	Location of proposed facility on the site Areas to be disturbed	Potential for physical destruction, damage, or alteration; isolation or alteration of the character of the property; introduction of visual, audible, or atmospheric elements out of character; and neglect of resources listed or eligible for listing on the National Register. Noncompliance with existing laws, regulations, and programmatic agreements
Historic resources	Site cultural resource inventory/management plan reflecting listing or eligibility for listing on National Register Existing programmatic agreements	Location of proposed facility on the site Areas to be disturbed	Potential for physical destruction, damage, or alteration; isolation or alteration of the character of the property; introduction of visual, audible, or atmospheric elements out of character; and neglect of resources listed or eligible for listing on the National Register. Noncompliance with existing laws, regulations, and programmatic agreements.
Native American resources	Site cultural resource inventory/management plan reflecting listing or eligibility for listing on National Register Existing programmatic agreements Resources identified through consultations with American Indian Tribal Governments	Location of proposed facility on the site Areas to be disturbed	Potential for disturbance of Native American resources as determined through consultations with potentially affected American Indian Tribal Governments (per DOE Order 1230.2) Noncompliance with existing laws, regulations, and programmatic agreements.
Paleontological resources	Site cultural resource inventory/management plan Existing Programmatic Agreements	Location of proposed facility on the site Areas to be disturbed	Potential for appropriation, excavation, injury, or destruction of resources without permission (per Antiquities Act of 1906). Noncompliance with existing laws, regulations, and programmatic agreements

Land resources analysis for the SPD EIS determined the potential beneficial or adverse impacts on land use and visual resources for the defined ROI. The ROI for land use at each candidate site varies due to disparities in population density and growth trends, the extent of Federal land ownership, adjacent land-use patterns and trends, and other geographic or safety considerations. The ROI for visual resources includes those lands within the viewshed of the proposed action and alternatives.

F.6.2 Description of Impact Assessment

F.6.2.1 Land-Use Analysis

Requirements for the SPD EIS included estimating the impacts of the alternatives on land use within each DOE site, adjacent Federal or State lands, adjacent communities, and wildlife or resource areas. At issue were the net land area affected; its relationship to conforming and nonconforming land uses; current growth trends, land values, and other socioeconomic factors pertaining to land use; and the projected modifications to other facility activities and missions consistent with the proposed alternatives (see Table F–6). Land-use impacts could vary considerably from site to site, depending on existing facility land-use configurations, adjoining land uses, plans for transportation security, proximity to residential areas, and other environmental and containment factors.

Table F–6. Impact Assessment Protocol for Land Resources

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Land use area used	Total site acreage; available acreage	Location of proposed facility on the site; total land area requirements	Facility land requirements greater than 30% of available acreage
Compatibility with existing or future land-use plans, policies, or regulations	Existing facility and regional land-use configurations; applicable plans, policies, or regulations	Location of proposed facility on the site; facility D&D procedures; expected modifications of other facility activities and missions to accommodate proposed alternatives	Incompatibility with existing facility or adjacent land use; encroachment by disturbed area onto sensitive lands protected by existing management plans or policies; significant long-term or permanent loss of land use resulting from facility construction, operation, or D&D
Visual resources	Delineation of nearby visual resources and viewsheds, including Class I areas	Location of proposed facility on the site; facility dimensions and appearance	Significant reduction of assigned VRM classification for a notable viewshed

Key: D&D, decontamination and decommissioning; VRM, Visual Resource Management.

Evaluation of existing land uses at each of the potentially affected sites required review of existing and future facility land-use plans. Where land adjacent to the proposed site is managed by local government, applicable community general plans, zoning ordinances, and population growth trend data were reviewed. Where such land is managed or under the jurisdiction of a Federal or State land management agency, the respective agency resource management plans and policies were reviewed. Total land area requirements include those areas to be occupied by the footprint of each building and nonbuilding support area, in conjunction with all paved roads, parking areas, graveled areas, and construction laydown areas, and any land graded and cleared of vegetation. Land area requirements were identified using proposed facility data reports.

F.6.2.2 Visual Resources Analysis

Visual resource impacts are changes in the physical features of the landscape attributable to the proposed action. Visual resource assessment was based on the Bureau of Land Management Visual Resource Management (VRM) classification scheme. Impacts on scenic or visual resources were analyzed by identifying existing VRM classifications and documenting any potential reductions therein at each of the alternative locations as a result of the proposed action or alternatives (see Table F–6). Existing class designation were derived from an inventory of scenic qualities, sensitivity levels, and distance zones for particular areas. The elements of scenic quality are landforms, vegetation, water, color, adjacent scenery, scarcity, and cultural modification. Scenic value is determined by the variety and harmonious composition of the elements of scenic quality. Sensitivity levels are determined by user volumes and user attention. Distance zones concern the visibility from travel routes or observation points.

Important concerns of the visual resources analysis were the degree of contrast between the proposed action and the surrounding landscape, the location and sensitivity levels of public vantage points, and the visibility of the proposed action from the vantage points. The distance from a vantage point to the affected area and atmospheric conditions were also taken into consideration, for distance and haze can diminish the degree of contrast and visibility. A qualitative assessment of the degree of contrast between the proposed facilities or activities and the existing visual landscape was also presented. Reduction of an assigned VRM classification could result if the affected area could be seen from the vantage point with a high sensitivity level.

F.7 INFRASTRUCTURE

F.7.1 Description of Affected Resources

Site infrastructure includes physical resources required to support the construction and operation of facilities. It includes the capacities of the onsite road and rail transportation networks; electric power and electrical load capacities; natural gas, coal, and fuel oil capacities; and water supply system capacities.

The ROI is generally limited to the boundaries of DOE sites. However, should infrastructure requirements exceed site capacities, the ROI would be expanded (for analysis) to include the sources of additional supply. For example, if electrical demand (with added facilities) exceeded site availability, then the ROI would be expanded to include the likely source of additional power: the power pool currently supplying the site.

F.7.2 Description of Impact Assessment

In general, infrastructure impacts were assessed by evaluating the requirements of each alternative against the site capacities. An impact assessment was made for each resource (road networks, rail interfaces, electricity, fuel, and water) for the various alternatives (see Table F-7). Tables reflecting site availability and infrastructure requirements were developed for each alternative. Data for these tables were obtained from reports describing the existing infrastructure at the sites, and from the data reports for each facility. If necessary, design mitigation considerations conducive to reduction of the infrastructure demand were also identified.

Any projected demand for infrastructure resources exceeding site availability can be regarded as an indicator of environmental impact. Whenever projected demand approaches or exceeds capacity, further analysis for that resource is warranted. Often, design changes can mitigate the impact of additional demand for a given resource. For example, substituting fuel oil for natural gas (or vice versa) for heating or industrial processes can be accomplished at little cost during the design of a facility, provided the potential for impact is identified early. Similarly, a dramatic "spike" in peak demand for electricity can sometimes be mitigated by changes to operational procedures or parameters.

F.8 WASTE MANAGEMENT

F.8.1 Description of Affected Resources

The operation of surplus plutonium disposition support facilities would generate several types of waste, depending on the alternative. Such wastes include the following:

Table F–7. Impact Assessment Protocol for Infrastructure

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Transportation Roads (km) Railroads (km)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Electricity Energy consumption (MWh/yr) Peak load (MW)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Fuel Natural gas (m^3/yr) Oil (l/yr) Coal (t/yr)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Water (l/yr)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity

- **Transuranic:** Waste containing more than 100 nCi of alpha-emitting transuranic (TRU) isotopes with half-lives greater than 20 year per gram of waste, except for (1) high-level waste; (2) waste that DOE has determined, with the concurrence of EPA, does not need the degree of isolation required by 40 CFR 191, and (3) waste that the U.S. Nuclear Regulatory Commission (NRC) has approved for disposal, case by case in accordance with 10 CFR 61. Mixed transuranic waste contains hazardous components regulated under the Resource Conservation and Recovery Act (RCRA).

- **Low-level:** Waste that contains radioactivity and is not classified as high-level waste, TRU waste, or spent nuclear fuel,[1] or the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the TRU concentration is less than 100 nCi/g of waste.

- **Mixed low-level:** Low-level waste that also contains hazardous components regulated under the RCRA.

- **Hazardous:** Under the RCRA, a solid waste that, because of its characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness, or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes appear on special EPA lists or possess at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act.

- **Nonhazardous:** Discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act.

[1] Fuel withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

The alternatives for surplus plutonium disposition could have an impact on existing site facilities devoted to the treatment, storage, and disposal of these categories of waste.

For new facilities, construction wastes would be similar to those generated by any construction project of comparable scale. Wastes generated during the modification of existing nuclear facilities, however, could produce additional radioactive or hazardous demolition debris.

Waste management activities in support of the disposition of surplus plutonium would be contingent on Records of Decision (RODs) issued for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a). Depending on future waste type–specific RODs, in accordance with that EIS, wastes could be treated and disposed of on the site or at regionally or centrally located waste management centers. According to the TRU Waste ROD issued on January 20, 1998, TRU and TRU mixed waste would be treated on the site according to the current planning-basis Waste Isolation Pilot Plant Waste Acceptance Criteria and shipped to the Waste Isolation Pilot Plant (WIPP) for disposal. The impacts of disposing of TRU waste at WIPP are described in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b). Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, it is assumed TRU waste would be stored on the site until 2016.

F.8.2 Description of Impact Assessment

As shown in Table F–8, impacts were assessed by comparing the projected waste stream volumes generated from the proposed activities at each site with current site waste generation rates and storage volumes.[2] Furthermore, projected waste generation rates for the proposed activities were compared with processing rates and capacities of those existing treatment, storage, and disposal facilities likely to be involved in managing the additional waste. Most likely, each waste type would be managed at many different facilities; for simplicity, however, it was assumed that the entire waste volume would be managed at one treatment facility, one storage facility, and one disposal facility.

Table F–8. Impact Assessment Protocol for Waste Management

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Waste management capacity TRU waste Low-level waste Mixed low-level waste Hazardous waste Nonhazardous waste	Site generation rates (m^3/yr) for each waste type Site management capacities (m^3) or rates (m^3/yr) for potentially affected treatment, storage, and disposal facilities for each waste type	Construction and operations generation rates (m^3/yr) for each waste type	SPD facility waste generation rates are a large percentage of existing site generation rates and a large percentage of capacities of applicable waste management facilities.
Disposal capacity for transuranic waste (including mixed TRU waste)	TRU waste volume (m^3) expected to be disposed of at WIPP Capacity at WIPP (m^3)	Total TRU waste generated (m^3) for SPD facilities	Combination of SPD facility TRU waste generation, and existing TRU waste generation exceeds capacity of WIPP.

Key: SPD, surplus plutonium disposition; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

[2] For the SPD EIS, only the impacts relative to the capacities of waste management facilities were considered. Environmental impacts of waste management facility operation are evaluated in other facility-specific or sitewide NEPA documents.

Next Section

F.9 SOCIOECONOMICS

F.9.1 Description of Affected Resources

Socioeconomic impacts may be defined as the environmental consequences of a proposed action in terms of demographic and economic changes. Two types of jobs would be created as a result of DOE's adopting any of the surplus plutonium disposition alternatives: (1) construction-related jobs, transient in nature and short in duration, and thus less likely to impact public services; and (2) jobs related to plant operations, required for a decade or more and thus possibly creating additional service requirements in the ROI.

F.9.2 Description of Impact Assessment

Before the socioeconomic analyses could begin, the socioeconomic environment had to be defined for two geographic regions, the regional economic area (REA) and ROI. The REA is used to assess potential effects of an action on the regional economy. REAs are the broad markets defined by the economic linkages among and between the regional industrial and service sectors and the communities within a region. These linkages determine the nature and magnitude of any multiplier effect associated with a change in economic activity.

For example, as work expands at a given site, the money spent on accomplishing this work flows into the local economy; it is spent on additional jobs, goods, and services within the REA. Using the Regional Input-Output Modeling System (RIMS II) developed by the Bureau of Economic Analysis of the U.S. Department of Commerce, the regional economic impacts of a proposed project can be estimated over the life of the project.

Similarly, potential demographic impacts were assessed for the ROI. The ROI could represent a smaller geographic area—one in which only the housing market and local community services would be significantly affected by a given alternative. Site-specific ROIs were identified as those counties in which at least 90 percent of the site's workforce reside. This distribution reflects existing residential preferences for people currently employed at the sites and was used to estimate the distribution of new workers required to support the alternatives.

For each REA, data were compiled on the current socioeconomic conditions, including unemployment rates, economic sector activities, and the civilian labor force. For each ROI, statistics were compiled on the housing demand and community services. These data were combined with population forecasts developed using U.S. Census Bureau data to project changes to reflect the various siting alternatives being considered. Site-specific data were then used to help determine whether the overall workforce would be increased by the alternatives being considered (see Table F–9).

In some cases, a site's overall workforce was projected to decrease at the same time additional workers would be needed to support an alternative under consideration in the SPD EIS. In these cases, there would be little change in the site's overall workforce from current levels, and thus very little change in requirements for community services would be expected from a particular alternative. In the alternative, where the projected increases in the site workforce were greater than current levels, the impacts on community services were assessed by determining the increase in community services required to maintain the current status.

F.10 HUMAN HEALTH RISK DURING NORMAL OPERATIONS

F.10.1 Description of Affected Resources

Assessments for the SPD EIS aimed in part at enhancing public understanding of the potential impacts of each of the alternatives on their own health and that of workers. Included was a description of the radiological and

Table F–9. Impact Assessment Protocol for Socioeconomics

Resource	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Workforce requirements	Site workforce projections from DOE sites	Estimated construction and operating staff requirements and timeframes	Workforce requirements added to sites' workforce projections
REA civilian labor force	Labor force projections based on State population projections	Estimated construction and operating staff requirements and timeframes	Workforce requirements as a percentage of the civilian labor force
Unemployment rate	1996 unemployment rates in counties surrounding sites and in host States	Estimated construction and operating staff requirements	Projected change in unemployment rates
Health care services Number of hospital beds per 100,000 residents	Latest available rates based on telephone interviews with area hospitals and State hospital associations	Estimated influx of new health care facilities to meet construction and operating staff requirements	Projected change in numbers to maintain current rates
Number of physicians per 100,000 residents	Latest available rates based on AMA data	Estimated influx of new health care employees to meet construction and operating staff requirements	Projected change in numbers to maintain current rates
Housing—Percent of occupied housing units	Latest available rates from the U.S. Census Bureau	Estimated influx of new housing units needed for influx of construction and operating staff requirements	Projected change in numbers to maintain current rates
Schools Percent operating capacity for school districts in ROI	Latest available rates based on telephone interviews with school districts	Estimated influx of new students generated by movement of employees and their families into ROI	Projected change in operating capacity for school districts in ROI
Teacher-to-student ratio	Latest available rates based on telephone interviews with school districts	Estimated influx of new students generated by movement of employees and their families into ROI	Projected change in number of teachers to maintain current teacher-to-student ratio
Community services Ratio of police to 100,000 residents	Latest number of sworn officers based on telephone interviews with police departments	Estimated influx of new officers to meet construction and operating staff requirements	Projected change in number of officers to maintain current police-to-resident ratio
Ratio of firefighters to 100,000 residents	Latest number of firefighters based on telephone interviews with fire departments	Estimated influx of new firefighters to meet construction and operating requirements	Projected change in number of firefighters to maintain current firefighter-to-resident ratio

Key: AMA, American Medical Association; REA, regional economic area; ROI, region of influence.

chemical releases resulting from construction activities and normal operations for each alternative, including No Action, and the impacts on public and occupational health.

The risks from radiation were not added to those from hazardous chemicals, given the considerable uncertainty as to their combined effects. Impacts of some chemicals are enhanced by radiation, while those of others are not affected or can even be reduced. The reverse also holds true: chemicals can increase, decrease, or not influence radiological effects.

For the public, impacts on individuals (maximally exposed and average exposed) and on the population within 80 km (50 mi) of the site were evaluated; for workers, the focus was impacts on individuals and on the total facility workforces. The basic health risk issue addressed was whether any of the alternatives would result in undue numbers of health effects (e.g., cancers among workers or the public). Since protection of human health is regulated by DOE, EPA, NRC, and the Occupational Safety and Health Administration (OSHA), estimates of public and worker doses and associated health risks are also necessary to demonstrate that surplus plutonium disposition facilities are being designed in compliance with the applicable standards issued by these agencies.

F.10.2 Description of Impact Assessment

F.10.2.1 Public Health Risks

The health risks to the general public were determined in the following ways: (1) for present operations, doses stated in the most recent environmental or safety reports were used to calculate health risks; and (2) for operations of the proposed facilities, incremental radiological and chemical doses were modeled using specific facility data and site-dependent parameters and converted into their associated health risks.

Radiological and chemical impacts associated with for the No Action Alternative were estimated from projected releases from all site facilities that are expected to be operating at the time the actions assessed in this SPD EIS commence. For each of the other alternatives, radiological and chemical effluents were obtained from facility data reports specific to each surplus plutonium disposition process.

Public health risk assessments from radiological releases during normal operations of the proposed facilities at the candidate sites were performed using the Generation II (GENII) computer code, to calculate doses from inhalation, ingestion of terrestrial foods, and direct exposure to radiation in plumes or on the ground. This type of assessment uses site-dependent factors, including meteorology, population distributions, agricultural production, and facility locations on a given site. As reflected in Table F–10, doses were calculated for the maximally exposed individual (MEI) member of the public, for the average exposed member of the public, and for the total population living within 80 km (50 mi) of a given release location (NRC 1977:1.109.30).

Total site doses were compared with regulatory limits and, for perspective, with background radiation levels in the vicinity of the site. These doses were also converted into a projected number of fatal cancers using a risk estimator of 500 fatal cancers per 1 million person-rem derived from data prepared by the National Research Council's Committees on the Biological Effects of Ionizing Radiations and by the International Commission on Radiological Protection Publication 60 (ICRP 1991). The calculated health effects were compared with those arising among the same population groups from other causes.

Since portions of the surplus plutonium disposition processes could involve the use of hazardous chemicals, there could be hazardous chemical emissions that have the potential to affect human health. As indicated in Table F–10, two general types of hazardous materials were assessed: (1) those that are carcinogenic and (2) those that are not carcinogenic but could adversely affect organs or tissues.

Table F–10. Impact Assessment Protocol for Human Health Risk

Risk	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Radiation: public			
Offsite MEI dose via airborne pathways	Current annual dose (mrem) to MEI via all airborne pathways at site	Annual radionuclide release rates (Ci) to air from proposed facility. Stack height. Location of proposed facility on the site.	Annual dose greater than 10 mrem via airborne releases (NESHAP limit).
Offsite MEI dose via liquid pathways	Current annual dose (mrem) to MEI via all liquid pathways at site	Not applicable. There are no liquid releases directly from proposed facility.	Annual dose via liquid releases greater than 4 mrem (SDWA limit is used as basis).
Offsite MEI dose via all pathways, including air, water, and others (e.g., direct radiation)	Current annual dose (mrem) to MEI via all pathways at site Annual radionuclide release rates to air and water from site release locations Joint frequency meteorological data Water dilution factors Distances from radionuclide release points to site boundary for 16 cardinal directions Exposure information associated with other potential pathways (e.g., direct radiation from each site area)	Annual radionuclide releases to air and via any other pathway (e.g., direct radiation) from proposed facility. No liquid releases directly from facility are expected. Stack height. Location of proposed facility on the site. Exposure information associated with other potential pathways (e.g., direct radiation).	Annual dose greater than 100 mrem via all pathways (DOE 5400.5)
Dose to population within 80 km (50 mi) of site via all pathways	Current annual population dose (person-rem) via all pathways at site Projected population distribution within an 80-km (50-mi) radius from radionuclide release points Latest available milk, meat, and vegetable distributions within an 80-km (50-mi) radius from radionuclide release points Joint frequency meteorological data Water usage values (e.g., fish harvest, number of water drinkers) Water dilution factors	Annual radionuclide release rates (Ci) to air from proposed facility. No liquid releases directly from facility are expected. Stack height. Location of proposed facility on the site.	Annual population dose greater than 100 person-rem via all pathways (proposed 10 CFR 834).
Radiation: occupational			
Average dose to involved (facility) worker[a]	Not applicable	Annual average dose (mrem) to the facility worker.	Annual dose of more than 750 mrem. This value represents 15% of 10 CFR 835 and 10 CFR 20 limit of 5,000 mrem/yr and 37.5% of DOE administrative control level of 2,000 mrem/yr, and has been chosen to ensure that dose received by average worker is well below dose limits and administrative control level.

Table F–10. Impact Assessment Protocol for Human Health Risk (continued)

Risk	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Average dose to noninvolved (site) worker[a]	Current annual average dose (mrem) among all noninvolved workers at site	Not applicable.	Annual dose of more than 250 mrem. This value represents 5% of 10 CFR 835 limit of 5,000 mrem/yr and 12.5% of the DOE administrative control level of 2,000 mrem/yr, and has been chosen to ensure that dose received by average worker is well below dose limits and administrative control level.
Total dose to involved (facility) workers	Not applicable	Annual total dose (person-rem) among all facility workers. Number of facility workers.	Annual dose of more than 750 mrem times number of involved workers.
Total dose to noninvolved (site) workers	Current annual total dose (person-rem) among all workers at site Number of noninvolved workers	Not applicable.	Annual dose of more than 250 mrem times number of noninvolved workers at site.
Radiation: construction workers			
Average dose to construction worker[a]	Level of existing contamination and dose expected from working in that area of site	Annual average and total dose to construction worker.	For average worker, 50% of values given above for public's MEI. This is based on interpretation of a construction worker as a member of the public and application of a reduction factor of 2 in going to an average rather than a maximally exposed worker.
Total dose to construction workers		Numbers of construction workers.	For total workforce, number of workers in workforce times doses for an average worker.
Hazardous chemicals: public			
Offsite MEI latent cancer incidence risk	Distribution of population in ROI Joint frequency meteorological data	Airborne release (kg/yr) of hazardous chemicals.	Probability of latent cancer incidence for MEI.
Offsite MEI noncancer risk	Distribution of population in ROI Joint frequency meteorological data	Airborne release (kg/yr) of hazardous chemicals.	Likelihood of noncancer effects for MEI.

[a] More meaningful in determining health risk than dose to maximally exposed worker, which varies significantly each year. Monitoring, however, will ensure that dose to the maximally exposed worker remains within regulatory limits.

Key: CFR, Code of Federal Regulations; MEI, maximally exposed individual; NESHAP, National Emission Standards for Hazardous Air Pollutants; ROI, region of influence; SDWA, Safe Drinking Water Act.

Hazardous chemical concentrations in the ambient air of the ROI were modeled using the ISCST3 air emissions model recommended by EPA (EPA 1996b). Latent cancer incidence risks for the maximally exposed individual in the offsite population from chemical releases under normal operation were estimated by comparing the concentrations of airborne hazardous chemicals to chemical-specific cancer inhalation unit risk factors established by EPA. For chronic noncarcinogenic effects, airborne concentrations were compared with EPA's chemical-specific reference concentrations, and a hazard index was calculated for each alternative at each site.

F.10.2.2 Occupational Health Risks

Health risks from radiological exposure were determined for two types of workers: the facility worker, or the worker inside one of the plutonium-processing facilities; and the site worker, or the worker elsewhere on the site but not involved in plutonium processing. Health risks to individual workers and to total workforces were assessed.

The facility worker's dose was based on data from design reports on specific surplus plutonium disposition facilities. It was assumed that the noninvolved site worker only receives a dose that results from his primary onsite activities. No additional dose to these workers would be expected from surplus plutonium disposition facility operation.

Worker doses were converted into the number of projected fatal cancers using the risk estimator of 400 fatal cancers per 1 million person-rem given in the International Commission on Radiological Protection Publication 60 (ICRP 1991). This risk estimator, compared with that for members of the public, reflects the absence of the most radiosensitive age groups (i.e., infants and children) in the workforce.

F.11 FACILITY ACCIDENTS

F.11.1 Description of Affected Resources

Processing any hazardous material poses a risk of accidents impacting involved workers (workers directly involved in facility processes), noninvolved workers (workers on the site but not directly involved in facility processes), and members of the public. The consequences of such accidents could involve the release of radioactive or chemical material or the release of hazardous (e.g., explosive) energy, beyond the intended confines of the process. Risk is determined by the development of a representative spectrum of accidents, each of which is conservatively characterized by a likelihood (i.e., expected frequency of occurrence) and a consequence.

For the purpose of this analysis, involved workers were defined as workers in the immediate vicinity of the process involved in the accident; noninvolved workers, as workers located at the closer of 1,000 m (3,281 ft) from the accident (emission) source or the site boundary; and members of the public, as persons residing outside the site boundary and within 80 km (50 mi) of the facility.

F.11.2 Description of Impact Assessment

To avoid duplication, the analysis of potential accidents performed for the SPD EIS took full cognizance of the corresponding analyses in the *Storage and Disposition Final PEIS* (DOE 1996a), including accident sequence development, source term definition, and consequence analysis. The analysis focused on the likelihoods and consequences of a variety of a bounding spectrum of accidents postulated for each alternative, from high-consequence, low-frequency accidents to low-consequence, high-frequency accidents.

One objective of the accident analysis, a follow-on to a hazard analysis, was to translate each source term into a probabilistic distribution of consequences based on site-specific modeling of meteorological dispersion of the hazardous material and resulting uptake of that material by members of the human population. To predict the impacts of postulated accidents on the health of workers and the public, source terms were translated into consequences using the Melcor Accident Consequence Code System (MACCS2).

Metrics used to measure the impact of each accident include the accident frequency, the mean and 95th percentile doses for the noninvolved worker at the closer of 1,000 m (3,281 ft) or the site boundary, the mean and 95th percentile doses for the MEI at the site boundary, and the mean and 95th percentile doses for members of the general public within 80 km (50 mi) of the facility. Additionally, the individual doses were translated into the probability of latent cancer fatality, and the dose to the general public into the expected number of latent cancer fatalities (see Table F–11). Additional information on the development of accident sequences, source term definition, and consequence analysis can be found in Appendix K.

Table F–11. Impact Assessment Protocol for Facility Accidents

Accident	Required Data		Measure of Impact
	Affected Environment	Facility Design	
Operational events External events NPH events	Meteorological data Data on population within 80 km (50 mi) of facility Site boundary data	Accident source terms Accident frequencies Facility location	Radiological dose at 1,000 m (3,281 ft) from accident source Probability of latent cancer fatality given dose at 1,000 m (3,281 ft) Radiological dose to offsite MEI Probability of latent cancer fatality given dose at site boundary Dose to general public within 80 km (50 mi) of facility Latent cancer fatalities among general public within 80 km (50 mi) of facility

Key: MEI, maximally exposed individual; NPH, natural phenomena hazard.

F.12 TRANSPORTATION IMPACTS

F.12.1 Description of Affected Resources

Overland transportation of any commodity involves a risk to both transportation crew members and members of the public. This risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of cargo. The transportation of plutonium, radioactive waste, or other nuclear materials can pose additional risks owing to the unique properties of the material.

Accordingly, DOE, NRC, and the U.S. Department of Transportation have instituted strict policies and regulations governing the transport of such materials. The requirements are applicable throughout a shipment's ROI, which encompasses the onsite roadways, as well as the public roads between DOE sites and between DOE sites and commercial sites. For site-to-site transport, for example, shippers are required to use interstate highways predominantly.

F.12.2 Description of Impact Assessment

The risk from incident-free transportation was assessed for persons living within 0.8 km (0.5 mi) of the route; the risk from hypothetical accidents, for persons living within 80 km (50 mi) of the route. Assessment of the human health risks of overland transportation is crucial to a complete appraisal of the environment impacts of transportation associated with the surplus plutonium disposition alternatives.

The impacts associated with overland transportation were calculated per shipment, and then multiplied by the number of shipments. This approach allowed for maximum flexibility in determining the risk for a variety of alternatives (see Table F–12).

Table F–12. Impact Assessment Protocol for Transportation

Risk	Required Data: Affected Environment	Required Data: Facility Design	Measure of Impact
Incident-free transportation			
Radiation dose to crew		Origin and destination of shipments Characterization of vehicles and material shipped	Dose and latent cancer fatalities to crew
Radiation dose to public On-link Off-link During stops	Population within 0.8 km (0.5 mi) of route Number of persons using a highway Traffic conditions along route	Origin and destination of shipments Characterization of vehicles and material shipped	Dose and latent cancer fatalities to public
Maximally exposed crew member		Origin and destination of shipments Characterization of vehicles and material shipped Location of workers	Radiation doses compared with 10 CFR 20 limits (2 mrem/hr and 100 mrem/yr)
Maximally exposed member of public		Origin and destination of shipments Characterization of vehicles and material shipped	Radiation doses compared with 10 CFR 20 limits (2 mrem/hr and 100 mrem/yr)
Health risks from vehicle emissions		Origin and destination of shipments Characterization of vehicles	Fatalities
Transportation accidents			
Radiological risk to public	Population within 80 km (50 mi) of route	Origin and destination of shipments Characterization of vehicles and material shipped	Doses and latent cancer fatalities
Nonradiological risk to public (nonradiological)	Traffic conditions along route	Origin and destination of shipments	Fatalities
Maximally exposed individual		Origin and destination of shipments Characterization of vehicles and material shipped	Doses and latent cancer fatalities

Key: CFR, Code of Federal Regulations.

Fundamental assumptions of this analysis were consistent with those of the *Storage and Disposition Final PEIS* (DOE 1996a), and the same computer codes, release data, and accident scenarios were used. The HIGHWAY computer program was used for selecting highway routes for transporting radioactive materials by truck. The HIGHWAY database is a computerized road atlas that currently describes approximately 386,242 km (240,000 mi) of roads. A complete description of the interstate system and all U.S. highways is included in the database. Most of the principal State highways and many local and community roadways are also identified. The code is updated periodically to reflect current road conditions, and has been benchmarked against the reported mileages and observations of commercial trucking firms.

The first analytic step in the ground transportation analysis was to determine the incident-free and accident risk factors per shipment, for transportation of the various types of hazardous materials. As with any risk estimate, the risk factors were calculated as the product of the probability and the magnitude of the exposure. Accident risk factors were calculated for radiological and nonradiological traffic accidents. The probabilities (much lower than unity [i.e., 1]) and the magnitudes of exposure were multiplied, yielding risk numbers. Incident-free risk factors were calculated for crew and public exposure to radiation emanating from the package and for public exposure to the chemical toxicity of the transportation vehicle exhaust. The probability of incident-free exposure is unity.

The RADTRAN4 computer code (Neuhauser and Kanipe 1993) was used for the incident-free and accident risk assessments to estimate the impacts on collective populations. RADTRAN 4 was developed by Sandia National Laboratories to calculate population risk associated with the transportation of radioactive materials by a variety of modes: truck, rail, air, ship, and barge. Calculations are in terms of the probabilities and consequences of potential exposure events.

The RISKIND computer code (Yuan et al. 1993) was used to estimate the incident-free doses to MEIs and to develop impact estimates for use in the accident consequence assessment. This code was developed for DOE's Office of Civilian Radioactive Waste Management to analyze the exposure of individuals during incident-free transportation. It also allows for a detailed assessment of the consequences for individuals and population subgroups of severe transportation accidents in various environmental settings.

RISKIND calculations supplemented the collective risk results achieved with RADTRAN 4; they addressed areas of specific concern to individuals and population subgroups. Essentially, the RISKIND analyses answered the "what if" questions, such as, "What if I live next to a site access road?" or "What if an accident happens near my town?"

Radiological doses, expressed in units of rem, were multiplied by the ICRP 60 (ICRP 1991) conversion factors and the estimated numbers of shipments to produce risk estimates in units of latent cancer fatalities. The vehicle emission risk factors were calculated in terms of latent fatalities; the vehicle accident risk factors, in fatalities. The nonradiological risk factors were multiplied by the number of shipments.

For each alternative, risks of both incident-free and accident conditions were assessed. For the incident-free assessment, risks were calculated for "collective populations" of potentially exposed individuals and for MEIs. (The collective population risk is a measure of the radiological risk posed to society as a whole by the alternative being considered. It was the primary means of comparing the various alternatives.) The accident assessment had two components: (1) a probabilistic risk assessment, which addressed the probabilities and consequences of a range of possible transportation accident environments, including low-probability accidents with high consequences and high-probability accidents with low consequences; and (2) an accident consequence assessment, which concerned only the consequences of the most severe transportation accidents postulated.

F.13 ENVIRONMENTAL JUSTICE

F.13.1 Description of Affected Resources

Constituting the affected environment are the low-income and minority populations residing in the potentially affected area. For the analysis of environmental justice relative to incident-free transportation, that area was defined as a corridor 1.6 km (1 mi) wide centered on rail or truck routes. For analyses pertaining to transportation accidents and evaluations of environmental justice in facility environs, it consisted of the geographical area within an 80 km (50 mi) distance of the accident site or facility.

Minority populations were split among four groups: Hispanic, Asians, Blacks, and Native Americans. The population group designated as Hispanic includes all persons who identified themselves as having Hispanic origins, regardless of race. For example, a person self-identified as Asian and of Hispanic origin was included among Hispanics. Persons self-identified as Asian and not of Hispanic origin were included in the Asian population.

Block group spatial resolution was used throughout the analysis (see Table F–13). The U.S. Census Bureau defines block group to include 250–500 housing units with 400 being typical. The minority population residing in the affected area was determined from data contained in Table P12 of Standard Tape File 3A published by the U.S. Bureau of the Census (DOC 1992). Low-income populations were estimated from data in Table P121 (DOC 1992:B-28, B-29), which provides statistical data characterizing income status relative to the poverty threshold for each block group.

Table F–13. Impact Assessment Protocol for Environmental Justice

Resource	Required Data: Affected Environment	Required Data: Health Effects	Measure of Impact
Minority population	Minority population data at block group spatial resolution from Table P12 of STF3A (DOC 1992)		Disproportionately high annual population dose to minority population (CEQ 1997:app. A)
	Distribution within 80 km (50 mi) of each candidate site	Population dose for sectors within 80-km (50-mi) radius of candidate site	
	Distribution within 1.6 km (1 mi) of transportation corridors	Population dose for areas within 1.6-km (1-mi) radius of transportation corridor	
Low-income population	Low-income population data at block group spatial resolution from Table P121 of STF3A (DOC 1992)		Disproportionately high annual population dose to low-income population (CEQ 1997:app. A)
	Distribution within 80 km (50 mi) of each candidate site	Population dose for sectors within 80-km (50-mi) radius of candidate site	
	Distribution within 1.6 km (1 mi) of transportation corridor	Population dose for areas within 1.6-km (1-mi) radius of transportation corridor	

Key: CEQ, Council on Environmental Quality; DOC, U.S. Department of Commerce; STF, Standard Tape File.

F.13.2 Description of Impact Assessment

Formal requirements for inclusion of environmental justice concerns in environmental documentation were initiated by Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, issued in February 1994. The Council on Environmental Quality has oversight responsibility for implementation of the Executive order in documentation prepared under the provisions of NEPA. The Council issued draft guidance for environmental justice in May 1996 (CEQ 1997). These guidelines provide the foundation for evaluation of environmental justice in this SPD EIS.

Analysis of environmental justice for the SPD EIS focused on the "block group," one of the geographical aggregations of demographic data typically provided by the Bureau of the Census (DOC 1992). Block groups provide the finest spatial resolution available for evaluation of low-income populations. It is rare, however, that the boundaries of block groups coincide with those of affected areas. Uniform population distribution within block groups is also uncommon. Such uniformity was assumed, however, for purposes of SPD EIS population estimates. Thus, for each block group, the percentage of the population included in the population count equaled the percentage of the geographical area of the block group that lay within the affected area. An upper bound for the potentially affected population was obtained by including the total population of partially included block groups in the population count; a lower bound, by excluding the total population of such block groups from the count.

The following definitions were used in the evaluation:

- **Minority individuals:** Persons who are members of any of the following population groups: Hispanic; American Indian, Eskimo, or Aleut (Native Americans); Asian or Pacific Islander; or Black. This definition includes all persons except those self-designated as not of Hispanic origin and as either White or "Other Race" (one of the classifications used by the U.S. Bureau of the Census in the 1990 census).

- **Minority population:** The total number of minority individuals residing within a potentially affected area.

- **Low-income individuals:** All persons whose self-reported income is below the poverty threshold as adopted by the U.S. Census Bureau (DOC 1992:app. B, B-28).

- **Low-income population:** The total number of low-income individuals residing within a potentially affected area.

If the analysis of health or other environmental effects showed that the actions consistent with the proposed alternatives would have significant impacts on the general population, then additional analysis of impacts on the minority and low-income populations was conducted. The analysis method was identical to that described for the evaluation of radiological impacts on the general population. Given the impracticality of extrapolating block level population and income data, minority and low-income populations within each block group were assumed to increase in direct proportion to the increase in general population from the year 1990 to the year of interest.

F.14 CUMULATIVE IMPACTS

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The cumulative impact analysis for the SPD EIS involved combining the impacts of the SPD EIS alternatives (including No Action) with the impacts of other past, present, and reasonably foreseeable activities in an ROI.

The ROIs for different resources can vary widely in extent. For example, the ROI for land use would include all impacts on land use in the environs of the specific area affected by the program alternatives. For groundwater, the ROI would generally be smaller, encompassing only those groundwater flow systems affected by the program alternatives. The ROI for socioeconomics could include all the cities and towns directly or indirectly affected by activities.

In general, cumulative impacts were calculated by adding the values for the baseline,[3] the proposed action, and other future actions. This cumulative value was then weighed against the appropriate impact indicators to determine the potential for impact. For this cumulative impact assessment, it was conservatively assumed that all facilities would operate concurrently at the DOE sites. Only selected indicators of cumulative impacts (see Table F–14) were evaluated.

Table F–14. Selected Indicators of Cumulative Impact

Category	Indicator
Resource use	Land occupied Electricity use Water use Workers required
Socioeconomics	Percent change in regional employment
Air quality	Percent of NAAQS for criteria pollutants
Human health	Offsite population MEI dose Total dose Fatalities Workers Average dose Total dose Fatalities
Waste generation	TRU waste LLW Mixed LLW Hazardous waste Sanitary wastewater

Key: LLW, low-level waste; MEI, maximally exposed individual; NAAQS, National Ambient Air Quality Standards; TRU, transuranic.

The analysis focused on the potential for cumulative impacts at each candidate site from DOE actions under detailed consideration at the time of this SPD EIS (see Table F–15). Non-DOE actions were also considered where information was readily available. Public documents prepared by agencies of Federal, State, and local government were the primary sources of information for the non-DOE actions.

It is assumed that construction impacts would not be cumulative, because such construction is typically of short duration, and construction impacts are generally temporary. D&D of the proposed facilities was not addressed in the cumulative impact estimates. Given the uncertainty regarding the timing of D&D, any impact estimate at this time would be highly speculative. A detailed evaluation of D&D will be provided in follow-on NEPA documentation closer to the actual time of those actions.

[3] The conditions attributable to actions, past and present, by DOE and other public and private entities.

Table F–15. Other Past, Present, and Reasonably Foreseeable Actions Included in the Cumulative Impact Assessment

Activities	Hanford	INEEL	Pantex	SRS
Storage and Disposition of Weapons-Usable Fissile Materials	X	X	X	X
Disposition of Surplus Highly Enriched Uranium				X
Construction and Operation of a Tritium Extraction Facility at SRS				X
Interim Management of Nuclear Materials at SRS				X
SRS Waste Management				X
Tritium Supply and Recycling				X
Waste Management	X	X	X	X
Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management	X	X		X
Foreign Research Reactor Spent Nuclear Fuel		X		X
Tank Waste Remediation System	X			
Shutdown of the River Water System at SRS				X
Hanford Reach of the Columbia River - Comprehensive River Conservation Study	X			
Stockpile Stewardship and Management			X	X
Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components			X	
Accelerator Production of Tritium at SRS				X
Hanford Remedial Action and Comprehensive Land Use	X			
Radioactive Releases from WNP and Vogtle Nuclear Power Plant Sites	X			X
Management of Plutonium Residues and Scrub Alloy at RFETS				X

Recent sitewide NEPA documents (see Table F–16) provide the latest comprehensive evaluation of cumulative impacts for the sites.

Table F–16. Recent Comprehensive National Environmental Policy Act Documents for the Department of Energy Sites

Site	Document	Year	ROD Issued[a]
Hanford	*Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*	1996	Pending
INEEL	*DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*	1995	March 1996
Pantex	*Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*	1996	January 1997
SRS	*Savannah River Site Waste Management Final Environmental Impact Statement*	1995	October 1995

[a] Date of the first ROD issued.

Key: ROD, Record of Decision.

F.15 REFERENCES

CEQ (Council on Environmental Quality), 1997, *Environmental Justice, Guidance Under the National Environmental Policy Act*, Executive Office of the President, Washington, DC, December 10.

DOC (U.S. Department of Commerce), 1992, *Census of Population and Housing, 1990: Summary Tape File 3 on CD-ROM*, Bureau of the Census, May.

DOE (U.S. Department of Energy), 1995, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, Office of Environmental Management, Idaho Operations Office, Idaho Falls, ID, April.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*, DOE/EIS-0225, Albuquerque Operations Office, Albuquerque, NM, November.

DOE (U.S. Department of Energy), 1997a, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1997b, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, NM, September.

DOE (U.S. Department of Energy), 1997c, *The National TRU Waste Management Plan*, rev. 1, DOE/NTP-96-1204, Carlsbad Area Office, Carlsbad, NM, December.

DOE (U.S. Department of Energy), 1997d, *U.S. Department of Energy Environmental Impact Statements and Environmental Assessments Status Chart*, http://tis.eh.doe.gov/nepa/process/1297eaeis.pdf (URL address, World Wide Web), Office of NEPA Policy and Assistance, Washington, DC, September 2.

EPA (U.S. Environmental Protection Agency), 1991, *Compilation of Air Pollutant Emission Factors: Mobile Sources*, 4th ed., vol. II, AP-42, supp. A, Office of Mobile Source Air Pollution Control, Ann Arbor, MI, January.

EPA (U.S. Environmental Protection Agency), 1993, *Determining Conformity of General Federal Actions to State or Federal Implementation Plans*, 58 FR 63214, Office of the Federal Register, Washington, DC, November 30.

EPA (U.S. Environmental Protection Agency), 1996a, *Compilation of Air Pollutant Emission Factors: Stationary Point and Area Sources*, 5th ed., vol. I, AP-42, supp. B, Office of Air Quality Planning and Standards, Office of Air and Radiation, Research Triangle Park, NC, November.

EPA (U.S. Environmental Protection Agency), 1996b, *Exposure Factor Handbook: General Factors*, vol. 1, EPA/600/P-95/002Ba, Office of Research and Development, National Center for Environmental Assessment, Washington, DC, August.

EPA (U.S. Environmental Protection Agency), 1997a, *National Primary and Secondary Ambient Air Quality Standards,* 40 CFR 50, March 31.

EPA (U.S. Environmental Protection Agency), 1997b, *National Emission Standards for Hazardous Air Pollutants,* "Subpart M–National Emission Standard for Asbestos, Standard for Waste Disposal for Manufacturing, Fabricating, Demolition, Renovation, and Spraying Operations," 40 CFR 61.150, July.

EPA (U.S. Environmental Protection Agency), 1997c, *National Emission Standards for Hazardous Air Pollutants,* "Subpart Y–National Emission Standard for Benzene Emissions from Benzene Storage Vessels," 40 CFR 61.270 and 61.276, July.

EPA (U.S. Environmental Protection Agency), 1997d, *Requirements for Preparation, Adoption, and Submittal of Implementation Plans,* "Permit Requirements," 40 CFR 51.165.

EPA (U.S. Environmental Protection Agency), 1997e, *Guideline on Air Quality Models (Revised),* Appendix W, 40 CFR 51, July.

ICRP (International Commission on Radiological Protection), 1991, *1990 Recommendations of the International Commission on Radiological Protection,* ICRP Publication 60, Elmsford, NY.

Neuhauser, K.S., and F.L. Kanipe, 1993, *RADTRAN4, Volume II Technical Manual,* SAND89-2370, Sandia National Laboratories, Albuquerque, NM, August.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR 50, Appendix I,* Regulatory Guide 1.109, Office of Standards Development, Washington, DC, October.

Yuan, Y.C., S.Y. Chan, D.J. LePoire, and R. Rothman, 1993, *RISKIND - A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel,* rev. 0, ANL/EAIS-06, Argonne National Laboratory, Argonne, IL, February.

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Appendix G
Air Quality

This appendix provides detailed data that support the air quality impact assessments in Chapter 4. Data are provided for the four candidate sites: the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), the Pantex Plant (Pantex), and the Savannah River Site (SRS).

G.1 HANFORD

G.1.1 Assessment Data

Emission rates for criteria, hazardous, and toxic air pollutants at Hanford are presented in Table F.1.2.2–1 of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (PEIS)* (DOE 1996a:F-6). These emission rates were used as input into the modeled No Action Alternative pollutant concentrations presented in that environmental impact statement (EIS) and reflect projected Hanford facility emissions for 2005. The storage alternative selected for Hanford results in no change in these concentrations (DOE 1996a:4-34). In addition to the concentrations projected for 2005, the concentrations for the Phased Implementation Alternative—Phase II Operation of the vitrification facilities presented in the *Tank Waste Remediation System Final EIS* (DOE 1996b:5-68) were included in the estimate of the No Action concentration for surplus plutonium disposition as shown in Table G–1. Other onsite activities related to programs analyzed in EISs for spent nuclear fuel and waste management are also included. Other activities at Hanford that may occur during the time period 2005–2015 are discussed in the cumulative impacts section. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–1. Estimated Concentrations ($\mu g/m^3$) From No Action at Hanford

Pollutant	Averaging Period	PEIS Estimated Base Year (2005)	Tank Waste Remediation	Other Onsite From PEIS	No Action
Carbon monoxide	8 hours	0.08	34	0	34.1
	1 hour	0.30	48	0	48.3
Nitrogen dioxide	Annual	0.03	0.12	0.1	0.25
PM_{10}	Annual	<0.01	0.0079	0	0.0179
	24 hours	0.02	0.75	0	0.77
Sulfur dioxide	Annual	<0.01	0.02	1.6	1.63
	24 hours	<0.01	1.6	7.3	8.91
	3 hours	0.01	3.6	26	29.6
	1 hour	0.02	4.0	29	32.9
Total suspended particulates	Annual	<0.01	0.0079	0	0.0179
	24 hours	<0.02	0.75	0	0.77
Benzene	Annual	(a)	0.000006	0	0.000006
Ethylene glycol	24 hours	(a)	0	0	0

[a] No sources of this pollutant have been identified at the site.
Key: PEIS, *Storage and Disposition Final PEIS*.
Source: DOE 1996a:4-34, 4-912; DOE 1996b:5-68.

G.1.2 Facilities

G.1.2.1 Pit Conversion Facility

G.1.2.1.1 Construction of Pit Conversion Facility

Potential air quality impacts from modification of the Fuels and Materials Examination Facility (FMEF) and construction of support facilities for pit disassembly and conversion at Hanford were analyzed using the Industrial Source Complex Model, Short-Term, Version 3 (ISCST3) as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–2.

Table G–2. Emissions (kg/yr) From Construction of Pit Conversion Facility in FMEF at Hanford

Pollutant	Diesel Equipment and Construction Fugitive Emissions	Vehicles
Carbon monoxide	1,000	7,920
Nitrogen dioxide	2,400	2,120
PM_{10}	3,500	7,220
Sulfur dioxide	160	0
Volatile organic compounds	200	976
Total suspended particulates	9,300	7,220

Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a.

Maximum air pollutant concentrations from construction activities are summarized in Table G–3.

Table G–3. Concentrations ($\mu g/m^3$) From Construction of Pit Conversion Facility in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	34.1	0.277	34.4
	1 hour	40,000	48.3	1.88	50.2
Nitrogen dioxide	Annual	100	0.25	0.0199	0.27
PM_{10}	Annual	50	0.0179	0.029	0.047
	24 hours	150	0.77	0.323	1.09
Sulfur dioxide	Annual	50	1.63	0.00133	1.63
	24 hours	260	8.91	0.0148	8.93
	3 hours	1,300	29.6	0.1	29.7
	1 hour	1,000	32.9	0.301	33.2
	1 hour	700[b]	32.9	0.301	33.2
Total suspended particulates	Annual	60	0.0179	0.0771	0.095
	24 hours	150	0.77	0.857	1.63

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.1.2 Operation of Pit Conversion Facility

Potential air quality impacts from operation of the pit conversion and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–4.

Table G–4. Emissions (kg/yr) From Operation of Pit Conversion Facility in FMEF at Hanford

Pollutant	Emergency Generator	Process	Vehicles
Carbon monoxide	520	0	41,800
Nitrogen dioxide	2,000	0	11,200
PM_{10}	50	0	38,100
Sulfur dioxide	34	0	0
Volatile organic compounds	58	0	5,150
Total suspended particulates	50	0	38,100

Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a.

Maximum air pollutant concentrations resulting from the emergency diesel generators and process sources, plus the No Action concentrations, are summarized in Table G–5. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–5. Concentrations ($\mu g/m^3$) From Operation of Pit Conversion Facility in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	34.1	0.144	34.2
	1 hour	40,000	48.3	0.978	49.3
Nitrogen dioxide	Annual	100	0.25	0.0166	0.267
PM_{10}	Annual	50	0.0179	0.000415	0.0183
	24 hours	150	0.77	0.00461	0.775
Sulfur dioxide	Annual	50	1.63	0.000282	1.63
	24 hours	260	8.91	0.00313	8.91
	3 hours	1,300	29.6	0.0213	29.6
	1 hour	1,000	32.9	0.064	33.0
	1 hour	700[b]	32.9	0.064	33.0
Total suspended particulates	Annual	60	0.0179	0.000415	0.0183
	24 hours	150	0.77	0.00461	0.775

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.2 Immobilization Facility

G.1.2.2.1 Construction of Immobilization Facility

Potential air quality impacts from modification of FMEF and construction of support facilities for plutonium conversion and immobilization (ceramic or glass) at Hanford were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–6.

Table G–6. Emissions (kg/yr) From Construction of Immobilization Facility in FMEF at Hanford

Pollutant	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	810	0	0	26,000
Nitrogen dioxide	2,090	0	0	6,960
PM_{10}	160[b]	121[b]	19[b]	23,700
Sulfur dioxide	210	0	0	0
Volatile organic compounds	170	0	0	3,200
Total suspended particulates	160	121	19	23,700

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998b, 1998c.

Maximum air pollutant concentrations from construction activities are summarized in Table G–7.

Table G–7. Concentrations ($\mu g/m^3$) From Construction of Immobilization Facility in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Ceramic or Glass	Total
Carbon monoxide	8 hours	10,000	34.1	0.224	34.3
	1 hour	40,000	48.3	1.52	49.8
Nitrogen dioxide	Annual	100	0.25	0.0173	0.267
PM_{10}	Annual	50	0.0179	0.00248	0.0204
	24 hours	150	0.77	0.0903	0.86
Sulfur dioxide	Annual	50	1.63	0.00174	1.63
	24 hours	260	8.91	0.0194	8.93
	3 hours	1,300	29.6	0.132	29.7
	1 hour	1,000	32.9	0.395	33.3
	1 hour	700[b]	32.9	0.395	33.3
Total suspended particulates	Annual	60	0.0179	0.00248	0.0204
	24 hours	150	0.77	0.0903	0.86

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.2.2 Operation of Immobilization Facility

Potential air quality impacts from operation of ceramic or glass immobilization and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–8.

Table G–8. Emissions (kg/yr) From Operation of Immobilization Facility in FMEF at Hanford

Pollutant	Emergency Generator	Ceramic Process	Glass Process	Vehicles
Carbon monoxide	390	3,500	0	36,600
Nitrogen dioxide	1,810	0	0	9,810
PM_{10}	130	0	0	33,400
Sulfur dioxide	120	0	0	0
Volatile organic compounds	150	0	0	4,510
Total suspended particulates	130	0	0	33,400

Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998b; 1998c.

Maximum air pollutant concentrations resulting from the emergency diesel generators and process sources, plus the No Action concentrations, are summarized in Table G–9. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–9. Concentrations ($\mu g/m^3$) From Operation of Immobilization Facility in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Ceramic	Total With Ceramic	Glass	Total With Glass
Carbon monoxide	8 hours	10,000	34.1	0.283	34.4	0.108	34.2
	1 hour	40,000	48.3	1.61	49.9	0.734	49.0
Nitrogen dioxide	Annual	100	0.25	0.015	0.265	0.015	0.265
PM_{10}	Annual	50	0.0179	0.00108	0.0190	0.00108	0.019
	24 hours	150	0.77	0.0120	0.782	0.012	0.782
Sulfur dioxide	Annual	50	1.63	0.001	1.63	0.001	1.63
	24 hours	260	8.91	0.0111	8.92	0.0111	8.92
	3 hours	1,300	29.6	0.0753	29.7	0.0753	29.7
	1 hour	1,000	32.9	0.226	33.1	0.226	33.1
	1 hour	700[b]	32.9	0.226	33.1	0.226	33.1
Total suspended particulates	Annual	60	0.0179	0.00108	0.0190	0.00108	0.019
	24 hours	150	0.77	0.0120	0.782	0.012	0.782

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.3 MOX Facility

G.1.2.3.1 Construction of MOX Facility

Potential air quality impacts from construction of new mixed oxide (MOX) and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–10.

Table G–10. Emissions (kg/yr) From Construction of New MOX Facility at Hanford

Pollutant	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	3,200	0	0	32,800
Nitrogen dioxide	8,400	0	0	8,790
PM_{10}	640[b]	5,350	1,090[b]	29,900
Sulfur dioxide	850	0	0	0
Volatile organic compounds	660	0	0	4,040
Total suspended particulates	640	10,500	1,090	29,900
Toxics[c]	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for the purpose of this analysis, resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Source: UC 1998d.

Maximum air pollutant concentrations from construction activities are summarized in Table G–11.

Table G–11. Concentrations ($\mu g/m^3$) From Construction of New MOX Facility at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	34.1	0.885	35.0
	1 hour	40,000	48.3	6.02	54.3
Nitrogen dioxide	Annual	100	0.25	0.0697	0.32
PM_{10}	Annual	50	0.0179	0.0576	0.0755
	24 hours	150	0.77	2.62	3.39
Sulfur dioxide	Annual	50	1.63	0.00705	1.64
	24 hours	260	8.91	0.0784	8.99
	3 hours	1,300	29.6	0.533	30.1
	1 hour	1,000	32.9	1.60	34.5
	1 hour	700[b]	32.9	1.60	34.5
Total suspended particulates	Annual	60	0.0179	0.102	0.12
	24 hours	150	0.77	4.71	5.48
Toxics[c]	Annual	0.12	0.000006	0.000008	0.000014

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) may be emitted during construction and were analyzed as benzene.
Source: EPA 1997; WDEC 1994.

G.1.2.3.2 Operation of MOX Facility

Potential air quality impacts from operation of the new MOX and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–12.

Table G–12. Emissions (kg/yr) From Operation of New MOX Facility at Hanford

Pollutant	Emergency Generator	Process	Vehicles
Carbon monoxide	374	0	34,200
Nitrogen dioxide	1,738	0	9,170
PM_{10}	122	0	31,200
Sulfur dioxide	114	0	0
Volatile organic compounds	142	0	4,210
Total suspended particulates	122	0	31,200
Toxics[a]	0	1,000	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.
Source: UC 1998d.

Maximum air pollutant concentrations resulting from the emergency diesel generators and process sources, plus the No Action concentrations, are summarized in Table G–13. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–13. Concentrations ($\mu g/m^3$) From Operation of New MOX Facility at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	34.1	0.103	34.2
	1 hour	40,000	48.3	0.704	49.0
Nitrogen dioxide	Annual	100	0.25	0.0144	0.264
PM_{10}	Annual	50	0.0179	0.00101	0.0189
	24 hours	150	0.77	0.0113	0.781
Sulfur dioxide	Annual	50	1.63	0.000946	1.63
	24 hours	260	8.91	0.0105	8.92
	3 hours	1,300	29.6	0.0715	29.7
	1 hour	1,000	32.9	0.214	33.1
	1 hour	700[b]	32.9	0.214	33.1
Total suspended particulates	Annual	60	0.0179	0.00101	0.0189
	24 hours	150	0.77	0.0113	0.781
Toxics[c]	24 hours	420	(d)	0.0406	0.0406

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
[c] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State risk-based acceptable source impact level for ethylene glycol is a 24-hr average of 420 $\mu g/m^3$.
[d] No sources of ethylene glycol have been identified at the site.
Source: EPA 1994; WDEC 1994.

G.1.2.4 Pit Conversion and Immobilization Facilities

G.1.2.4.1 Construction of Pit Conversion and Immobilization Facilities

Potential air quality impacts from modification of FMEF and construction of support facilities for pit disassembly and conversion and plutonium conversion and immobilization (ceramic or glass) at Hanford were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–14.

Maximum air pollutant concentrations from construction activities are summarized in Table G–15.

Table G–14. Emissions (kg/yr) From Construction of Pit Conversion and Immobilization Facilities in FMEF at Hanford

	Pit Conversion		Immobilization			
Pollutant	**Diesel Equipment and Construction Fugitive Emissions**	**Vehicles**	**Diesel Equipment**	**Construction Fugitive Emissions[a]**	**Concrete Batch Plant**	**Vehicles**
Carbon monoxide	1,000	7,920	810	0	0	30,000
Nitrogen dioxide	2,400	2,120	2,090	0	0	8,050
PM_{10}	3,500	7,220	160[b]	121[b]	19[b]	27,400
Sulfur dioxide	160	0	210	0	0	0
Volatile organic compounds	200	976	170	0	0	3,700
Total suspended particulates	9,300	7,220	160	121	19	27,400

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a, 1998b, 1998c.

Table G–15. Concentrations ($\mu g/m^3$) From Construction of Pit Conversion and Immobilization Facilities in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	Ceramic or Glass	Total
Carbon monoxide	8 hours	10,000	34.1	0.277	0.224	34.6
	1 hour	40,000	48.3	1.88	1.52	51.7
Nitrogen dioxide	Annual	100	0.25	0.0199	0.0173	0.287
PM_{10}	Annual	50	0.0179	0.029	0.00248	0.0494
	24 hours	150	0.77	0.323	0.0903	1.18
Sulfur dioxide	Annual	50	1.63	0.00133	0.00174	1.63
	24 hours	260	8.91	0.0148	0.0194	8.94
	3 hours	1,300	29.6	0.1	0.132	29.8
	1 hour	1,000	32.9	0.301	0.395	33.6
	1 hour	700[b]	32.9	0.301	0.395	33.6
Total suspended particulates	Annual	60	0.0179	0.0771	0.00248	0.0975
	24 hours	150	0.77	0.857	0.0903	1.72

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.4.2 Operation of Pit Conversion and Immobilization Facilities

Potential air quality impacts from operation of pit conversion, ceramic or glass immobilization, and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–16.

Table G–16. Emissions (kg/yr) From Operation of Pit Conversion and Immobilization Facilities in FMEF at Hanford

	Pit Conversion			Immobilization			
Pollutant	**Emergency Generator**	**Process**	**Vehicles**	**Emergency Generator**	**Ceramic Process**	**Glass Process**	**Vehicles**
Carbon monoxide	520	0	41,800	390	3,500[a]	0	36,600
Nitrogen dioxide	2,000	0	11,200	1,810	0	0	9,810
PM_{10}	50	0	38,100	130	0	0	33,400
Sulfur dioxide	34	0	0	120	0	0	0
Volatile organic compounds	58	0	5,150	150	0	0	4,510
Total suspended particulates	50	0	38,100	130	0	0	33,400

[a] 10,400 for 50-t (55-ton) case.
Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a, 1998b, 1998c.

Maximum air pollutant concentrations resulting from the emergency diesel generators and process sources, plus No Action concentrations, are summarized in Table G–17. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–17. Concentrations ($\mu g/m^3$) From Operation of Pit Conversion and Immobilization Facilities in FMEF at Hanford

					Immobilization			Total[a]	
Pollutant	**Averaging Period**	**Most Stringent Standard or Guidelines[b]**	**No Action**	**Pit Conversion**	**17 or 50 t Glass**	**17 t Ceramic**	**50 t Ceramic**	**With 17 t Ceramic**	**With 50 t Ceramic**
CO	8 hours	10,000	34.1	0.144	0.108	0.283	0.628	34.5	34.9
	1 hour	40,000	48.3	0.978	0.734	1.61	3.33	50.9	52.6
NO_2	Annual	100	0.25	0.0166	0.015	0.015	0.015	0.282	0.282
PM_{10}	Annual	50	0.0179	0.000415	0.00108	0.00108	0.00108	0.0194	0.0194
	24 hours	150	0.77	0.00461	0.012	0.012	0.012	0.787	0.787
SO_2	Annual	50	1.63	0.000282	0.001	0.001	0.001	1.63	1.63
	24 hours	260	8.91	0.00313	0.0111	0.0111	0.0111	8.92	8.92
	3 hours	1,300	29.6	0.0213	0.0753	0.0753	0.0753	29.7	29.7
	1 hour	1,000	32.9	0.064	0.226	0.226	0.226	33.2	33.2
	1 hour	700[c]	32.9	0.064	0.226	0.226	0.226	33.2	33.2
TSP	Annual	60	0.0179	0.000415	0.00108	0.00108	0.00108	0.0194	0.0194
	24 hours	150	0.77	0.00461	0.012	0.012	0.012	0.787	0.787

[a] The concentrations for glass are less than or the same as those for ceramic.
[b] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[c] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
Key: CO, carbon monoxide; FMEF, Fuels and Materials Examination Facility; NO_2, nitrogen dioxide; SO_2, sulfur dioxide; TSP, total suspended particulates.
Source: EPA 1997; WDEC 1994.

G.1.2.5 Pit Conversion and MOX Facilities

G.1.2.5.1 Construction of Pit Conversion and MOX Facilities

Potential air quality impacts from modification of FMEF and construction of support facilities for pit disassembly and conversion and MOX fuel fabrication at Hanford were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–18.

Table G–18. Emissions (kg/yr) From Construction of Pit Conversion and MOX Facilities in FMEF at Hanford

	Pit Conversion		MOX			
Pollutant	**Diesel Equipment and Construction Fugitive Emissions**	**Vehicles**	**Diesel Equipment**	**Construction Fugitive Emissions[a]**	**Concrete Batch Plant**	**Vehicles**
Carbon monoxide	1,000	7,920	648	0	0	32,800
Nitrogen dioxide	2,400	2,120	1,670	0	0	8,790
PM_{10}	3,500	7,220	128[b]	4,750	363[b]	29,900
Sulfur dioxide	160	0	170	0	0	0
Volatile organic compounds	200	976	133	0	0	4,040
Total suspended particulates	9,300	7,220	128	9,350	363	29,900
Toxics[c]	0	0	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a, 1998d.

Maximum air pollutant concentrations from construction activities are summarized in Table G–19.

G.1.2.5.2 Operation of Pit Conversion and MOX Facilities

Potential air quality impacts from operation of pit conversion, MOX, and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–20.

Table G–19. Concentrations ($\mu g/m^3$) From Construction of Pit Conversion and MOX Facilities in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Total
Carbon monoxide	8 hours	10,000	34.1	0.277	0.179	34.5
	1 hour	40,000	48.3	1.88	1.22	51.4
Nitrogen dioxide	Annual	100	0.25	0.0199	0.0139	0.284
PM_{10}	Annual	50	0.0179	0.029	0.0429	0.0898
	24 hours	150	0.77	0.323	2.05	3.14
Sulfur dioxide	Annual	50	1.63	0.00133	0.00141	1.63
	24 hours	260	8.91	0.0148	0.0157	8.94
	3 hours	1,300	29.6	0.1	0.107	29.8
	1 hour	1,000	32.9	0.301	0.32	33.5
	1 hour	700[b]	32.9	0.301	0.32	33.5
Total suspended particulates	Annual	60	0.0179	0.0771	0.0822	0.177
	24 hours	150	0.77	0.857	3.79	5.42
Toxics[c]	Annual	0.12	0.000006	0	0.000008	0.000014

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

Table G–20. Emissions (kg/yr) From Operation of Pit Conversion and MOX Facilities in FMEF at Hanford

	Pit Conversion			MOX		
Pollutant	Emergency Generator	Process	Vehicles	Emergency Generator	Process	Vehicles
Carbon monoxide	520	0	41,800	374	0	34,200
Nitrogen dioxide	2,000	0	11,200	1,738	0	9,170
PM_{10}	50	0	38,100	122	0	31,200
Sulfur dioxide	34	0	0	114	0	0
Volatile organic compounds	58	0	5,150	142	0	4,210
Total suspended particulates	50	0	38,100	122	0	31,200
Toxics[a]	0	0	0	0	1,000	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.
Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998a, 1998d.

Maximum air pollutant concentrations resulting from the emergency diesel generators and process sources, plus the No Action concentrations, are summarized in Table G–21. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–21. Concentrations ($\mu g/m^3$) From Operation of Pit Conversion and MOX Facilities in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Total
Carbon monoxide	8 hours	10,000	34.1	0.144	0.103	34.3
	1 hour	40,000	48.3	0.978	0.704	50.0
Nitrogen dioxide	Annual	100	0.25	0.0166	0.0144	0.281
PM_{10}	Annual	50	0.0179	0.000415	0.00101	0.0193
	24 hours	150	0.77	0.00461	0.0113	0.786
Sulfur dioxide	Annual	50	1.63	0.000282	0.000946	1.63
	24 hours	260	8.91	0.00313	0.0105	8.92
	3 hours	1,300	29.6	0.0213	0.0715	29.7
	1 hour	1,000	32.9	0.064	0.214	33.2
	1 hour	700[b]	32.9	0.064	0.214	33.2
Total suspended particulates	Annual	60	0.0179	0.000415	0.00101	0.0193
	24 hours	150	0.77	0.00461	0.0113	0.786
Toxics[c]	24 hours	420	(d)	0	0.0406	0.0406

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
[c] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State risk-based acceptable source impact level for ethylene glycol is a 24-hr average of 420 $\mu g/m^3$.
[d] No sources of ethylene glycol have been identified at the site.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.6 Immobilization and MOX Facilities

G.1.2.6.1 Construction of Immobilization and MOX Facilities

Potential air quality impacts from modification of FMEF and construction of support facilities for collocating MOX fuel fabrication and plutonium conversion and immobilization (ceramic or glass) at Hanford were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–22.

Maximum air pollutant concentrations from construction activities are summarized in Table G–23.

Table G–22. Emissions (kg/yr) From Construction of Immobilization and MOX Facilities Collocated in FMEF at Hanford

	Immobilization (Ceramic or Glass)				MOX			
Pollutant	Diesel Equipment	Construction Concrete Fugitive Emissions[a]	Batch Plant	Vehicles	Diesel Equipment	Construction Concrete Fugitive Emissions[a]	Batch Plant	Vehicles
Carbon monoxide	1,200	0	0	34,300	648	0	0	32,800
Nitrogen dioxide	3,120	0	0	9,190	1,670	0	0	8,790
PM_{10}	240[b]	121[b]	46[b]	31,300	128	4,750	363	29,900
Sulfur dioxide	320	0	0	0	170	0	0	0
Volatile organic compounds	250	0	0	4,230	133	0	0	4,040
Total suspended particulates	240	121	46	31,300	128	9,350	363	29,900
Toxics[c]	0	0	0	0	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998b, 1998c, 1998d.

Table G–23. Concentrations ($\mu g/m^3$) From Construction of Immobilization and MOX Facilities Collocated in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Ceramic or Glass	MOX	Total
Carbon monoxide	8 hours	10,000	34.1	0.332	0.179	34.6
	1 hour	40,000	48.3	2.26	1.22	51.8
Nitrogen dioxide	Annual	100	0.25	0.0259	0.0139	0.29
PM_{10}	Annual	50	0.0179	0.00338	0.0429	0.0642
	24 hours	150	0.77	0.109	2.05	2.93
Sulfur dioxide	Annual	50	1.63	0.00265	0.00141	1.63
	24 hours	260	8.91	0.0295	0.0157	8.96
	3 hours	1,300	29.6	0.201	0.107	29.9
	1 hour	1,000	32.9	0.602	0.32	33.8
	1 hour	700[b]	32.9	0.602	0.32	33.8
Total suspended particulates	Annual	60	0.0179	0.00338	0.0822	0.103
	24 hours	150	0.77	0.109	3.79	4.67
Toxics[c]	Annual	0.12	0.000006	0	0.000008	0.000014

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.6.2 Operation of Immobilization and MOX Facilities

Potential air quality impacts from operation of the collocated MOX and ceramic or glass immobilization, and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–24.

Table G–24. Emissions (kg/yr) From Operation of Immobilization and MOX Facilities Collocated in FMEF at Hanford

	Immobilization				MOX		
Pollutant	**Emergency Generator**	**Ceramic Process**	**Glass Process**	**Vehicles**	**Emergency Generator**	**Process**	**Vehicles**
Carbon monoxide	390	3,500	0	36,600	374	0	34,200
Nitrogen dioxide	1,810	0	0	9,810	1,738	0	9,170
PM_{10}	130	0	0	33,400	122	0	31,200
Sulfur dioxide	120	0	0	0	114	0	0
Volatile organic compounds	150	0	0	4,510	142	0	4,210
Total suspended particulates	130	0	0	33,400	122	0	31,200
Toxics[a]	0	0	0	0	0	1000	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.
Key: FMEF, Fuels and Materials Examination Facility.
Source: UC 1998b, 1998c, 1998d.

Maximum air pollutant concentrations resulting from the emergency diesel generators and process sources are summarized in Table G–25. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–25. Concentrations ($\mu g/m^3$) From Operation of Immobilization and MOX Facilities Collocated in FMEF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Immobilization Ceramic	Immobilization Glass	MOX	Total With Ceramic	Total With Glass
Carbon monoxide	8 hours	10,000	34.1	0.283	0.108	0.103	34.5	34.3
	1 hour	40,000	48.3	1.61	0.734	0.704	50.6	49.7
Nitrogen dioxide	Annual	100	0.25	0.015	0.015	0.0144	0.279	0.279
PM_{10}	Annual	50	0.0179	0.00108	0.00108	0.00101	0.02	0.02
	24 hours	150	0.77	0.012	0.012	0.0113	0.793	0.793
Sulfur dioxide	Annual	50	1.63	0.001	0.001	0.000946	1.63	1.63
	24 hours	260	8.91	0.0111	0.0111	0.0105	8.93	8.93
	3 hours	1,300	29.6	0.0753	0.0753	0.0715	29.7	29.7
	1 hour	1,000	32.9	0.226	0.226	0.214	33.3	33.3
	1 hour	700[b]	32.9	0.226	0.226	0.214	33.3	33.3
Total suspended particulates	Annual	60	0.0179	0.00108	0.00108	0.00101	0.020	0.020
	24 hours	150	0.77	0.012	0.012	0.0113	0.793	0.793
Toxics[c]	24 hours	420	(d)	0	0	0.0406	0.0406	0.0406

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
[c] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State risk-based acceptable source impact level for ethylene glycol is a 24-hr average of 420 $\mu g/m^3$.
[d] No source of ethylene glycol have been identified at the site.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.7 Pit Conversion, Immobilization, and MOX Facilities

G.1.2.7.1 Construction of Pit Conversion, Immobilization, and MOX Facilities

Potential air quality impacts from modification of FMEF for pit disassembly and conversion and plutonium conversion and immobilization (ceramic or glass), and new construction of MOX and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–26.

Maximum air pollutant concentrations from construction activities are summarized in Table G–27.

Table G–26. Emissions (kg/yr) From Construction of Pit Conversion and Immobilization Facilities in FMEF and MOX in New Construction at Hanford

	Pit Conversion		Immobilization				MOX			
Pollutant	Diesel Equipment & Construction Fugitive Emissions	Veh	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Veh	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Veh
CO	1,000	7,920	810	0	0	30,000	3,200	0	0	32,800
NO_2	2,400	2,120	2,090	0	0	8,050	8,400	0	0	8,790
PM_{10}	3,500	7,220	160[b]	121[b]	19[b]	27,400	640[b]	5,350	1,090[b]	29,900
SO_2	160	0	210	0	0	0	850	0	0	0
VOC	200	976	170	0	0	3,700	660	0	0	4,040
TSP	9,300	7,220	160	121	19	27,400	640	10,500	1,090	29,900
Toxics[c]	0	0	0	0	0	0	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as TSP emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Key: CO, carbon monoxide; FMEF, Fuels and Materials Examination Facility; NO_2, nitrogen dioxide; SO_2, sulfur dioxide; TSP, total suspended particulates; Veh, vehicles; VOC, volatile organic compounds.
Source: UC 1998a, 1998b, 1998c, 1998d.

Table G–27. Concentrations ($\mu g/m^3$) From Construction of Pit Conversion and Immobilization Facilities in FMEF and MOX in New Construction at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Ceramic or Glass	Total
Carbon monoxide	8 hours	10,000	34.1	0.277	0.885	0.224	35.5
	1 hour	40,000	48.3	1.88	6.02	1.52	57.7
Nitrogen dioxide	Annual	100	0.25	0.199	0.0697	0.0173	0.536
PM_{10}	Annual	50	0.0179	0.029	0.0576	0.00248	0.107
	24 hours	150	0.77	0.323	2.62	0.0903	3.8
Sulfur dioxide	Annual	50	1.63	0.00133	0.00705	0.00174	1.64
	24 hours	260	8.91	0.0148	0.0784	0.0194	9.02
	3 hours	1,300	29.6	0.1	0.533	0.132	30.4
	1 hour	1,000	32.9	0.301	1.60	0.395	35.2
	1 hour	700[b]	32.9	0.301	1.60	0.395	35.2
Total suspended particulates	Annual	60	0.0179	0.0771	0.102	0.00248	0.199
	24 hours	150	0.77	0.857	4.71	0.0903	6.43
Toxics[c]	Annual	0.12	0.000006	0	0.000008	0	0.000014

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.1.2.7.2 Operation of Pit Conversion, Immobilization, and MOX Facilities

Potential air quality impacts from operation of the three surplus plutonium disposition and support facilities at Hanford were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–28.

Table G–28. Emissions (kg/yr) From Operation of Pit Conversion and Immobilization Facilities in FMEF and MOX in New Construction at Hanford

	Pit Conversion			MOX			Immobilization			
Pollutant	**EG**	**Process**	**Veh**	**EG**	**Process**	**Veh**	**EG**	**Ceramic Process**	**Glass Process**	**Veh**
Carbon monoxide	520	0	41,800	374	0	34,200	390	3,500	0	36,600
Nitrogen dioxide	2,000	0	11,200	1,738	0	9,170	1,810	0	0	9,810
PM_{10}	50	0	38,100	122	0	31,200	130	0	0	33,400
Sulfur dioxide	34	0	0	114	0	0	120	0	0	0
Volatile organic compounds	58	0	5,150	142	0	4,210	150	0	0	4,510
Total suspended particulates	50	0	38,100	122	0	31,200	130	0	0	33,400
Toxics[a]	0	0	0	0	1,000	0	0	0	0	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.

Key: EG, emergency generator; FMEF, Fuels and Materials Examination Facility; Veh, vehicle.

Source: UC 1998a, 1998b, 1998c, 1998d.

Maximum air pollutant concentrations resulting from the emergency diesel generators and process sources, plus the No Action concentrations, are summarized in Table G–29. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–29. Concentrations ($\mu g/m^3$) From Operation of Pit Conversion and Immobilization Facilities in FMEF and MOX in New Construction at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Immobilization		Total With Ceramic	Total With Glass
						Ceramic	Glass		
Carbon monoxide	8 hours	10,000	34.1	0.144	0.103	0.283	0.108	34.6	34.5
	1 hour	40,000	48.3	0.978	0.704	1.61	0.734	51.6	50.7
Nitrogen dioxide	Annual	100	0.25	0.0166	0.0144	0.015	0.015	0.296	0.296
PM_{10}	Annual	50	0.0179	0.000415	0.00101	0.00108	0.00108	0.0204	0.0204
	24 hours	150	0.77	0.00461	0.0113	0.012	0.012	0.798	0.798
Sulfur dioxide	Annual	50	1.63	0.000282	0.000946	0.001	0.001	1.63	1.63
	24 hours	260	8.91	0.00313	0.0105	0.0111	0.0111	8.93	8.93
	3 hours	1,300	29.6	0.0213	0.0715	0.0753	0.0753	29.8	29.8
	1 hour	1,000	32.9	0.064	0.214	0.226	0.226	33.4	33.4
	1 hour	700[b]	32.9	0.064	0.214	0.226	0.226	33.4	33.4
Total suspended particulates	Annual	60	0.0179	0.000415	0.00101	0.00108	0.00108	0.0204	0.0204
	24 hours	150	0.77	0.00461	0.0113	0.012	0.012	0.798	0.798
Toxics[c]	24 hours	420	(d)	0	0.0406	0	0	0.0406	0.0406

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.
[c] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State risk-based acceptable source impact level for ethylene glycol is a 24-hr average of 420 $\mu g/m^3$.
[d] No sources of ethylene glycol have been identified at the site.
Key: FMEF, Fuels and Materials Examination Facility.
Source: EPA 1997; WDEC 1994.

G.2 INEEL

G.2.1 Assessment Data

Emission rates for criteria, hazardous, and toxic pollutants at INEEL are presented in Table F.1.2.4–1 of the *Storage and Disposition Final PEIS* (DOE 1996a:F-10). These emission rates were used as input into the modeled No Action pollutant concentrations presented in that document and reflect INEEL facility emissions for 1990, which were assumed to be representative of No Action for 2005. The storage alternative selected for INEEL results in no change in these concentrations (DOE 1996a:4-138). Other onsite activities related to programs analyzed in EISs for spent nuclear fuel and waste management are also included in the estimates of the No Action concentration for surplus plutonium disposition shown in Table G–30. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–30. Estimated Concentrations ($\mu g/m^3$) From No Action at INEEL

Pollutant	Averaging Period	PEIS Estimated Base Year (2005)	Other Onsite From PEIS	No Action
Carbon monoxide	8 hours	284	18	302
	1 hour	614	605	1,219
Nitrogen dioxide	Annual	4	7	11
PM_{10}	Annual	3	0	3
	24 hours	33	6	39
Sulfur dioxide	Annual	6	0	6
	24 hours	135	2	137
	3 hours	579	12	591
Benzene	Annual	0.029	0	0.029
Ethylene glycol	24 hours	0[a]	0	0

[a] No concentration of this pollutant was reported in the source document.
Key: PEIS, *Storage and Disposition Final PEIS.*
Source: DOE 1996a:4-138, 4-928, 4-929.

G.2.2 Facilities

G.2.2.1 Pit Conversion Facility

G.2.2.1.1 Construction of Pit Conversion Facility

Potential air quality impacts from modification of the Fuel Processing Facility (FPF) and construction of new support facilities at INEEL for pit disassembly and conversion were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–31.

Maximum air pollutant concentrations from construction activities are summarized in Table G–32 but are not expected to result in the exceedance of the ambient air quality standards.

Table G–31. Emissions (kg/yr) From Construction of Pit Conversion Facility in FPF at INEEL

Pollutant	Diesel Equipment and Construction Fugitive Emissions	Vehicles
Carbon monoxide	1,300	28,900
Nitrogen dioxide	5,600	7,270
PM_{10}	3,900	21,800
Sulfur dioxide	370	0
Volatile organic compounds	460	3,530

Key: FPF, Fuel Processing Facility.
Source: UC 1998e.

Table G–32. Concentrations ($\mu g/m^3$) From Construction of Pit Conversion Facility in FPF at INEEL

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	302	0.524	303
	1 hour	40,000	1,219	1.42	1,220
Nitrogen dioxide	Annual	100	11	0.0658	11.1
PM_{10}	Annual	50	3	0.0458	3.05
	24 hours	150	39	0.585	39.6
Sulfur dioxide	Annual	80	6	0.00434	6
	24 hours	365	137	0.0555	137
	3 hours	1,300	591	0.223	591

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Key: FPF, Fuel Processing Facility.
Source: EPA 1997; ID DHW 1995.

G.2.2.1.2 Operation of Pit Conversion Facility

Potential air quality impacts from operation of the pit conversion and support facilities at INEEL were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–33.

Table G–33. Emissions (kg/yr) From Operation of Pit Conversion Facility in FPF at INEEL

Pollutant	Boilers	Emergency Generator	Process	Vehicles
Carbon monoxide	580	520	0	74,100
Nitrogen dioxide	18,000	2,000	0	18,600
PM_{10}	1,250	50	0	56,000
Sulfur dioxide	30,000	34	0	0
Volatile organic compounds	62	58	0	9,050

Key: FPF, Fuel Processing Facility.
Source: UC 1998e.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–34.

Table G–34. Concentrations (μg/m³) From Operation of Pit Conversion Facility in FPF at INEEL

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	302	0.253	302
	1 hour	40,000	1,219	0.80	1,220
Nitrogen dioxide	Annual	100	11	0.0838	11.1
PM_{10}	Annual	50	3	0.00477	3.00
	24 hours	150	39	0.0494	39.1
Sulfur dioxide	Annual	80	6	0.101	6.10
	24 hours	365	137	1.01	138
	3 hours	1,300	591	5.42	596

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Key: FPF, Fuel Processing Facility.
Source: EPA 1997; ID DHW 1995.

At the nearest prevention of significant deterioration (PSD) Class I area, Craters of the Moon National Monument, the contribution to air pollutant concentrations is less than 0.01 μg/m³ for nitrogen dioxide, particulate matter with an aerodynamic diameter less than or equal to 10 μm (PM_{10}), and sulfur dioxide, except for the 24-hr sulfur dioxide value, which is 0.05 μg/m³, and the 3-hr sulfur dioxide value, which is 0.23 μg/m³. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

G.2.2.2 MOX Facility

G.2.2.2.1 Construction of MOX Facility

Potential air quality impacts from construction of new MOX and support facilities at INEEL were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–35.

Maximum air pollutant concentrations from construction activities are summarized in Table G–36.

Table G–35. Emissions (kg/yr) From Construction of New MOX Facility at INEEL

Pollutant	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	3,200	0	0	99,200
Nitrogen dioxide	8,400	0	0	24,900
PM_{10}	640	5,330	1,090	74,900
Sulfur dioxide	850	0	0	0
Volatile organic compounds	660	0	0	12,100
Toxics[b]	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Source: *UC 1998f.*

Table G–36. Concentrations ($\mu g/m^3$) From Construction of New MOX Facility at INEEL

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	302	1.29	303
	1 hour	40,000	1,219	3.48	1,220
Nitrogen dioxide	Annual	100	11	0.0986	11.1
PM_{10}	Annual	50	3	0.0816	3.08
	24 hours	150	39	4.26	43.3
Sulfur dioxide	Annual	80	6	0.00998	6.01
	24 hours	365	137	0.127	137
	3 hours	1,300	591	0.512	592
Toxics[b]	Annual	0.12	0.029	0.00001	0.029

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Source: EPA 1997; ID DHW 1995.

G.2.2.2.2 Operation of MOX Facility

Potential air quality impacts from operation of the new MOX and support facilities at INEEL were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–37.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–38.

Table G–37. Emissions (kg/yr) From Operation of New MOX Facility at INEEL

Pollutant	Boilers	Emergency Generator	Process	Vehicles
Carbon monoxide	4,000	374	0	77,600
Nitrogen dioxide	10,900	1,738	0	19,500
PM_{10}	530	122	0	58,600
Sulfur dioxide	60,500	114	0	0
Volatile organic compounds	0	142	0	9,470
Toxics[a]	0	0	1,000	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.
Source: UC 1998f.

Table G–38. Concentrations ($\mu g/m^3$) From Operation of New MOX Facility at INEEL

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	302	0.45	302
	1 hour	40,000	1,219	2.02	1,220
Nitrogen dioxide	Annual	100	11	0.0569	11.1
PM_{10}	Annual	50	3	0.00321	3.00
	24 hours	150	39	0.0361	39.0
Sulfur dioxide	Annual	80	6	0.204	6.20
	24 hours	365	137	2.04	139
	3 hours	1,300	591	11.0	602
Toxics[b]	24 hours	6350	(c)	0.197	0.197

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State acceptable ambient concentration for ethylene glycol is a 24-hr average of 6350 $\mu g/m^3$.
[c] No source of ethylene glycol has been identified at the site.
Source: EPA 1997; ID DHW 1995.

At the nearest PSD Class I area, Craters of the Moon National Monument, the contribution to air pollutant concentrations is less than 0.01 $\mu g/m^3$ for nitrogen dioxide and PM_{10}. For sulfur dioxide the annual value is 0.01 $\mu g/m^3$, the 24-hr value is 0.11 $\mu g/m^3$, and the 3-hr value is 0.46 $\mu g/m^3$. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

G.2.2.3 Pit Conversion and MOX Facilities

G.2.2.3.1 Construction of Pit Conversion and MOX Facilities

Potential air quality impacts from modification of FPF for pit disassembly and conversion and construction of new MOX and support facilities at INEEL were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–39.

Table G–39. Emissions (kg/yr) From Construction of Pit Conversion in FPF and New MOX Facility at INEEL

	Pit Conversion		MOX			
Pollutant	Diesel Equipment and Construction Fugitive Emissions	Vehicles	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	1,300	28,900	3,200	0	0	99,200
Nitrogen dioxide	5,600	7,270	8,400	0	0	24,900
PM_{10}	3,900	21,800	640	5,330	1,090	74,900
Sulfur dioxide	370	0	850	0	0	0
Volatile organic compounds	460	3,530	660	0	0	12,100
Toxics[b]	0	0	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Key: FPF, Fuel Processing Facility.
Source: UC 1998e, 1998f.

Maximum air pollutant concentrations from construction activities are summarized in Table G–40.

Table G–40. Concentrations ($\mu g/m^3$) From Construction of Pit Conversion in FPF and New MOX Facility at INEEL

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Total
Carbon monoxide	8 hours	10,000	302	0.524	1.29	304
	1 hour	40,000	1,219	1.42	3.48	1,220
Nitrogen dioxide	Annual	100	11	0.0658	0.0986	11.2
PM_{10}	Annual	50	3	0.0458	0.0816	3.13
	24 hours	150	39	0.585	4.26	43.8
Sulfur dioxide	Annual	80	6	0.00434	0.00998	6.01
	24 hours	365	137	0.0555	0.127	137
	3 hours	1,300	591	0.223	0.512	592
Toxics[b]	Annual	0.12	0.029	0	0.00001	0.029

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Key: FPF, Fuel Processing Facility.
Source: EPA 1997; ID DHW 1995.

G.2.2.3.2 Operation of Pit Conversion and MOX Facilities

Potential air quality impacts from operation of the new pit conversion, MOX, and support facilities at INEEL were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from boilers, emissions from emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–41.

Table G–41. Emissions (kg/yr) From Operation of Pit Conversion in FPF and New MOX Facility at INEEL

Pollutant	Pit Conversion Boilers	Pit Conversion Emergency Generator	Pit Conversion Process	Pit Conversion Vehicles	MOX Boilers	MOX Emergency Generator	MOX Process	MOX Vehicles
Carbon monoxide	580	520	0	74,100	4,000	374	0	77,600
Nitrogen dioxide	18,000	2,000	0	18,600	10,900	1,738	0	19,500
PM_{10}	1,250	50	0	56,000	530	122	0	58,600
Sulfur dioxide	30,000	34	0	0	60,500	114	0	0
Volatile organic compounds	62	58	0	9,050	0	142	0	9,470
Toxics[a]	0	0	0	0	0	0	1,000	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.
Key: FPF, Fuel Processing Facility.
Source: UC 1998e, 1998f.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–42.

Table G–42. Concentrations ($\mu g/m^3$) From Operation of Pit Conversion in FPF and New MOX Facility at INEEL

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Total
Carbon monoxide	8 hours	10,000	302	0.253	0.45	303
	1 hour	40,000	1,219	0.80	2.02	1,220
Nitrogen dioxide	Annual	100	11	0.0838	0.0569	11.1
PM_{10}	Annual	50	3	0.00477	0.00321	3.01
	24 hours	150	39	0.0494	0.0361	39.1
Sulfur dioxide	Annual	80	6	0.101	0.204	6.31
	24 hours	365	137	1.01	2.04	140
	3 hours	1,300	591	5.42	11.0	607
Toxics[b]	24 hours	6,350	(c)	0	0.197	0.197

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State acceptable ambient concentration for ethylene glycol is a 24-hr average of 6,350 $\mu g/m^3$.
[c] No sources of ethylene glycol have been identified at the site.
Key: FPF, Fuel Processing Facility.
Source: EPA 1997; ID DHW 1995.

At the nearest PSD Class I area, Craters of the Moon National Monument, the contribution to air pollutant concentrations are 0.01 $\mu g/m^3$ or less for nitrogen dioxide and PM_{10}. For sulfur dioxide the annual value is 0.01 $\mu g/m^3$, the 24-hr value is 0.16 $\mu g/m^3$, and the 3-hr value is 0.69 $\mu g/m^3$. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

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G.3 PANTEX

G.3.1 Assessment Data

Emission rates for criteria, hazardous, and toxic air pollutants at Pantex are presented in Table 4.7.2.1–3 of the *Final Environmental Impact Statement for the Continued Operation of Pantex* (DOE 1996c:4-147). These emission rates were used as input into the modeled pollutant concentrations presented in that document and reflect Pantex facility emissions for over a 10-year period to about 2006. These concentrations are assumed to be representative of No Action for 2005 and include the upgrade storage alternative selected for Pantex and discussed in the *Storage and Disposition Final PEIS* (DOE 1996a:4-190). Other onsite activities related to programs analyzed in EISs for stockpile stewardship management and waste management are added to these concentrations as shown in Table G–43. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–43. Estimated Concentrations ($\mu g/m^3$) From No Action at Pantex

Pollutant	Averaging Period	PEIS No Action[a]	Other Onsite From PEIS	No Action
Carbon monoxide	8 hours	602	17.5	620
	1 hour	2,900	92.8	2,990
Nitrogen dioxide	Annual	0.542	1.4	1.94
PM_{10}	Annual	8.73	0.06	8.79
	24 hours	88.5	0.93	89.4
Sulfur dioxide	Annual	0	0	0
	24 hours	0.00002	0	0.00002
	3 hours	0.00008	0	0.00008
	30 minutes	0.00016	0	0.00016
Total suspended particulates	3 hours	(a)	(a)	(a)
	1 hour	(a)	(a)	(a)
Benzene	24 hours	7.8	0	7.8[b]
	1 hour	19.4	0	19.4
Ethylene glycol	24 hours	0	0	0
	1 hour	0	0	0

[a] Three- and 1-hr concentrations for total suspended particulates were not reported in the source document.
[b] Twenty-four-hour concentration was estimated from the 1-hr concentration.
Key: PEIS, *Storage and Disposition Final PEIS.*
Source: DOE 1996a:4-936, 4-937; DOE 1996c:4-139.

G.3.2 Facilities

G.3.2.1 Pit Conversion Facility

G.3.2.1.1 Construction of Pit Conversion Facility

Potential air quality impacts from construction of new pit conversion and support facilities at Pantex were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–44.

Maximum air pollutant concentrations from construction activities are summarized in Table G–45.

Table G–44. Emissions (kg/yr) From Construction of New Pit Conversion Facility at Pantex

Pollutant	Diesel Equipment and Construction Fugitive Emissions	Vehicles
Carbon monoxide	6,400	27,400
Nitrogen dioxide	29,200	7,620
PM_{10}	20,300	26,300
Sulfur dioxide	1,900	0
Volatile organic compounds	2,400	3,480
Total suspended particulates	47,500	26,300

Source: UC 1998g.

Table G–45. Concentrations ($\mu g/m^3$) From Construction of New Pit Conversion Facility at Pantex

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	620	3.77	623
	1 hour	40,000	2,990	23.5	3,020
Nitrogen dioxide	Annual	100	1.94	0.501	2.44
PM_{10}	Annual	50	8.79	0.349	9.14
	24 hours	150	89.4	4.18	93.6
Sulfur dioxide	Annual	80	0	0.0326	0.0326
	24 hours	365	0.00002	0.392	0.392
	3 hours	1,300	0.00008	1.71	1.71
	30 minutes	1,048	0.00016	6.98	6.98
Total suspended particulates	3 hours	200	(b)	42.7	42.7
	1 hour	400	(b)	174	174

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates were not listed in the source document.
Source: EPA 1997; TNRCC 1997a, 1997b.

G.3.2.1.2 Operation of Pit Conversion Facility

Potential air quality impacts from operation of the pit conversion and support facilities at Pantex were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–46.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators and process sources, plus the No Action concentrations, are summarized in Table G–47. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–46. Emissions (kg/yr) From Operation of New Pit Conversion Facility at Pantex

Pollutant	Boilers	Emergency Generator	Process	Vehicles
Carbon monoxide	780	520	0	38,800
Nitrogen dioxide	700	2,000	0	10,800
PM_{10}	300	50	0	37,300
Sulfur dioxide	13	34	0	0
Volatile organic compounds	132	58	0	4,920
Total suspended particulates	300	50	0	37,300

Source: UC 1998g.

Table G–47. Concentrations ($\mu g/m^3$) From Operation of New Pit Conversion Facility at Pantex

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	620	0.381	620
	1 hour	40,000	2,990	2.14	2,990
Nitrogen dioxide	Annual	100	1.94	0.0374	1.98
PM_{10}	Annual	50	8.79	0.00215	8.79
	24 hours	150	89.4	0.0225	89.5
Sulfur dioxide	Annual	80	0	0.00064	0.00064
	24 hours	365	0.00002	0.00753	0.00755
	3 hours	1,300	0.00008	0.0327	0.0328
	30 minutes	1,048	0.00016	0.129	0.129
Total suspended particulates	3 hours	200	(b)	0.0937	0.0937
	1 hour	400	(b)	0.273	0.273

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates were not listed in the source document.
Source: EPA 1997; TNRCC 1997a, 1997b.

G.3.2.2 MOX Facility

G.3.2.2.1 Construction of MOX Facility

Potential air quality impacts from construction of new MOX and support facilities at Pantex were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–48.

Maximum air pollutant concentrations from construction activities are summarized in Table G–49.

Table G–48. Emissions (kg/yr) From Construction of New MOX Facility at Pantex

Pollutant	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	3,200	0	0	31,200
Nitrogen dioxide	8,400	0	0	8,660
PM_{10}	640[b]	5,360	1,090[b]	30,000
Sulfur dioxide	850	0	0	0
Volatile organic compounds	660	0	0	3,960
Total suspended particulates	640	10,600	1,090	30,000
Toxics[c]	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Source: UC 1998h.

Table G–49. Concentrations ($\mu g/m^3$) From Construction of New MOX Facility at Pantex

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	620	1.88	621
	1 hour	40,000	2,990	11.8	3,000
Nitrogen dioxide	Annual	100	1.94	0.144	2.09
PM_{10}	Annual	50	8.79	0.119	8.91
	24 hours	150	89.4	5.85	95.3
Sulfur dioxide	Annual	80	0	0.0146	0.0146
	24 hours	365	0.00002	0.175	0.175
	3 hours	1,300	0.00008	0.765	0.765
	30 minutes	1,048	0.00016	3.12	3.12
Total suspended particulates	3 hours	200	(b)	46.0	46.0
	1 hour	400	(b)	188	188
Toxics[c]	24 hours	3[d]	7.8[e]	0.00091	7.8
	1 hour	75[d]	19.4	0.0162	19.4

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates were not listed in the source document.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
[d] Effects-screening level of the Texas Natural Resources and Conservation Commission. Such levels are not ambient air standards, but merely "tools" used by the Toxicology and Risk Assessment staff to evaluate impacts of air pollutant emissions. Thus, exceedance of the screening levels by ambient air contaminants does not necessarily indicate a problem. That circumstance, however, would prompt a more thorough evaluation.
[e] Twenty-four-hour concentration was estimated from the 1-hr concentration.
Source: EPA 1997; TNRCC 1997a, 1997b.

G.3.2.2.2 Operation of MOX Facility

Potential air quality impacts from operation of the new MOX and support facilities at Pantex were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–50.

Table G–50. Emissions (kg/yr) From Operation of New MOX Facility at Pantex

Pollutant	Boilers	Emergency Generator	Process	Vehicles
Carbon monoxide	900	374	0	34,800
Nitrogen dioxide	1,225	1,738	0	9,660
PM_{10}	206	122	0	33,400
Sulfur dioxide	9	114	0	0
Volatile organic compounds	85	142	0	4,410
Total suspended particulates	206	122	0	33,400
Toxics	0	0	1,000	0

Source: UC 1998h.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators and process sources, plus the No Action concentrations, are summarized in Table G–51. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–51. Concentrations ($\mu g/m^3$) From Operation of New MOX Facility at Pantex

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	620	0.306	620
	1 hour	40,000	2,990	1.64	2,990
Nitrogen dioxide	Annual	100	1.94	0.0351	1.98
PM_{10}	Annual	50	8.79	0.00298	8.79
	24 hours	150	89.4	0.0335	89.5
Sulfur dioxide	Annual	80	0	0.002	0.002
	24 hours	365	0.00002	0.0239	0.0239
	3 hours	1,300	0.00008	0.104	0.104
	30 minutes	1,048	0.00016	0.421	0.422
Total suspended particulates	3 hours	200	(b)	0.143	0.143
	1 hour	400	(b)	0.51	0.51
Toxics[c]	24 hours	26	0	0.217	0.217
	1 hour	260	0	5.30	5.30

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates were not listed in the source document.
[c] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State effects-screening levels for ethylene glycol are a 24-hr average of 26 $\mu g/m^3$ and a 1-hr average of 260 $\mu g/m^3$.
Source: EPA 1997; TNRCC 1997a, 1997b.

G.3.2.3 Pit Conversion and MOX Facilities

G.3.2.3.1 Construction of Pit Conversion and MOX Facilities

Potential air quality impacts from construction of new pit conversion, MOX, and support facilities at Pantex were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–52.

Table G–52. Emissions (kg/yr) From Construction of New Pit Conversion and MOX Facilities at Pantex

	Pit Conversion		MOX			
Pollutant	Diesel Equipment & Construction Fugitive Emissions	Vehicles	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	6,400	27,400	3,200	0	0	31,200
Nitrogen dioxide	29,200	7,620	8,400	0	0	8,660
PM_{10}	20,300	26,300	640[b]	5,360	1,090[b]	30,000
Sulfur dioxide	1,900	0	850	0	0	0
Volatile organic compounds	2,400	3,480	660	0	0	3,960
Total suspended particulates	47,500	26,300	640	10,600	1,090	30,000
Toxics[c]	0	0	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for MOX for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Source: UC 1998g, 1998h.

Maximum air pollutant concentrations from construction activities are summarized in Table G–53.

G.3.2.3.2 Operation of Pit Conversion and MOX Facilities

Potential air quality impacts from operation of the new pit conversion, MOX, and support facilities at Pantex were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–54.

Table G–53. Concentrations (μ/m^3) From Construction of New Pit Conversion and MOX Facilities at Pantex

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Total
Carbon monoxide	8 hours	10,000	620	3.77	1.88	626
	1 hour	40,000	2,990	23.5	11.8	3,030
Nitrogen dioxide	Annual	100	1.94	0.501	0.144	2.59
PM_{10}	Annual	50	8.79	0.349	0.119	9.26
	24 hours	150	89.4	4.18	5.85	99.4
Sulfur dioxide	Annual	80	0	0.0326	0.0146	0.0472
	24 hours	365	0.00002	0.392	0.175	0.567
	3 hours	1,300	0.00008	1.71	0.765	2.48
	30 minutes	1,048	0.00016	6.98	3.12	10.1
Total suspended particulates	3 hours	200	(b)	42.7	46.0	88.7
	1 hour	400	(b)	174	188	362
Toxics[c]	24 hours	3	7.8[d]	0.00	0.00091	7.8
	1 hour	75	19.4	0.00	0.0162	19.4

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates were not listed in the source document.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
[d] Twenty-four-hour concentration was estimated from 1-hr concentration.
Source: EPA 1997; TNRCC 1997a, 1997b.

Table G–54. Emissions (kg/yr) From Operation of New Pit Conversion and MOX Facilities at Pantex

	Pit Conversion				MOX			
Pollutant	Boilers	Emergency Generator	Process	Vehicles	Boilers	Emergency Generator	Process	Vehicles
Carbon monoxide	780	520	0	38,800	900	374	0	34,800
Nitrogen dioxide	700	2,000	0	10,800	1,225	1,738	0	9,660
PM_{10}	300	50	0	37,300	206	122	0	33,400
Sulfur dioxide	13	34	0	0	9	114	0	0
Volatile organic compounds	132	58	0	4,920	85	142	0	4,410
Total suspended particulates	300	50	0	37,300	206	122	0	33,400
Toxics[a]	0	0	0	0	0	0	1000	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.
Source: UC 1998g, 1998h.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–55. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–55. Concentrations ($\mu g/m^3$) From Operation of New Pit Conversion and MOX Facilities at Pantex

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Total
Carbon monoxide	8 hours	10,000	620	0.381	0.306	621
	1 hour	40,000	2,990	2.14	1.64	2,990
Nitrogen dioxide	Annual	100	1.94	0.0374	0.0351	2.01
PM_{10}	Annual	50	8.79	0.00215	0.00298	8.80
	24 hours	150	89.4	0.0225	0.0335	89.5
Sulfur dioxide	Annual	80	0	0.00064	0.002	0.00264
	24 hours	365	0.00002	0.00753	0.0239	0.0315
	3 hours	1,300	0.00008	0.0327	0.104	0.137
	30 minutes	1,048	0.00016	0.129	0.421	0.550
Total suspended particulates	3 hours	200	(b)	0.0937	0.143	0.237
	1 hour	400	(b)	0.273	0.51	0.783
Toxics[c]	24 hours	26	0	0.00	0.217	0.217
	1 hour	260	0	0.00	5.30	5.30

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Three- and 1-hr concentrations for total suspended particulates were not listed in the source document.
[c] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State effects-screening levels for ethylene glycol are a 24-hr average of 26 $\mu g/m^3$ and a 1-hr average of 260 $\mu g/m^3$.
Source: EPA 1997; TNRCC 1997a, 1997b.

G.4 SRS

G.4.1 Assessment Data

Emission rates for criteria, hazardous, and toxic air pollutants at SRS are presented in Table F.1.2.7–1 of the *Storage and Disposition Final PEIS* (DOE 1996a:F-18). These emission rates were used as input into the modeled No Action pollutant concentrations presented in that EIS and reflect SRS facility emissions for 1990. Concentration estimates that include the Upgrade with RFETS nonpit material storage option selected for SRS presented in the *Storage and Disposition Final S&D PEIS* (DOE 1996a:4-299) plus the other onsite activities related to programs analyzed in EISs related to foreign research reactor spent nuclear fuel, HEU disposition, interim management of nuclear materials, spent nuclear fuel, stockpile stewardship management, tritium supply and recycling, and waste management (DOE 1996a:4-953, 4-954) are assumed to be representative of No Action for 2005 and are shown in Table G–56. Other activities at SRS, which may occur during the time period 2005–2015, are discussed in the cumulative impacts section. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–56. Estimated Concentrations ($\mu g/m^3$) From No Action at SRS

Pollutant	Averaging Period	PEIS No Action	Other Onsite From PEIS	No Action
Carbon monoxide	8 hours	22.12	41.88	64
	1 hour	171.58	107.1	279
Nitrogen dioxide	Annual	5.77	3.53	9.30
PM_{10}	Annual	3.01	1.125	4.14
	24 hours	50.71	5.68	56.4
Sulfur dioxide	Annual	14.71	0.386	15.1
	24 hours	200.1	19.09	219
	3 hours	849.46	112.2	962
Total suspended particulates	Annual	12.6	2.065	14.7
Benzene	24 hours	31.711	0.001	31.7
Ethylene glycol	24 hours	0.195	0	0.195

Key: PEIS, *Storage and Disposition Final PEIS*.
Source: DOE 1995: E-10–E-13; DOE 1996a:4-299, 4-953, 4-954.

G.4.2 Facilities

G.4.2.1 Pit Conversion Facility

G.4.2.1.1 Construction of Pit Conversion Facility

Potential air quality impacts from construction of new pit conversion and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–57.

Maximum air pollutant concentrations from construction activities are summarized in Table G–58.

Table G–57. Emissions (kg/yr) From Construction of New Pit Conversion Facility at SRS

Pollutant	Diesel Equipment and Construction Fugitive Emissions	Vehicles
Carbon monoxide	5,700	24,200
Nitrogen dioxide	13,000	7,020
PM_{10}	19,300	24,800
Sulfur dioxide	1,200	0
Volatile organic compounds	400	3,240
Total suspended particulates	43,400	24,800

Source: UC 1998i.

Table G–58. Concentrations ($\mu g/m^3$) From Construction of New Pit Conversion Facility at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	64	0.811	64.9
	1 hour	40,000	279	3.69	282
Nitrogen dioxide	Annual	100	9.30	0.0268	9.33
PM_{10}	Annual	50	4.14	0.0397	4.18
	24 hours	150	56.4	0.979	57.4
Sulfur dioxide	Annual	80	15.1	0.00247	15.1
	24 hours	365	219	0.0609	219
	3 hours	1,300	962	0.365	962
Total suspended particulates	Annual	75	14.7	0.0893	14.8

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Source: EPA 1997; SCDHEC 1996.

G.4.2.1.2 Operation of Pit Conversion Facility

Potential air quality impacts from operation of the new pit conversion and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–59.

Table G–59. Emissions (kg/yr) From Operation of New Pit Conversion Facility at SRS

Pollutant	Boilers	Emergency Generator	Process	Vehicles
Carbon monoxide	440	520	0	39,600
Nitrogen dioxide	15,000	2,000	0	11,500
PM_{10}	1,050	50	0	40,500
Sulfur dioxide	25,000	34	0	0
Volatile organic compounds	52	58	0	5,300
Total suspended particulates	1,050	50	0	40,500

Source: UC 1998i.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–60. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–60. Concentrations ($\mu g/m^3$) From Operation of New Pit Conversion Facility at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	64	0.0891	64.1
	1 hour	40,000	279	0.364	279
Nitrogen dioxide	Annual	100	9.30	0.0225	9.32
PM_{10}	Annual	50	4.14	0.00139	4.14
	24 hours	150	56.4	0.0201	56.4
Sulfur dioxide	Annual	80	15.1	0.0307	15.1
	24 hours	365	219	0.42	220
	3 hours	1,300	962	1.09	963
Total suspended particulates	Annual	75	14.7	0.00139	14.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Source: EPA 1997; SCDHEC 1996.

G.4.2.2 Immobilization Facility in Building 221–F

G.4.2.2.1 Construction of Immobilization Facility in Building 221–F

Potential air quality impacts from modification of Building 221–F and construction of support facilities for plutonium conversion and immobilization (ceramic or glass) at SRS were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–61.

Table G–61. Emissions (kg/yr) From Construction of Immobilization Facility in Building 221–F at SRS

Pollutant	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	1,070	0	0	49,200
Nitrogen dioxide	2,750	0	0	14,300
PM_{10}	210[b]	410[b]	47[b]	50,400
Sulfur dioxide	280	0	0	0
Volatile organic compounds	220	0	0	6,590
Total suspended particulates	210	410	47	50,400

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
Source: UC 1998j, 1998k.

Maximum air pollutant concentrations from construction activities are summarized in Table G–62.

Table G–62. Concentrations ($\mu g/m^3$) From Construction of Immobilization Facility in Building 221–F at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Ceramic or Glass	Total
Carbon monoxide	8 hours	10,000	64	0.168	64.2
	1 hour	40,000	279	0.723	279
Nitrogen dioxide	Annual	100	9.30	0.00623	9.31
PM_{10}	Annual	50	4.14	0.00148	4.14
	24 hours	150	56.4	0.172	56.6
Sulfur dioxide	Annual	80	15.1	0.000634	15.1
	24 hours	365	219	0.0154	219
	3 hours	1,300	962	0.0906	962
Total suspended particulates	Annual	75	14.7	0.00148	14.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Source: EPA 1997; SCDHEC 1996.

G.4.2.2.2 Operation of Immobilization Facility in Building 221–F

Potential air quality impacts from operation of the ceramic or glass immobilization and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–63.

Table G–63. Emissions (kg/yr) From Operation of Immobilization Facility in Building 221–F at SRS

Pollutant	Boilers	Emergency Generator	Ceramic Process	Glass Process	Vehicles
Carbon monoxide	140	390	3,500	0	41,300
Nitrogen dioxide	4,540	1,810	0	0	12,000
PM_{10}	350	130	0	0	42,300
Sulfur dioxide	13,300	120	0	0	0
Volatile organic compounds	30	150	0	0	5,530
Total suspended particulates	350	130	0	0	42,300

Source: UC 1998j, 1998k.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–64. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–64. Concentrations ($\mu g/m^3$) From Operation of Immobilization Facility in Building 221–F at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Ceramic	Total With Ceramic	Glass	Total With Glass
Carbon monoxide	8 hours	10,000	64	0.148	64.1	0.066	64.1
	1 hour	40,000	279	0.589	279	0.272	279
Nitrogen dioxide	Annual	100	9.30	0.00968	9.31	0.00968	9.31
PM_{10}	Annual	50	4.14	0.000724	4.14	0.000724	4.14
	24 hours	150	56.4	0.013	56.4	0.013	56.4
Sulfur dioxide	Annual	80	15.1	0.0166	15.1	0.0166	15.1
	24 hours	365	219	0.229	219	0.229	219
	3 hours	1,300	962	0.615	962	0.615	962
Total suspended particulates	Annual	75	14.7	0.000724	14.7	0.000724	14.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Source: EPA 1997; SCDHEC 1996.

G.4.2.3 Immobilization Facility in New Construction

G.4.2.3.1 Construction of New Immobilization Facility

Potential air quality impacts from construction of new ceramic or glass immobilization and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–65.

Table G–65. Emissions (kg/yr) From Construction of New Immobilization Facility at SRS

Pollutant	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	4,550	0	0	52,600
Nitrogen dioxide	11,750	0	0	15,300
PM_{10}	899[b]	3,270	2,076[b]	53,800
Sulfur dioxide	1,190	0	0	0
Volatile organic compounds	930	0	0	7,040
Total suspended particulates	899	6,140	2,076	53,800

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for this analysis resulting in some overestimate of PM_{10} concentrations.
Source: UC 1998l, 1998m.

Maximum air pollutant concentrations from construction activities are summarized in Table G–66.

Table G–66. Concentrations ($\mu g/m^3$) From Construction of New Immobilization Facility at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Ceramic or Glass	Total
Carbon monoxide	8 hours	10,000	64	0.648	64.6
	1 hour	40,000	279	2.94	282
Nitrogen dioxide	Annual	100	9.30	0.0242	9.32
PM_{10}	Annual	50	4.14	0.0129	4.15
	24 hours	150	56.4	1.33	57.7
Sulfur dioxide	Annual	80	15.1	0.00245	15.1
	24 hours	365	219	0.0604	219
	3 hours	1,300	962	0.362	962
Total suspended particulates	Annual	75	14.7	0.0187	14.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Source: EPA 1997; SCDHEC 1996.

G.4.2.3.2 Operation of New Immobilization Facility

Potential air quality impacts from operation of the new ceramic or glass immobilization and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–67.

Table G–67. Emissions (kg/yr) From Operation of New Immobilization Facility at SRS

Pollutant	Boilers	Emergency Generator	Ceramic Process	Glass Process	Vehicles
Carbon monoxide	140	390	3,500	0	35,900
Nitrogen dioxide	4,540	1,810	0	0	10,400
PM_{10}	350	130	0	0	36,700
Sulfur dioxide	13,270	120	0	0	0
Volatile organic compounds	30	150	0	0	4,800
Total suspended particulates	350	130	0	0	36,700

Source: UC 1998l, 1998m.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–68. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–68. Concentrations ($\mu g/m^3$) From Operation of New Immobilization Facility at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Ceramic	Total With Ceramic	Glass	Total With Glass
Carbon monoxide	8 hours	10,000	64	0.141	64.1	0.0603	64.1
	1 hour	40,000	279	0.576	279	0.261	279
Nitrogen dioxide	Annual	100	9.30	0.0093	9.31	0.0093	9.31
PM_{10}	Annual	50	4.14	0.000697	4.14	0.000697	4.14
	24 hours	150	56.4	0.0125	56.4	0.0125	56.4
Sulfur dioxide	Annual	80	15.1	0.0166	15.1	0.0166	15.1
	24 hours	365	219	0.229	219	0.229	219
	3 hours	1,300	962	0.613	962	0.613	962
Total suspended particulates	Annual	75	14.7	0.000697	14.7	0.00697	14.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Source: EPA 1997; SCDHEC 1996.

G.4.2.4 MOX Facility

G.4.2.4.1 Construction of MOX Facility

Potential air quality impacts from construction of new MOX and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–69.

Maximum air pollutant concentrations from construction activities are summarized in Table G–70.

Table G–69. Emissions (kg/yr) From Construction of New MOX Facility at SRS

Pollutant	Diesel Equipment	Construction Fugitive Emissions[a]	Concrete Batch Plant	Vehicles
Carbon monoxide	3,200	0	0	29,300
Nitrogen dioxide	8,400	0	0	8,490
PM_{10}	640[b]	4,740	1,090[b]	30,000
Sulfur dioxide	850	0	0	0
Volatile organic compounds	660	0	0	3,920
Total suspended particulates	640	9,340	1,090	30,000
Toxics[c]	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Source: UC 1998n.

Table G–70. Concentrations ($\mu g/m^3$) From Construction of New MOX Facility at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	64	0.455	64.5
	1 hour	40,000	279	2.07	281
Nitrogen dioxide	Annual	100	9.30	0.0173	9.32
PM_{10}	Annual	50	4.14	0.013	4.15
	24 hours	150	56.4	1.33	57.7
Sulfur dioxide	Annual	80	15.1	0.00175	15.1
	24 hours	365	219	0.0431	219
	3 hours	1,300	962	0.259	962
Total suspended particulates	Annual	75	14.7	0.0227	14.7
Toxics[b]	24 hours	150	31.7	0.000224	31.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Source: EPA 1997; SCDHEC 1996.

G.4.2.4.2 Operation of MOX Facility

Potential air quality impacts from operation of the new MOX and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–71.

Table G–71. Emissions (kg/yr) From Operation of New MOX Facility at SRS

Pollutant	Boilers	Emergency Generator	Process	Vehicles
Carbon monoxide	1,630	374	0	32,700
Nitrogen dioxide	4,450	1,740	0	9,470
PM_{10}	215	122	0	33,400
Sulfur dioxide	24,700	114	0	0
Volatile organic compounds	0	142	0	4,370
Total suspended particulates	215	122	0	33,400
Toxics[a]	0	0	1000	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.
Source: UC 1998n.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–72. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–72. Concentrations ($\mu g/m^3$) From Operation of New MOX Facility at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Contribution	Total
Carbon monoxide	8 hours	10,000	64	0.109	64.1
	1 hour	40,000	279	0.345	279
Nitrogen dioxide	Annual	100	9.30	0.00905	9.31
PM_{10}	Annual	50	4.14	0.000515	4.14
	24 hours	150	56.4	0.00979	56.4
Sulfur dioxide	Annual	80	15.1	0.0306	15.1
	24 hours	365	219	0.42	220
	3 hours	1,300	962	1.11	963
Total suspended particulates	Annual	75	14.7	0.000515	14.7
Toxics[b]	24 hours	650	0.195	0.0585	0.254

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State standard for ethylene glycol is a 24-hr average of 650 $\mu g/m^3$.
Source: EPA 1997; SCDHEC 1996.

G.4.2.5 Pit Conversion and Immobilization Facilities

G.4.2.5.1 Construction of Pit Conversion and Immobilization Facilities

Potential air quality impacts from construction of new pit conversion, immobilization (ceramic and glass), and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Similar analyses were conducted for potential air quality impacts from modification of Building 221–F and construction of support facilities for plutonium conversion and immobilization (ceramic and glass). Construction impacts result from emissions from fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–73.

Table G–73. Emissions (kg/yr) From Construction of New Pit Conversion Facility and Immobilization in Building 221–F or New Construction at SRS

	Pit Conversion		Immobilization (Ceramic or Glass)							
	Diesel Equipment and Construction Fugitive Emissions		Diesel Equipment		Construction Fugitive Emissions[a]		Concrete Batch Plant		Vehicles	
Pollutant		Veh	221–F	New	221–F	New	221–F	New	221–F	New
Carbon monoxide	5,700	24,200	1,070	4,550	0	0	0	0	49,200	52,600
Nitrogen dioxide	13,000	7,022	2,750	11,750	0	0	0	0	14,300	15,300
PM_{10}	19,300	24,800	210[b]	899[b]	410[b]	3,270	47[b]	2,076[b]	50,400	53,800
Sulfur dioxide	1,200	0	280	1,190	0	0	0	0	0	0
Volatile organic compounds	400	3,240	220	930	0	0	0	0	6,590	7,040
Total suspended particulates	43,400	24,800	210	899	410	6,140	47	2,076	50,400	53,800

[a] Does not include fugitive emissions from concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
Key: Veh, vehicles.
Source: UC 1998i, 1998j, 1998k, 1998l, 1998m.

Maximum air pollutant concentrations from construction activities are summarized in Table G–74.

Table G–74. Concentrations ($\mu g/m^3$) From Construction of New Pit Conversion Facility and Immobilization in Building 221–F or New Construction at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	Immobilization (Ceramic or Glass) 221–F	Immobilization (Ceramic or Glass) New	Total With 221–F	Total With New
Carbon monoxide	8 hours	10,000	64	0.811	0.168	0.648	65.0	65.5
	1 hour	40,000	279	3.69	0.723	2.94	284	286
Nitrogen dioxide	Annual	100	9.30	0.0268	0.00623	0.0242	9.33	9.35
PM_{10}	Annual	50	4.14	0.0397	0.00148	0.0129	4.18	4.19
	24 hours	150	56.4	0.979	0.172	1.33	57.6	58.7
Sulfur dioxide	Annual	80	15.1	0.00247	0.000634	0.00245	15.1	15.1
	24 hours	365	219	0.0609	0.0154	0.0604	219	219
	3 hours	1,300	962	0.365	0.0906	0.362	962	963
Total suspended particulates	Annual	75	14.7	0.0893	0.00148	0.0187	14.8	14.8

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period.
Source: EPA 1997; SCDHEC 1996.

G.4.2.5.2 Operation of Pit Conversion and Immobilization Facilities

Potential air quality impacts from operation of pit conversion and ceramic or glass immobilization facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–75.

Table G–75. Emissions (kg/yr) From Operation of New Pit Conversion Facility and Immobilization in Building 221–F or New Construction at SRS

Pollutant	Pit Conversion Boilers	Pit Conversion EG	Pit Conversion Process	Pit Conversion Veh	Immobilization (221–F or New) Boilers	Immobilization EG	Immobilization Ceramic Process[a]	Immobilization Veh (221–F)	Immobilization Veh (New)
Carbon monoxide	440	520	0	39,600	140	390	10,400[b]	41,300	35,900
Nitrogen dioxide	15,000	2,000	0	11,500	4,540	1,810	0	12,000	10,400
PM_{10}	1,050	50	0	40,500	350	130	0	42,300	36,700
Sulfur dioxide	25,000	34	0	0	13,270	120	0	0	0
Volatile organic compounds	52	58	0	5,300	30	150	0	5,530	4,800
Total suspended particulates	1,050	50	0	40,500	350	130	0	42,300	36,700

[a] The concentrations for glass are less than or the same as those for ceramic.
[b] For the 50-t (55-ton) case, 3,500 for the hybrid case.
Key: EG, emergency generator; Veh, vehicles.
Source: UC 1998i, 1998j, 1998k, 1998l, 1998m.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–76. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–76. Concentrations ($\mu g/m^3$) From Operation of New Pit Conversion Facility and Immobilization in Building 221–F or New Construction at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	Immobilization (Ceramic)[b]		Total With 221–F	Total With New
					221–F	New		
Carbon monoxide	8 hours	10,000	64	0.0891	0.31[c]	0.299[c]	64.4	64.4
	1 hour	40,000	279	0.364	1.21[c]	1.20[c]	281	281
Nitrogen dioxide	Annual	100	9.30	0.0225	0.00968	0.0093	9.33	9.33
PM_{10}	Annual	50	4.14	0.00139	0.000724	0.000697	4.14	4.14
	24 hours	150	56.4	0.0201	0.013	0.0125	56.4	56.4
Sulfur dioxide	Annual	80	15.1	0.0307	0.0166	0.0166	15.1	15.1
	24 hours	365	219	0.42	0.229	0.229	220	220
	3 hours	1,300	962	1.09	0.615	0.613	964	964
Total suspended particulates	Annual	75	14.7	0.00139	0.000724	0.000697	14.7	14.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] The concentrations for glass are less than or the same as those for ceramic.
[c] For the 50-t (55-ton) case.
Source: EPA 1997; SCDHEC 1996.

G.4.2.6 Pit Conversion and MOX Facilities

G.4.2.6.1 Construction of Pit Conversion and MOX Facilities

Potential air quality impacts from construction of new pit conversion, MOX, and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–77.

Maximum air pollutant concentrations from construction activities are summarized in Table G–78.

Table G–77. Emissions (kg/yr) From Construction of New Pit Conversion and MOX Facilities at SRS

Pollutant	Pit Conversion: Diesel Equipment and Construction Fugitive Emissions	Pit Conversion: Vehicles	MOX: Diesel Equipment	MOX: Construction Fugitive Emissions[a]	MOX: Concrete Batch Plant	MOX: Vehicles
Carbon monoxide	5,700	24,200	3,200	0	0	29,300
Nitrogen dioxide	13,000	7,020	8,400	0	0	8,490
PM_{10}	19,300	24,800	640[b]	4,740	1,090[b]	30,000
Sulfur dioxide	1,200	0	850	0	0	0
Volatile organic compounds	400	3,240	660	0	0	3,920
Total suspended particulates	43,400	24,800	640	9,340	1,090	30,000
Toxics[c]	0	0	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as total suspended particulate emissions for purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Source: UC 1998i, 1998n.

Table G–78. Concentrations ($\mu g/m^3$) From Construction of New Pit Conversion and MOX Facilities at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Total
Carbon monoxide	8 hours	10,000	64	0.811	0.455	65.3
	1 hour	40,000	279	3.69	2.07	285
Nitrogen dioxide	Annual	100	9.30	0.0268	0.0173	9.34
PM_{10}	Annual	50	4.14	0.0397	0.013	4.19
	24 hours	150	56.4	0.979	1.33	58.7
Sulfur dioxide	Annual	80	15.1	0.00247	0.00175	15.1
	24 hours	365	219	0.0609	0.0431	219
	3 hours	1,300	962	0.365	0.259	963
Total suspended particulates	Annual	75	14.7	0.0893	0.0227	14.8
Toxics[b]	24 hours	150	31.7	0	0.000224	31.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, and hexane) could be emitted during construction and were analyzed as benzene.
Source: EPA 1997; SCDHEC 1996.

G.4.2.6.2 Operation of Pit Conversion and MOX Facilities

Potential air quality impacts from operation of the new pit conversion and MOX facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–79.

Table G–79. Emissions (kg/yr) From Operation of New Pit Conversion and MOX Facilities at SRS

Pollutant	Pit Conversion				MOX			
	Boilers	EG	Process	Vehicles	Boilers	EG	Process	Vehicles
Carbon monoxide	440	520	0	39,600	1,630	374	0	32,700
Nitrogen dioxide	15,000	2,000	0	11,500	4,450	1,740	0	9,470
PM_{10}	1,050	50	0	40,500	215	122	0	33,400
Sulfur dioxide	25,000	34	0	0	24,700	114	0	0
Volatile organic compounds	52	58	0	5,300	0	142	0	4,370
Total suspended particulates	1,050	50	0	40,500	215	122	0	33,400
Toxics[a]	0	0	0	0	0	0	1,000	0

[a] Toxic hydrocarbons may be emitted as ethylene glycol.
Key: EG, emergency generator.
Source: UC 1998i, 1998n.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–80. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–80. Concentrations ($\mu g/m^3$) From Operation of New Pit Conversion and MOX Facilities at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Total
Carbon monoxide	8 hours	10,000	64	0.0891	0.109	64.2
	1 hour	40,000	279	0.364	0.345	280
Nitrogen dioxide	Annual	100	9.30	0.0225	0.00905	9.33
PM_{10}	Annual	50	4.14	0.00139	0.000515	4.14
	24 hours	150	56.4	0.0201	0.00979	56.4
Sulfur dioxide	Annual	80	15.1	0.0307	0.0306	15.2
	24 hours	365	219	0.42	0.42	220
	3 hours	1,300	962	1.09	1.11	964
Total suspended particulates	Annual	75	14.7	0.00139	0.000515	14.7
Toxics[b]	24 hours	650	0.195	0	0.0585	0.254

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State standard for ethylene glycol is a 24-hr average of 650 $\mu g/m^3$.
Source: EPA 1997; SCDHEC 1996.

G.4.2.7 Immobilization and MOX Facilities

G.4.2.7.1 Construction of Immobilization and MOX Facilities

Potential air quality impacts from construction of new immobilization (ceramic or glass), MOX, and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Similar analyses were conducted for potential air quality impacts from modification of Building 221–F and construction of support facilities for plutonium conversion and immobilization (ceramic or glass). Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from disturbance of soil by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–81.

Maximum air pollutant concentrations from construction activities are summarized in Table G–82.

Table G–81. Emissions (kg/yr) From Construction of Immobilization in Building 221–F or New Construction, and New MOX Facility at SRS

	Immobilization (Ceramic or Glass)								MOX			
	DE		CFE[a]		CBP		Veh					
Pollutant	221–F	New	221–F	New	221–F	New	221–F	New	DE	CFE[a]	CBP	Veh
CO	1,070	4,550	0	0	0	0	49,200	52,600	3,200	0	0	29,300
NO_2	2,750	11,750	0	0	0	0	14,300	15,300	8,400	0	0	8,490
PM_{10}	210[b]	899[b]	410[b]	3,270	47[b]	2,076[b]	50,400	53,800	640[b]	4,740	1,090[b]	30,000
SO_2	280	1,190	0	0	0	0	0	0	850	0	0	0
VOC	220	930	0	0	0	0	6,590	7,040	660	0	0	3,920
TSP	210	899	410	6,140	47	2,076	50,400	53,800	640	9,340	1,090	30,000
Toxics[c]	0	0	0	0	0	0	0	0	0	<1	0	0

[a] Does not include fugitive emissions from concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as TSP emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Key: CBP, concrete batch plant; CFE, construction fugitive emissions; CO, carbon monoxide; DE, diesel equipment; NO_2, nitrogen dioxide; SO_2, sulfur dioxide; TSP, total suspended particulates; Veh, vehicles; VOC, volatile organic compounds.
Source: UC 1998j, 1998k, 1998l, 1998m, 1998n.

Table G–82. Concentrations ($\mu g/m^3$) From Construction of Immobilization in Building 221–F or New Construction, and New MOX Facility at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Immobilization (Ceramic or Glass) 221–F	Immobilization (Ceramic or Glass) New	MOX	Total With 221–F	Total With New
Carbon monoxide	8 hours	10,000	64	0.168	0.648	0.455	64.6	65.1
	1 hour	40,000	279	0.723	2.94	2.07	282	284
Nitrogen dioxide	Annual	100	9.30	0.00623	0.0242	0.0173	9.32	9.34
PM_{10}	Annual	50	4.14	0.00148	0.0129	0.013	4.15	4.16
	24 hours	150	56.4	0.172	1.33	1.33	57.9	59.1
Sulfur dioxide	Annual	80	15.1	0.000634	0.00245	0.00175	15.1	15.1
	24 hours	365	219	0.0153	0.0604	0.0431	219	219
	3 hours	1,300	962	0.0906	0.362	0.259	962	963
Total suspended particulates	Annual	75	14.7	0.00148	0.0187	0.0227	14.7	14.7
Toxics[b]	24 hours	150	31.7	0	0	0.000224	31.7	31.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Source: EPA 1997; SCDHEC 1996.

G.4.2.7.2 Operation of Immobilization and MOX Facilities

Potential air quality impacts from operation of the modified or new immobilization (ceramic or glass), new MOX, and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from boilers, emergency diesel generators, process emissions, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–83.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–84. Radiological impacts, including those from emissions to the air, are discussed in Appendix J.

Table G–83. Emissions (kg/yr) From Operation of Immobilization in Building 221–F or New Construction, and New MOX Facility at SRS

Pollutant	Immobilization (221–F or New)					MOX			
	Boilers	Emergency Generator	Ceramic[a] Process	Vehicles 221–F	Vehicles New	Boilers	Emergency Generator	Process	Vehicles
Carbon monoxide	140	390	3,500	41,300	35,900	1,630	374	0	32,700
Nitrogen dioxide	4,540	1,810	0	12,000	10,400	4,450	1,740	0	9,470
PM_{10}	350	130	0	42,300	36,700	215	122	0	33,400
Sulfur dioxide	13,270	120	0	0	0	24,700	114	0	0
Volatile organic compounds	30	150	0	5,530	4,800	0	142	0	4,370
Total suspended particulates	350	130	0	42,300	36,700	215	122	0	33,400
Toxics[b]	0	0	0	0	0	0	0	1000	0

[a] The concentrations for glass are less than or the same as those for ceramic.
[b] Toxic hydrocarbons may be emitted as ethylene glycol.
Source: UC 1998j, 1998k, 1998l, 1998m, 1998n.

Table G–84. Concentrations ($\mu g/m^3$) From Operation of Immobilization in Building 221–F or New Construction, and New MOX Facility at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Immobilization (Ceramic)[b] 221–F	Immobilization (Ceramic)[b] New	MOX	Total With 221–F	Total With New
Carbon monoxide	8 hours	10,000	64	0.148	0.141	0.109	64.3	64.3
	1 hour	40,000	279	0.589	0.576	0.345	280	280
Nitrogen dioxide	Annual	100	9.30	0.00968	0.0093	0.00905	9.32	9.32
PM_{10}	Annual	50	4.14	0.000724	0.000697	0.000515	4.14	4.14
	24 hours	150	56.4	0.013	0.0125	0.00979	56.4	56.4
Sulfur dioxide	Annual	80	15.1	0.0166	0.0166	0.0306	15.1	15.1
	24 hours	365	219	0.229	0.229	0.42	220	220
	3 hours	1,300	962	0.615	0.613	1.11	963	963
Total suspended particulates	Annual	75	14.7	0.000724	0.000697	0.000515	14.7	14.7
Toxics[c]	24 hours	650	0.195	0	0	0.0585	0.254	0.254

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] The concentrations for glass are less than or the same as those for ceramic.
[c] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed as ethylene glycol. The State standard for ethylene glycol is a 24-hr average of 650 $\mu g/m^3$.
Source: EPA 1997; SCDHEC 1996.

G.4.2.8 Pit Conversion, Immobilization, and MOX Facilities

G.4.2.8.1 Construction of Pit Conversion, Immobilization, and MOX Facilities

Potential air quality impacts from construction of new pit disassembly, immobilization (ceramic and glass), MOX, and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Similar analyses were conducted for potential air quality impacts from modification of Building 221–F and construction of support facilities for plutonium conversion and immobilization (ceramic and glass). Construction impacts result from emissions from diesel fuel-burning construction equipment, particulate matter emissions from soil disturbance by construction equipment and other vehicles (construction fugitive emissions), operation of a concrete batch plant, employee vehicles, and trucks moving materials and wastes. Emissions from construction of a new facility are higher than for modification of an existing facility described previously. Emissions from these sources are summarized in Table G–85.

Table G–85. Emissions (kg/yr) From Construction of New Pit Conversion and MOX Facilities, and Immobilization in Building 221–F or New Construction at SRS

	Pit Conversion		Immobilization (Ceramic or Glass)								MOX			
	DE &		DE		CFE[a]		CBP		Veh					
Pollutant	CFE	Veh	221–F	New	221–F	New	221–F	New	221–F	New	DE	CFE[a]	CBP	Veh
CO	5,700	24,200	1,070	4,550	0	0	0	0	49,200	52,600	3,200	0	0	29,300
NO_2	13,000	7,020	2,750	11,750	0	0	0	0	14,300	15,300	8,400	0	0	8,490
PM_{10}	19,300	24,800	210[b]	899[b]	410[b]	3,270	47[b]	2,076[b]	50,400	53,800	640[b]	4,740	1,090[b]	30,000
SO_2	1,200	0	280	1,190	0	0	0	0	0	0	850	0	0	0
VOC	400	3,240	220	930	0	0	0	0	6,590	7,040	660	0	0	3,920
TSP	43,400	24,800	210	899	410	6,140	47	2,076	50,400	53,800	640	9,340	1,090	30,000
Toxics[c]	0	0	0	0	0	0	0	0	0	0	0	<1	0	0

[a] Does not include fugitive emissions from the concrete batch plant.
[b] PM_{10} emissions were assumed to be the same as TSP emissions for the purpose of this analysis resulting in some overestimate of PM_{10} concentrations.
[c] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction.
Key: CBP, concrete batch plant; CFE, construction fugitive emissions; CO, carbon monoxide; DE, diesel equipment; NO_2, nitrogen dioxide; SO_2, sulfur dioxide; TSP, total suspended particulates; Veh, vehicles; VOC, volatile organic compounds.
Source: UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n.

Maximum air pollutant concentrations from construction activities are summarized in Table G–86.

Table G–86. Concentrations ($\mu g/m^3$) From Construction of New Pit Conversion and MOX Facilities, and Immobilization in Building 221–F or New Construction at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	MOX	Immobilization (Ceramic or Glass) 221–F	Immobilization (Ceramic or Glass) New	Total With 221–F	Total With New
Carbon monoxide	8 hours	10,000	64	0.811	0.455	0.168	0.648	65.4	66.0
	1 hour	40,000	279	3.69	2.07	0.723	2.94	285	288
Nitrogen dioxide	Annual	100	9.30	0.0268	0.0173	0.00623	0.0242	9.35	9.37
PM_{10}	Annual	50	4.14	0.0397	0.0130	0.00148	0.0129	4.19	4.21
	24 hours	150	56.4	0.979	1.33	0.172	1.33	58.7	60.0
Sulfur dioxide	Annual	80	15.1	0.00247	0.00175	0.000634	0.00245	15.1	15.1
	24 hours	365	219	0.0609	0.0431	0.0154	0.0604	219	219
	3 hours	1,300	962	0.365	0.259	0.0906	0.362	963	963
Total suspended particulates	Annual	75	14.7	0.0893	0.0227	0.00148	0.0187	14.8	14.8
Toxics[b]	24 hours	150	31.7	0	0.000224	0	0	31.7	31.7

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.
Source: EPA 1997; SCDHEC 1996.

G.4.2.8.2 Operation of Pit Conversion, Immobilization, and MOX Facilities

Potential air quality impacts from operation of the three surplus plutonium disposition and support facilities at SRS were analyzed using ISCST3 as described in Appendix F.1. Operation impacts result from emissions from emergency diesel generators, process emissions, steam boilers, employee vehicles, and trucks moving materials and wastes. Emissions from these sources are summarized in Table G–87.

Table G–87. Emissions (kg/yr) From Operation of New Pit Conversion and MOX Facilities, and Immobilization in Building 221–F or New Construction at SRS

	Pit Conversion				Immobilization (221–F or New)					MOX			
Pollutant	Boilers	EG	Process	Veh	Boilers	EG	Ceramic Process[a]	Veh (221–F)	Veh (New)	Boilers	EG	Process	Veh
CO	440	520	0	39,600	140	390	3,500	41,300	35,900	1,630	374	0	32,700
NO_2	15,000	2,000	0	11,500	4,540	1,810	0	12,000	10,400	4,450	1,740	0	9,470
PM_{10}	1,050	50	0	40,500	350	130	0	42,300	36,700	215	122	0	33,400
SO_2	25,000	34	0	0	13,300	120	0	0	0	24,700	114	0	0
VOC	52	58	0	5,300	30	150	0	5,530	4,800	0	142	0	4,370
TSP	1,050	50	0	40,500	350	130	0	42,300	36,700	215	122	0	33,400
Toxics[b]	0	0	0	0	0	0	0	0	0	0	0	1,000	0

[a] The concentrations for glass are less than or the same as those for ceramic.
[b] Toxic hydrocarbons may be emitted as ethylene glycol.
Key: CO, carbon monoxide; EG, emergency generator; NO_2, nitrogen dioxide; SO_2, sulfur dioxide; TSP, total suspended particulates; Veh, vehicles; VOC, volatile organic compounds.
Source: UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n.

Maximum air pollutant concentrations resulting from the boilers, emergency diesel generators, and process sources, plus the No Action concentrations, are summarized in Table G–88. Radiological impacts, including those emissions to the air, are discussed in Appendix J.

Table G–88. Concentrations ($\mu g/m^3$) From Operation of New Pit Conversion and MOX Facilities, and Immobilization in Building 221–F or New Construction at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	No Action	Pit Conversion	Immobilization (Ceramic)[b] 221–F	Immobilization (Ceramic)[b] New	MOX	Total With 221–F	Total With New
Carbon monoxide	8 hours	10,000	64	0.0891	0.148	0.141	0.109	64.4	64.3
	1 hour	40,000	279	0.364	0.589	0.576	0.345	280	280
Nitrogen dioxide	Annual	100	9.30	0.0225	0.00968	0.0093	0.00905	9.34	9.34
PM_{10}	Annual	50	4.14	0.00139	0.000724	0.000697	0.000515	4.14	4.14
	24 hours	150	56.4	0.0201	0.013	0.0125	0.00979	56.4	56.4
Sulfur dioxide	Annual	80	15.1	0.0307	0.0166	0.0166	0.0306	15.2	15.2
	24 hours	365	219	0.42	0.229	0.229	0.42	220	220
	3 hours	1,300	962	1.09	0.615	0.613	1.11	964	964
Total suspended particulates	Annual	75	14.7	0.00139	0.000724	0.000697	0.000515	14.7	14.7
Toxics[c]	24 hours	650	0.195	0	0	0	0.0585	0.254	0.254

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] The concentrations for glass are less than or the same as those for ceramic.
[c] Toxic hydrocarbons may be emitted as ethylene glycol and other pollutants and were analyzed ethylene glycol. The State standard for ethylene glycol is a 24-hr average of 650 $\mu g/m^3$.
Source: EPA 1997; SCDHEC 1996.

G.5 REFERENCES

DOE (U.S. Department of Energy), 1995, *Savannah River Site Waste Management Final Environmental Impact Statement*, DOE/EIS-0217, Savannah River Operations Office, Aiken, SC, July.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, Richland Operations Office, Richland, WA, August.

DOE (U.S. Department of Energy), 1996c, *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*, DOE/EIS-0225, Albuquerque Operations Office, Albuquerque, NM, November.

EPA (U.S. Environmental Protection Agency), 1997, *National Primary and Secondary Ambient Air Quality Standards*, 40 CFR 50, March 31.

ID DHW (Idaho Department of Health and Welfare), 1995, *Rules for the Control of Air Pollution in Idaho*, 577, "Ambient Standards for Specific Air Pollutants"; 585, "Toxic Air Pollutants Non-Carcinogenic Increments"; 586, "Toxic Air Pollutants Carcinogenic Increments"; IDAPA 16, Title 01, Chapter 01, Boise, ID.

SCDHEC (South Carolina Department of Health and Environmental Control), 1996, *Regulation 61-62, Air Pollution Control Regulations and Standards*, Standard 2, "Ambient Air Quality Standards"; Standard 8, "Toxic Air Pollutants," Air Pollution Control, Columbia, SC.

TNRCC (Texas Natural Resources and Conservation Commission), 1997a, Toxicology and Risk Assessment (TARA) Section Staff, memo to Interested Parties, *Effects Screening Levels (ESLs) List*, Austin, TX, September 5.

TNRCC (Texas Natural Resources and Conservation Commission), 1997b, *TNRCC Rules*, 101, "General Rules (Air Quality)"; 112, "Control of Air Pollution from Sulfur Compounds (Reg. II)"; 113, "Control of Air Pollution from Toxic Materials (Reg. III)," Austin, TX.

UC (Regents of the University of California), 1998a, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Hanford Site*, LA-UR-97-2907, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998b, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Hanford*, UCRL-ID-128276, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998c, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford*, UCRL-ID-128275, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998d, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Hanford Site*, LA-UR-97-2064, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998e, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Idaho National Engineering and Environmental Laboratory, Final Draft*, LA-UR-97-2908, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998f, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Idaho National Engineering and Environmental Laboratory*, LA-UR-97-2065, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998g, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Pantex Plant*, LA-UR-97-2909, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998h, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Pantex Plant*, LA-UR-97-2067, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998i, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Savannah River Site*, LA-UR-97-2910, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998j, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Savannah River Site*, UCRL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998k, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Savannah River Site*, UCRL-ID-128272, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998l, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in New Facilities at Savannah River Site*, UCRL-ID-128273, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998m, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site*, UCRL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998n, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Savannah River Site*, LA-UR-97-2066, Los Alamos National Laboratory, Los Alamos, NM.

WDEC (Washington Department of Ecology), 1994, *Washington Administrative Code*, Title 173, Chapter 173-460, "Controls for New Sources of Toxic Air Pollutants"; Chapter 173-470, "Standards for Particulate Matter"; Chapter 173-474, "Ambient Air Quality Standards for Sulfur Oxide"; Chapter 173-475, "Ambient Air Quality Standards for Carbon Monoxide, Ozone, and Nitrogen Dioxide"; Chapter 173-481, "Ambient Air Quality and Environmental Standards for Fluorides."

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Appendix H
Waste Management

This appendix describes the impacts on the waste management infrastructure that would occur if the proposed surplus plutonium disposition facilities were located at the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), Pantex Plant (Pantex), or Savannah River Site (SRS), or if lead assembly fabrication activities were located at INEEL (Argonne National Laboratory–West [ANL–W]), Hanford, Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), or SRS. The waste types evaluated in this section are transuranic (TRU) waste (including mixed TRU waste), low-level waste (LLW), mixed LLW, hazardous waste, nonhazardous solid waste, and nonhazardous liquid waste. Major adverse impacts are not expected at any of the U.S. Department of Energy (DOE) sites, although Pantex may have to convert some existing storage capacity into storage space for TRU waste and LLW. Facilities for drum-gas testing, real-time radiography, and loading the TRU waste package transporter (TRUPACT) for shipment to the Waste Isolation Pilot Plant (WIPP) may also be required at Pantex. The *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) assumes that all TRU waste generated by surplus plutonium disposition facilities would have to be stored on the site until WIPP is ready to accept this waste in 2016 (DOE 1997a:17). Impacts from additional TRU waste storage at the DOE sites should not be major. A description of the methods used to estimate impacts on waste management facilities is presented in Appendix F.8.

Decisions in the Records of Decision (RODs) for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (WM PEIS) (DOE 1997b) could affect where DOE would send wastes in the future and could result in the closing of some existing waste management facilities and construction of new facilities at DOE sites. The ROD for TRU waste issued on January 20, 1998, states that each of the DOE sites that currently has or will generate TRU waste will prepare and store its TRU waste on the site for eventual shipment to WIPP. RODs for LLW, mixed LLW, and hazardous waste are pending.

H.1 HANFORD

H.1.1 Assessment Data

Impacts on Hanford waste management facilities were estimated using information on existing environmental conditions from Chapter 3 and information on the characteristics of the proposed surplus plutonium disposition facilities from Chapter 2 and the facility data reports. A description of the methods used to evaluate impacts on waste management facilities is presented in Appendix F.8.

H.1.2 Facilities

H.1.2.1 Pit Conversion Facility

H.1.2.1.1 Construction of Pit Conversion Facility

Table H–1 compares the expected construction waste generation rates for the facility that may be constructed at Hanford with the existing generation rates for Hanford waste. No radioactive waste would be generated during the 3-year construction period because this action involves modification of uncontaminated buildings only (UC 1998a). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Table H–1. Potential Waste Management Impacts of Construction of Pit Conversion Facility in FMEF at Hanford

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	13	560	2
Nonhazardous			
Liquid	1,300	200,000	1
Solid	28	43,000	<1

[a] See definitions in Appendix F.8.
[b] UC 1998a.
[c] From the waste management section in Chapter 3.
Key: FMEF, Fuels and Materials Examination Facility.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in U.S. Department of Transportation (DOT) approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998a). Hazardous waste generation for this facility is estimated to be 2 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste includes office garbage, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998a). Nonrecyclable solid sanitary waste would be sent off the site and would likely be disposed of in the Richland Sanitary Landfill. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be less than 1 percent of existing annual waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets (UC 1998a). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for this facility is estimated to be 1 percent of existing annual site waste generation, 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the Washington Public Power Supply System (WPPSS) Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.1.2.1.2 Operation of Pit Conversion Facility

The waste management facilities within the pit conversion facility would process, temporarily store, and ship all wastes generated. Table H–2 compares the expected waste generation rates from operating the new facility at Hanford with the existing generation rates for Hanford waste. No high-level waste (HLW) would be generated by the facility (UC 1998a). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in

Table H–2. Potential Waste Management Impacts of Operation of Pit Conversion Facility in FMEF at Hanford

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	18	450	4
LLW	60	3,902	2
Mixed LLW	1	847	<1
Hazardous	2	560	<1
Nonhazardous			
Liquid	40,000	200,000	20
Solid	1,800	43,000	4

[a] See definitions in Appendix F.8.
[b] UC 1998d.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; TRU, transuranic.

accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* being prepared by the DOE Richland Operations Office (DOE 1997c).

TRU wastes generated during operations include spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, and solidified inorganic solutions. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facility (UC 1998a). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation for this facility is estimated to be 4 percent of existing annual waste generation and 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 180 m^3 (235 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 2 percent of the 11,450 m^3 (14,977 yd^3) of contact-handled TRU waste currently in storage, and 1 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 860 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of approximately 260 m^2 (310 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at Hanford should not be major.

The 180 m^3 (235 yd^3) of TRU waste generated by this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation. Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998a). A total of 600 m^3 (785 yd^3) of LLW would be generated over the operation period. LLW generation for this facility is estimated to be 2 percent of existing annual waste generation, less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) disposal capacity of the LLW Burial Grounds, and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 m^3 (780 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW includes lead shielding, solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998a). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Hanford currently treats and disposes of mixed LLW on the site. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this facility is estimated to be 1 m^3/yr (1.3 yd^3/yr) or less than 1 percent of existing annual waste generation, and less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. Over the operating life of the facility, the 10 m^3 (13 yd^3) of mixed LLW generated would be less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) disposal capacity in the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998a). Hazardous waste generation for this facility is estimated to be less than 1 percent of existing annual waste generation. These wastes should not have a major impact on the hazardous waste management system at Hanford.

Nonhazardous solid waste includes office garbage, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998a). The remaining solid sanitary waste would be sent off the site for disposal in the Richland Sanitary Landfill. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be 4 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and process wastewater from lab sinks and drains, mop water, and cooling tower blowdown. Wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer that connects to the WPPSS wastewater treatment system (UC 1998a). Nonhazardous liquid waste generation for this facility is estimated to be 20 percent of the existing annual site waste generation, 17 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 17 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system.

H.1.2.2 Immobilization Facility

H.1.2.2.1 Construction of Immobilization Facility

Table H–3 compares the expected construction waste generation rates for the immobilization facility that may be constructed at Hanford with the existing generation rates for Hanford waste. No radioactive waste would be generated during the 3-year construction period because this action involves modification of uncontaminated buildings only (UC 1998b, 1998c). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. Construction waste generation would be the same for both the ceramic and glass immobilization technologies and would be the same for the 17-t (19-ton) and 50-t (55-ton) immobilization scenarios, because the same size facility would be built under any scenario (UC 1998a, 1998b).

Table H–3. Potential Waste Management Impacts of Construction of Immobilization Facility in FMEF at Hanford

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	4	560	1
Nonhazardous			
Liquid	3,700	200,000	2
Solid	150	43,000	<1

[a] See definitions in Appendix F.8.
[b] UC 1998b, 1998c.
[c] From the waste management section in Chapter 3.
Key: FMEF, Fuels and Materials Examination Facility.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints, chemicals, as well as rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998b, 1998c). Hazardous waste generation for this facility is estimated to be 1 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998b, 1998c). Nonrecyclable solid sanitary waste would be sent off the site and would likely be disposed of in the Richland Sanitary Landfill. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonhazardous solid waste generation for this facility is estimated to be less than 1 percent of existing annual waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets (UC 1998b, 1998c). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for this facility is estimated to be 2 percent of existing annual site waste generation, 2 percent of the

235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 2 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.1.2.2.2 Operation of Immobilization Facility

The waste management facilities within the immobilization facility would process, temporarily store, and ship all wastes generated. Table H–4 compares the expected waste generation rates from operating the new facility at Hanford with the existing generation rates for Hanford waste. Although HLW would be used in the immobilization process, no HLW would be generated by the facility (UC 1998b, 1998c). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Waste generation would be the same for both ceramic and glass immobilization technologies, but varies between the 17-t (19-ton) and the 50-t (55-ton) immobilization cases (UC 1998b, 1998c). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* being prepared by the DOE Richland Operations Office (DOE 1997c).

Table H–4. Potential Waste Management Impacts of Operation of Immobilization Facility in FMEF at Hanford

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b] 17 t	Estimated Waste Generation (m^3/yr)[b] 50 t	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation 17 t	Percent of Site Waste Generation 50 t
TRU[d]	95	126	450	21	28
LLW	60	80	3,902	2	2
Mixed LLW	1	1	847	<1	<1
Hazardous	30	30	560	5	5
Nonhazardous					
Liquid	23,000	25,000	200,000	12	13
Solid	230	230	43,000	1	1

[a] See definitions in Appendix F.8.
[b] UC 1998b, 1998c.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; TRU, transuranic.

TRU wastes generated during operations include metal cladding from fuel elements, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, and solidified inorganic solutions. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998b, 1998c). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation for this facility is estimated to be 21 to 28 percent of existing annual waste generation and 5 to 7 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 950 to 1,260 m^3 (1,240 to 1,650 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 8 to 11 percent of the 11,450 m^3 (14,977 yd^3) of contact-handled TRU waste currently in storage and 6 to 7 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 4,500 to 6,000 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of approximately 1,400 to 1,800 m^2 (1,670 to 2,150 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.14 to 0.18 ha (0.35 to 0.44 acre) of land at Hanford should not be major.

The 950 to 1,260 m^3 (1,240 to 1,650 yd^3) of TRU waste generated by this facility would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, and solidified inorganic solutions. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facility before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation (UC 1998b, 1998c). A total of 600 to 800 m^3 (780 to 1,000 yd^3) of LLW would be generated over the operation period. LLW generation for this facility is estimated to be 2 percent of existing annual waste generation, less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) disposal capacity of the LLW Burial Grounds and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 to 800 m^3 (780 to 1,000 yd^3) of waste would require 0.17 to 0.23 ha (0.42 to 0.57 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW includes lead shielding, solvents contaminated with plutonium, and scintillation vials from the analytical laboratory (UC 1998b, 1998c). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Hanford currently treats and disposes of mixed LLW on the site. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this facility is estimated to be 1 m^3/yr (1.3 yd^3/yr), or less than 1 percent of existing annual waste generation. The 1 m^3/yr (1.3 yd^3/yr) of mixed LLW would be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. Over the operating life of this facility, the 10 m^3 (13 yd^3) of mixed LLW generated would be less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) disposal capacity in the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional mixed LLW at Hanford should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, lubrication oils, film processing fluids, hydraulic fluids, coolants, paints, chemicals, batteries, fluorescent light tubes, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998b, 1998c). Assuming that all hazardous waste is managed onsite, hazardous waste generation for this facility is estimated to be 5 percent of existing annual waste generation. These wastes should not have a major impact on the hazardous waste management system at Hanford.

Nonhazardous solid waste includes office garbage, machine shop wastes, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998b, 1998c). The remaining solid sanitary waste would be sent off the site for disposal in the Richland Sanitary Landfill. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be 1 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from cooling tower blowdown. Wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer that connects to the WPPSS wastewater treatment system (UC 1998b, 1998c). Nonhazardous-liquid-waste generation for this facility is estimated to be 12 to 13 percent of the existing annual site waste generation, 10 to 11 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 10 to 11 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system.

H.1.2.3 MOX Facility

H.1.2.3.1 Construction of MOX Facility

Table H–5 compares the expected construction waste generation rates for the facility that may be constructed at Hanford with the existing generation rates for Hanford waste. No radioactive waste would be generated during the 3-year construction period because this action involves new construction or modification of uncontaminated buildings only (UC 1998d). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. The amount of waste generated during construction would vary if the Fuels and Materials Examination Facility (FMEF) needs to be modified to accept the mixed oxide (MOX) facility versus constructing a new building (UC 1998c:attachment).

Table H–5. Potential Waste Management Impacts of Construction of MOX Facility in FMEF or New Construction at Hanford

	Estimated Waste Generation (m^3/yr)[b]		Site Waste Generation	Percent of Site Waste Generation	
Waste Type[a]	FMEF	New	(m^3/yr)[c]	FMEF	New
Hazardous	6	11	560	1	2
Nonhazardous					
Liquid	12,000	13,000	200,000	6	7
Solid	280	820	43,000	1	2

[a] See definitions in Appendix F.8.
[b] UC 1998d.
[c] From the waste management section in Chapter 3.
Key: FMEF, Fuels and Materials Examination Facility.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints, chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998d). Hazardous waste generation for this facility is estimated to be 1 to 2 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998d). Nonrecyclable solid sanitary waste would be sent off the site and would likely be disposed of in the Richland Sanitary Landfill. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonhazardous solid waste generation for this facility is estimated to be 1 to 2 percent of existing annual waste generation. Because these wastes would be managed at offsite facilities, the additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from dewatering (UC 1998d). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid-waste generation for this facility is estimated to be 6 to 7 percent of existing annual site waste generation, 5 to 6 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 5 to 6 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.1.2.3.2 Operation of MOX Facility

The waste management facilities within the MOX facility would process, temporarily store, and ship all wastes generated. Table H–6 compares the expected waste generation rates from operating the new facility at Hanford with the existing generation rates for Hanford waste. No HLW would be generated by the facility (UC 1998d). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Waste generation during operations would be the same whether the MOX facility is located in FMEF or in a new building (UC 1998d:attachment). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* being prepared by the DOE Richland Operations Office (DOE 1997c).

Table H–6. Potential Waste Management Impacts of Operation of MOX Facility in FMEF or New Construction at Hanford

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	46	450	10
LLW	34	3,902	1
Mixed LLW	2	847	<1
Hazardous	<1	560	<1
Nonhazardous			
Liquid	25,000	200,000	13
Solid	<150	43,000	<1

[a] See definitions in Appendix F.8.
[b] UC 1998d.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.

Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; TRU, transuranic.

TRU wastes generated during operations include spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998d). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation for this facility is estimated to be 10 percent of existing annual waste generation and 3 percent of the 1,820-m^3/yr (2,380-yd^3/yr) planned capacity of the Waste Receiving and Processing Facility. A total of 460 m^3 (600 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 4 percent of the 11,450 m^3 (14,977 yd^3) of contact-handled TRU waste currently in storage and 3 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 2,200 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of approximately 660 m^2 (790 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.1 ha (0.25 acre) of land at Hanford should not be major.

The 460 m^3 (600 yd^3) of TRU waste generated by this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, and solidified inorganic solutions. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facility before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation (UC 1998d). A total of 340 m^3 (445 yd^3) of LLW would be generated over the operation period. LLW generation for this facility is estimated to be 1 percent of existing annual waste generation, less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) disposal capacity of the LLW Burial Grounds, and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 340 m^3 (440 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW includes solvents contaminated with plutonium and scintillation vials from the analytical laboratory (UC 1998d). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Hanford currently treats and disposes of mixed LLW on the site. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this facility is estimated to be 2 m^3/yr (2.6 yd^3/yr) or less than 1 percent of existing annual waste generation. The 2 m^3/yr (2.6 yd^3/yr) of mixed LLW would be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. Over the operating life of this facility, the 20 m^3 (26 yd^3) of mixed LLW generated would be less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) disposal capacity in the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, lubricants, oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998d). Hazardous waste generation for this facility is estimated to be less than 1 percent of existing annual waste generation. These wastes should not have a major impact on the hazardous waste management system at Hanford.

Nonhazardous solid waste includes office garbage, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998d). The remaining solid sanitary waste would be sent off the site for disposal in the Richland Sanitary Landfill. Nonrecyclable, nonhazardous solid waste generation for this facility is estimated to be less than 1 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets; process wastewater from lab sinks and drains, mop water, and cooling tower blowdown; and treated wastewater from the liquid effluent treatment system. Wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer that connects to the WPPSS wastewater treatment system (UC 1998d). Nonhazardous-liquid-waste generation for this facility is estimated to be 13 percent of the existing annual site waste generation, 11 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 11 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system.

H.1.2.4 Pit Conversion and Immobilization Facilities

H.1.2.4.1 Construction of Pit Conversion and Immobilization Facilities

Table H–7 compares the expected construction waste generation rates for the facilities that may be constructed at Hanford with the existing generation rates for Hanford waste. No radioactive waste would be generated during the 3-year construction period because this action involves modification of uncontaminated buildings only (UC 1998a, 1998b, 1998c). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. Construction waste generation would be the same for both the ceramic and glass immobilization technologies and would be the same for the 17-t (19-ton) and 50-t (55-ton) immobilization scenarios, because the same size facility would be built under any scenario (UC 1998b, 1998c).

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998a, 1998b, 1998c). Hazardous waste generation for this combination of facilities is estimated to be 3 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998a, 1998b, 1998c). Nonrecyclable

Table H–7. Potential Waste Management Impacts of Construction of Pit Conversion and Immobilization Facilities in FMEF at Hanford

	Estimated Waste Generation (m^3/yr)[b]			Percent of Site Waste Generation		
Waste Type[a]	Pit Conversion	Immobilization (Ceramic or Glass)	Site Waste Generation (m^3/yr)[c]	Pit Conversion	Immobilization (Ceramic or Glass)	Both Facilities
Hazardous	13	4	560	2	1	3
Nonhazardous						
Liquid	1,300	3,700	200,000	1	2	3
Solid	28	150	43,000	<1	<1	<1

[a] See definitions in Appendix F.8.
[b] UC 1998a, 1998b, 1998c.
[c] From the waste management section in Chapter 3.
Key: FMEF, Fuels and Materials Examination Facility.

solid sanitary waste would be sent off the site and would likely be disposed of in the Richland Sanitary Landfill. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be less than 1 percent of existing annual waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets (UC 1998a, 1998b, 1998c). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for this combination of facilities is estimated to be 3 percent of existing annual site waste generation, 3 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 3 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.1.2.4.2 Operation of Pit Conversion and Immobilization Facilities

The waste management facilities within the pit conversion and immobilization facilities would process, temporarily store, and ship all wastes generated. Table H–8 compares the expected waste generation rates from operating the new facilities at Hanford with the existing generation rates for Hanford waste. Although HLW would be used in the immobilization process, no HLW would be generated by the facilities (UC 1998a, 1998b, 1998c). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Waste generation would be the same for both the ceramic and glass immobilization technologies, but varies between the 17-t (19-ton) and the 50-t (55-ton) immobilization cases (UC 1998b, 1998c). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* being prepared by the DOE Richland Operations Office (DOE 1997c).

Table H–8. Potential Waste Management Impacts of Operation of Pit Conversion and Immobilization Facilities in FMEF at Hanford

	Estimated Waste Generation (m^3/yr)[b]				Percent of Site Waste Generation			
		Immobilization (Ceramic or Glass)		Site Waste		Immobilization (Ceramic or Glass)		
Waste Type[a]	Pit Conversion	17 t	50 t	Generation (m^3/yr)[c]	Pit Conversion	17 t	50 t	Both Facilities
TRU[d]	18	95	126	450	4	21	28	25 to 32
LLW	60	60	80	3,902	2	2	2	3 to 4
Mixed LLW	1	1	1	847	<1	<1	<1	<1
Hazardous	2	30	30	560	<1	5	5	6
Nonhazardous								
Liquid	40,000	23,000	25,000	200,000	20	12	13	32 to 33
Solid	1,800	230	230	43,000	4	1	1	5

[a] See definitions in Appendix F.8.
[b] UC 1998a, 1998b, 1998c.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.

Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; TRU, transuranic.

TRU wastes generated during operations include metal cladding from fuel elements, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, and solidified inorganic solutions. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998a, 1998b, 1998c). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation for this combination of facilities is estimated to be 25 to 32 percent of existing annual waste generation and 6 to 8 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,130 to 1,440 m^3 (1,480 to 1,880 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 10 to 13 percent of the 11,450 m^3 (14,977 yd^3) of contact-handled TRU waste currently in storage and 7 to 8 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 5,400 to 6,900 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 1,600 to 2,100 m^2 (1,910 to 2,510 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.16 to 0.21 ha (0.40 to 0.51 acre) of land at Hanford should not be major.

The 1,130 to 1,440 m^3 (1,480 to 1,880 yd^3) of TRU waste generated by these facilities would be approximately 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP, and within the 168,500-m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation (UC 1998a, 1998b, 1998c). Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998c). A total of 1,200 to 1,400 m^3 (1,570 to 1,830 yd^3) of LLW would be generated over the operation period. LLW generation for this combination of facilities is estimated to be 3 to 4 percent of existing annual waste generation, less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) disposal capacity of the LLW Burial Grounds, and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480 m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,200 to 1,400 m^3 of waste would require 0.34 to 0.40 ha (0.84 to 0.99 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW includes lead shielding, solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998a, 1998b, 1998c). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Hanford currently treats and disposes of mixed LLW on the site. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this combination of facilities is estimated to be 2 m^3/yr (2.6 m^3/yr) or less than 1 percent of existing annual waste generation, and less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. Over the operating lives of these facilities, the 20 m^3 (26 ft^3) of mixed LLW generated would be less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) disposal capacity in the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998a, 1998b, 1998c). Hazardous waste generation for this combination of facilities is estimated to be 6 percent of existing annual waste generation. These wastes should not have a major impact on the hazardous waste management system at Hanford.

Nonhazardous solid waste includes office garbage, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998a, 1998b, 1998c). The remaining solid sanitary waste would be sent off the site for disposal in the Richland Sanitary Landfill. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 5 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and, process wastewater from lab sinks and drains, mop water, and cooling tower blowdown. Wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer that connects to the WPPSS wastewater treatment system (UC 1998a, 1998b, 1998c). Nonhazardous liquid waste generation for this combination of facilities is estimated to be 32 to 33 percent of the existing annual site waste generation, 27 to 28 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 27 to 28 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system.

H.1.2.5 Pit Conversion and MOX Facilities

H.1.2.5.1 Construction of Pit Conversion and MOX Facilities

Table H–9 compares the expected construction waste generation rates for the facilities that may be constructed at Hanford with the existing generation rates for Hanford waste. No radioactive waste would be generated during the 3-year construction period because this action involves new construction or modification of uncontaminated buildings only (UC 1998a, 1998d). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. The amount of waste generated during construction would vary if FMEF needs to be modified to accept the MOX facility versus constructing a new building (UC 1998d:attachment).

Table H–9. Potential Waste Management Impacts of Construction of Pit Conversion and MOX Facilities in FMEF or New MOX Facility at Hanford

	Estimated Waste Generation (m^3/yr)[b]			Site Waste	Percent of Site Waste Generation		
	Pit	MOX		Generation	Pit		Both
Waste Type[a]	Conversion	FMEF	New	(m^3/yr)[c]	Conversion	MOX	Facilities
Hazardous	13	6	11	560	2	1 to 2	3 to 4
Nonhazardous							
Liquid	1,300	12,000	13,000	200,000	1	6 to 7	7
Solid	28	280	820	43,000	<1	1 to 2	1 to 2

[a] See definitions in Appendix F.8.
[b] UC 1998a, 1998d.
[c] From the waste management section in Chapter 3.
Key: FMEF, Fuels and Materials Examination Facility.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998a, 1998d). Hazardous waste generation for this combination of facilities is estimated to be 3 to 4 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998a, 1998d). Nonrecyclable solid sanitary waste would be sent off the site and would likely be disposed of in the Richland Sanitary Landfill. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 1 to 2 percent of existing annual waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from dewatering (UC 1998a, 1998d). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities.

Nonhazardous liquid waste generation for this combination of facilities is estimated to be 7 percent of existing annual site waste generation, 6 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 6 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.1.2.5.2 Operation of Pit Conversion and MOX Facilities

The waste management facilities within the pit conversion and MOX facilities would process, temporarily store, and ship all wastes generated. Table H–10 compares the expected waste generation rates from operating the new facilities at Hanford with the existing generation rates for Hanford waste. No HLW would be generated by the facilities (UC 1998a, 1998d). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Waste generation during operations would be the same whether the MOX facility is located in FMEF or in a new building (UC 1998d:attachment). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* being prepared by the DOE Richland Operations Office (DOE 1997c).

Table H–10. Potential Waste Management Impacts of Operation of Pit Conversion and MOX Facilities in FMEF or New MOX Facility at Hanford

	Estimated Waste Generation (m^3/yr)[b]		Site Waste	Percent of Site Waste Generation		
Waste Type[a]	Pit Conversion	MOX	Generation (m^3/yr)[c]	Pit Conversion	MOX	Both Facilities
TRU[d]	18	46	450	4	10	14
LLW	60	34	3,902	2	1	2
Mixed LLW	1	2	847	<1	<1	<1
Hazardous	2	<1	560	<1	<1	1
Nonhazardous						
Liquid	40,000	25,000	200,000	20	13	33
Solid	1,800	<150	43,000	4	<1	5

[a] See definitions in Appendix F.8.
[b] UC 1998a, 1998d.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; TRU, transuranic.

TRU wastes generated during operations include spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998a, 1998d). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facililty at Hanford.

TRU waste generation for this combination of facilities is estimated to be 14 percent of existing annual waste generation and 4 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 640 m^3 (837 yd^3) of TRU waste would be generated over the 10-year operation period.

This would be 6 percent of the 11,450 m^3 (14,977 yd^3) of contact-handled TRU waste currently in storage and 4 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 3,000 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of approximately 900 m^2 (1,100 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.1 ha (0.25 acre) of land at Hanford should not be major.

The 640 m^3 (837 yd^3) of TRU waste generated by these facilities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation. Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998a). A total of 940 m^3 (1,230 yd^3) of LLW would be generated over the operation period. LLW generation for this combination of facilities is estimated to be 2 percent of existing annual waste generation, less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) disposal capacity of the LLW Burial Grounds, and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.27 ha (0.67 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW includes lead shielding, solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998a, 1998d). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Hanford currently treats and disposes of mixed LLW on the site. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this combination of facilities is estimated to be 3 m^3/yr (3.9 yd^3/yr) or less than 1 percent of existing annual waste generation, and less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. Over the operating lives of these facilities, the 30 m^3 (39 yd^3) of mixed LLW generated would be less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) disposal capacity in the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998a, 1998d). Hazardous waste generation for this combination of facilities is estimated to be 1 percent of existing annual waste generation. These wastes should not have a major impact on the hazardous waste management system at Hanford.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998a, 1998d). The remaining solid sanitary waste would be sent off the site for disposal in the Richland Sanitary Landfill. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 5 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets; process wastewater from lab sinks and drains, mop water, and cooling tower blowdown; and treated wastewater from the liquid effluent treatment system. Wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer that connects to the WPPSS wastewater treatment system (UC 1998a, 1998d). Nonhazardous liquid waste generation for this combination of facilities is estimated to be 33 percent of the existing annual site waste generation, 28 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 28 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system.

H.1.2.6 Immobilization and MOX Facilities

H.1.2.6.1 Construction of Immobilization and MOX Facilities

Table H–11 compares the expected construction waste generation rates for the facilities that may be constructed at Hanford with the existing generation rates for Hanford waste. No radioactive waste would be generated during the 3-year construction period because this action involves new construction or modification of uncontaminated buildings only (UC 1998b, 1998c, 1998d). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. Construction waste generation would be the same for ceramic and glass immobilization technologies (UC 1998b, 1998c), although the amount of waste generated during construction would vary if FMEF needs to be modified to accept the immobilization and MOX facilities versus constructing a new building for MOX (UC 1998d).

Table H–11. Potential Waste Management Impacts of Construction of Collocating Immobilization and MOX Facilities in FMEF or New MOX Facility at Hanford

	Estimated Waste Generation (m^3/yr)[b]					Percent of Site Waste Generation			
	IF in FMEF (Ceramic or Glass)		MOX		Site Waste Generation (m^3/yr)[c]	IF		Both Facilities	
Waste Type[a]	w/ MOX	w/o MOX	FMEF	New		Ceramic or Glass	MOX	Both in FMEF	New MOX
Hazardous	7	4	6	11	560	1	1-2	2	3
Nonhazardous									
Liquid	6,300	3,700	12,000	13,000	200,000	2-3	6-7	9	8
Solid	230	150	280	820	43,000	<1-1	1-2	1	2

a See definitions in Appendix F.8.
b UC 1998b, 1998c, 1998d.
c From the waste management section in Chapter 3.
Key: FMEF, Fuels and Materials Examination Facility; IF, Immobilization Facility.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998b, 1998c, 1998d). Hazardous waste generation for this combination of facilities is estimated to be 2 to 3 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998b, 1998c, 1998d). Nonrecyclable solid sanitary waste would be sent off the site and would likely be disposed of in the Richland Sanitary Landfill. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 1 to 2 percent of existing annual waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from dewatering (UC 1998b, 1998c, 1998d). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for this combination of facilities is estimated to be 8 to 9 percent of existing annual site waste generation, 7 to 8 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 7 to 8 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.1.2.6.2 Operation of Immobilization and MOX Facilities

The waste management facilities within the immobilization and MOX facilities would process, temporarily store, and ship all wastes generated. Table H–12 compares the expected waste generation rates from operating the new facilities at Hanford with the existing generation rates for Hanford waste. Although HLW would be used in the immobilization process, no HLW would be generated by the facilities (UC 1998b, 1998c, 1998d). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Waste generation would be the same for ceramic and glass immobilization technologies (UC 1998b, 1998c) and would be the same whether the MOX facility is located in FMEF or in a new building (UC 1998d:attachment). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* being prepared by the DOE Richland Operations Office (DOE 1997c).

TRU wastes generated during operations include metal cladding from fuel elements, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998b, 1998c, 1998d). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time

Table H–12. Potential Waste Management Impacts of Operation of Collocating Immobilization and MOX Facilities in FMEF or New MOX Facility at Hanford

	Estimated Waste Generation (m^3/yr)[b]			Percent of Site Waste Generation		
Waste Type[a]	Immobilization (Ceramic or Glass)	MOX	Site Waste Generation (m^3/yr)[c]	Immobilization (Ceramic or Glass)	MOX	Both Facilities
TRU[d]	95	46	450	21	10	31
LLW	60	34	3,902	2	1	2
Mixed LLW	1	2	847	<1	<1	<1
Hazardous	30	<1	560	5	<1	6
Nonhazardous						
Liquid	23,000	25,000	200,000	12	13	24
Solid	230	<150	43,000	1	<1	1

[a] See definitions in Appendix F.8.
[b] UC 1998b, 1998c, 1998d.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; TRU, transuranic.

radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation for this combination of facilities is estimated to be 31 percent of existing annual waste generation and 8 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,410 m^3 (1,840 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 12 percent of the 11,450 m^3 (14,977 yd^3) of contact-handled TRU waste currently in storage, and 8 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 6,700 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 2,000 m^2 (2,400 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.20 ha (0.49 acre) of land at Hanford should not be major.

The 1,410 m^3 (1,840 yd^3) of TRU waste generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, and solidified inorganic solutions. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste (UC 1998b, 1998c). LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation (UC 1998b, 1998c, 1998d). A total of 940 m^3 (1,230 yd^3) of LLW would be generated over the operation period. LLW generation for this combination of facilities is estimated to be 2 percent of existing annual waste generation, less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) disposal capacity of the LLW Burial Grounds, and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition*

Final PEIS (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.27 ha (0.67 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW includes lead shielding, solvents contaminated with plutonium, and scintillation vials from the analytical laboratory (UC 1998b, 1998c, 1998d). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Hanford currently treats and disposes of mixed LLW on the site. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this combination of facilities is estimated to be 3 m^3/yr (3.9 yd^3/yr) or less than 1 percent of existing annual waste generation, and less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. Over the operating life of these facilities, the 30 m^3 (39 yd^3) of mixed LLW generated would be less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) disposal capacity in the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, lubricants, oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998b, 1998c, 1998d). Hazardous waste generation for this combination of facilities is estimated to be less than 6 percent of existing annual waste generation. These wastes should not have a major impact on the hazardous waste management system at Hanford.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998b, 1998c, 1998d). The remaining solid sanitary waste would be sent off the site for disposal in the Richland Sanitary Landfill. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 1 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets; process wastewater from lab sinks and drains, mop water, cooling tower blowdown; and treated wastewater from the liquid effluent treatment system. Wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer that connects to the WPPSS wastewater treatment system (UC 1998b, 1998c, 1998d). Nonhazardous liquid waste generation for this combination of facilities is estimated to be 24 percent of the existing annual site waste generation, 20 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 20 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system.

H.1.2.7 Pit Conversion, Immobilization, and MOX Facilities

H.1.2.7.1 Construction of Pit Conversion, Immobilization, and MOX Facilities

Table H–13 compares the expected construction waste generation rates for the facilities that may be constructed at Hanford with the existing generation rates for Hanford waste. No radioactive waste would be generated during the 3-year construction period because this action involves new construction and modification of uncontaminated buildings only (UC 1998a, 1998b, 1998c, 1998d). In addition, no soil contaminated with

Table H–13. Potential Waste Management Impacts of Construction of Pit Conversion and Immobilization Facilities in FMEF and New MOX Facility at Hanford

	Estimated Waste Generation (m^3/yr)[b]				Percent of Site Waste Generation			
Waste Type[a]	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	Site Waste Generation (m^3/yr)[c]	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	All Facilities
Hazardous	13	4	11	560	2	1	2	5
Nonhazardous								
Liquid	1,300	3,700	13,000	200,000	1	2	7	9
Solid	28	150	820	43,000	<1	<1	2	2

[a] See definitions in Appendix F.8.
[b] UC 1998a, 1998b, 1998c, 1998d.
[c] From the waste management section in Chapter 3.
Key: FMEF, Fuels and Materials Examination Facility.

hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. Construction waste generation would be the same for ceramic and glass immobilization technologies (UC 1998b, 1998c).

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, motor oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during the 3-year construction period would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998a, 1998b, 1998c, 1998d). Hazardous waste generation for this combination of facilities is estimated to be 5 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998a, 1998b, 1998c, 1998d). Nonrecyclable solid sanitary waste would be sent off the site and would likely be disposed of in the Richland Sanitary Landfill. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 2 percent of existing annual waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from dewatering (UC 1998a, 1998b, 1998c, 1998d). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for this combination of facilities is estimated to be 9 percent of existing annual site waste generation, 8 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 8 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.1.2.7.2 Operation of Pit Conversion, Immobilization, and MOX Facilities

The waste management facilities within the pit conversion, immobilization, and MOX facilities would process, temporarily store, and ship all wastes generated. Table H–14 compares the expected waste generation rates from operating the new facilities at Hanford with the existing generation rates for Hanford waste. Although HLW would be used in the immobilizatoin process, no HLW would be generated by the facilities (UC 1998a, 1998b, 1998c, 1998d). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Waste generation would be the same for ceramic and glass immobilization technologies (UC 1998b, 1998c). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* being prepared by the DOE Richland Operations Office (DOE 1997c).

Table H–14. Potential Waste Management Impacts of Operation of Pit Conversion and Immobilization Facilities in FMEF and New MOX Facilities at Hanford

	Estimated Waste Generation (m^3/yr)[b]				Percent of Site Waste Generation			
Waste Type[a]	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	Site Waste Generation (m^3/yr)[c]	Pit Conversion	Immobilization (Ceramic or Glass)	MOX	All Facilities
TRU[d]	18	95	46	450	4	21	10	35
LLW	60	60	34	3,902	2	2	1	4
Mixed LLW	1	1	2	847	<1	<1	<1	<1
Hazardous	2	30	<1	560	<1	5	<1	6
Nonhazardous								
Liquid	40,000	23,000	25,000	200,000	20	12	13	44
Solid	1,800	230	<150	43,000	4	1	<1	5

a See definitions in Appendix F.8.
b UC 1998a, 1998b, 1998c, 1998d.
c From the waste management section in Chapter 3.
d Includes mixed TRU waste.
Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; TRU, transuranic.

TRU wastes generated during operations include metal cladding from fuel elements, spent filters, sweepings, used containers and equipment, paper and cloth wipes, analytical and quality control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facility (UC 1998a, 1998b, 1998c, 1998d). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation for this combination of facilities is estimated to be 35 percent of existing annual waste generation and 9 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,590 m^3 (2,080 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 14 percent of the 11,450 m^3 (14,977 yd^3) of contact-handled TRU waste currently in storage, and 9 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 7,600 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of approximately 2,300 m^2 (2,750 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.23 ha (0.57 acre) of land at Hanford should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU waste generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste (UC 1998a, 1998b, 1998c). LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation (UC 1998a, 1998b, 1998c, 1998d). Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998d). A total of 1,540 m^3 (2,010 yd^3) of LLW would be generated over the operation period. LLW generation for this combination of facilities is estimated to be 4 percent of existing annual waste generation, less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) disposal capacity of the LLW Burial Grounds, and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,540 m^3 of waste would require 0.44 ha (1.1 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW includes lead shielding, solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998a, 1998b, 1998c, 1998d). Mixed LLW would be stabilized, packaged, and stored onsite for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Hanford currently treats and disposes of mixed LLW on the site. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this combination of facilities is estimated to be 4 m^3/yr (5.2 yd^3/yr) or less than 1 percent of existing annual waste generation, and less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. Over the operating lives of these facilities, the 40 m^3 (52 yd^3) of mixed LLW generated would be less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) disposal capacity in the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998a, 1998b, 1998c, 1998d). Hazardous waste generation for this combination of facilities is estimated to be 6 percent of existing annual waste generation. These wastes should not have a major impact on the hazardous waste management system at Hanford.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998a, 1998b, 1998c, 1998d). The remaining solid sanitary waste would be sent off the site for disposal in the Richland Sanitary Landfill. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 5 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets; process wastewater from lab sinks and drains, mop water, cooling tower blowdown, boiler blowdown; and treated wastewater from the liquid effluent treatment system. Nonhazardous process wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer which connects to the WPPSS wastewater treatment system (UC 1998a, 1998b, 1998c, 1998d). Nonhazardous liquid waste generation for this combination of facilities is estimated to be 44 percent of the existing annual site waste generation, 37 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 37 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, the management of this additional waste should not have a major impact on the system.

Next Section

H.2 INEEL

H.2.1 Assessment Data

Impacts on INEEL waste management facilities were estimated using information on existing environmental conditions from Chapter 3 and information on the characteristics of the proposed surplus plutonium disposition facilities from Chapter 2 and the facility data reports. A description of the methods used to evaluate impacts on waste management facilities is presented in Appendix F.8.

H.2.2 Facilities

H.2.2.1 Pit Conversion Facility

H.2.2.1.1 Construction of Pit Conversion Facility

Table H–15 compares the expected construction waste generation rates for the pit conversion facility that may be constructed at INEEL with the existing site waste generation rates. No radioactive waste would be generated during the 3-year construction period because this facility involves the modification of an uncontaminated building (UC 1998e). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations.

Table H–15. Potential Waste Management Impacts of Construction of Pit Conversion Facility in FPF at INEEL

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	16	835	2
Nonhazardous			
Liquid	2,300	2,000,000	<1
Solid	40	62,000	<1

[a] See definitions in Appendix F.8.
[b] UC 1998e.
[c] From the waste management section in Chapter 3.
Key: FPF, Fuel Processing Facility.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998e). Hazardous waste generation for this facility is estimated to be 2 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the INEEL hazardous waste management system.

Nonhazardous solid waste includes office garbage, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite recycling or onsite disposal facilities (UC 1998e). Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore would not be included in the waste volumes. Construction debris would be disposed of in the INEEL onsite landfill complex in the Central Facilities Area (CFA). Nonrecyclable solid sanitary waste would be sent off the site for disposal in the Bonneville County landfill. Nonhazardous solid waste generation for this facility is estimated to be less than 1 percent of existing annual waste generation. Assuming all nonhazardous solid waste were disposed of on the site, this additional waste would require less than 1 percent of the 48,000-m^3/yr (62,800-yd^3/yr) capacity in the CFA landfill complex. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at INEEL.

Nonhazardous liquid waste includes sanitary waste from any sinks, showers, and water closets (UC 1998e). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that most of this waste would be collected in portable toilets and managed at offsite facilities. Nonhazardous liquid waste generation for this facility is estimated to be less than 1 percent of existing annual waste generation, 1 percent of the 166,000-m^3/yr (217,000-yd^3/yr) capacity of the Fuel Processing Facility (FPF) sanitary sewer system, and less than 1 percent of the 3.2 million-m^3/yr (4.2 million-yd^3/yr) capacity of the Idaho Nuclear Technology and Engineering Center (INTEC) Sewage Treatment Plant. Therefore, the generation of nonhazardous liquid waste should not have a major impact on the system during construction.

H.2.2.1.2 Operation of Pit Conversion Facility

The waste management facilities within the pit conversion facility would process, temporarily store, and ship all wastes generated. Table H–16 compares the expected waste generation rates from operating the new facility at INEEL with the existing site waste generation rates. No HLW would be generated by the pit conversion facility (UC 1998e). Depending in part on decisions in the ROD for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commerical facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage and disposal of radioactive, hazardous, and mixed wastes at INEEL are described in the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final EIS* (DOE 1995a).

Table H–16. Potential Waste Management Impacts of Operation of Pit Conversion Facility in FPF at INEEL

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	18	(e)	NA
LLW	60	2,624	2
Mixed LLW	1	180	1
Hazardous	2	835	<1
Nonhazardous			
Liquid	41,000	2,000,000	2
Solid	1,800	62,000	3

[a] See definitions in Appendix F.8.
[b] UC 1998e.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
[e] TRU waste is not routinely generated at INEEL, although 39,300 m^3 (51,400 yd^3) of contact-handled TRU waste is currently in storage.

Key: FPF, Fuel Processing Facility; LLW, low-level waste; NA, not applicable; TRU, transuranic.

TRU wastes generated during operations include spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, and solidified inorganic solutions. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the pit conversion facility. Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Longer-term storage, drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned Waste Characterization Facility at INEEL (UC 1998e). TRU waste is not routinely generated at INEEL, although 39,300 m^3 (51,400 yd^3) of contact-handled TRU waste is currently in storage.

TRU waste generation for this facility is estimated to be 18 m^3/yr (24 yd^3/yr) or a total of 180 m^3 (235 yd^3) over the 10-year operation period. This would be less than 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) capacity of the planned Advanced Mixed Waste Treatment Project and less than 1 percent of the 177,300-m^3 (231,900-yd^3) storage capacity available at the Radioactive Waste Management Complex. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 860 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 260 m^2 (310 yd^2) would be required. The impacts of storing additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at INEEL should not be major.

The 180 m^3 (235 yd^3) of TRU waste generated by this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and is within the 168,500-m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operation would originate from activities in the processing areas that contain the glove-box lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facility before being transferred for additional treatment and/or disposal in existing facilities on the site. Liquid LLW would be evaporated or solidified before being packaged for accumulation. Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998e). LLW generation for this facility is estimated to be 2 percent of existing annual waste generation, 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity at the Radioactive Waste Management Complex, and less than 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of the Radioactive Waste Management Complex. If the LLW were treated at Waste Experimental Reduction Facility, the 60 m^3 (78 yd^3) of annual waste generation would be less than 1 percent of the 49,610 m^3 (64,890 yd^3) annual facility capacity. A total of 600-m^3 (780-yd^3) LLW would be generated over the operation period. Using the 6,264 m^3/ha (3,315 yd^3/acre) disposal land usage factor for INEEL published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 m^3 (780 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space. Therefore, impacts of the management of this additional LLW at INEEL should not be major.

Mixed LLW includes solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998e). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for INEEL. INEEL currently treats some mixed LLW on the site and ships some to Envirocare of Utah. Onsite disposal is planned in a new mixed LLW disposal facility. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this facility is estimated to be 1 m^3/yr (1.3 yd^3/yr) or 1 percent of the existing annual waste generation, and less than 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project.

Over the operating life of this facility, the 10 m^3 (13 yd^3) of mixed LLW generated would be less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity at the Radioactive Waste Management Complex. Therefore, the management of this additional waste at INEEL should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at onsite and offsite permitted facilities (UC 1998e). Hazardous waste generation for this facility is estimated to be less than 1 percent of the existing annual waste generation and 1 percent of the 1,600-m^3 (2,090-yd^3) onsite storage capacity. Assuming that all the hazardous waste were treated at the Waste Experimental Reduction Facility, this additional waste would be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) capacity of the system. Therefore, impacts on the hazardous waste management system at INEEL should not be major.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998e). The remaining solid sanitary waste would be sent off the site for disposal in the Bonneville County landfill. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be 3 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at INEEL.

Nonhazardous liquid waste includes sanitary waste from sinks, showers and water closets, and process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and boiler blowdown. Nonhazardous wastewater would be treated, if necessary, before being discharged to the FPF sanitary sewer that connects to the INTEC wastewater treatment system (UC 1998e). Nonhazardous liquid waste generation for this facility is estimated to be 2 percent of the existing annual site waste generation, 25 percent of the 166,000-m^3/yr (217,000-yd^3/yr) capacity of the FPF sanitary sewer system, and 1 percent of the 3.2 million-m^3/yr (4.2 million-yd^3/yr) capacity of the INTEC Sewage Treatment Plant. Therefore, the management of this additional waste should not have a major impact on the system.

H.2.2.2 MOX Facility

H.2.2.2.1 Construction of MOX Facility

Table H–17 compares the expected construction waste generation rates for the new MOX facility that may be constructed at INEEL with the existing site waste generation rates. No radioactive waste would be generated during the 3-year construction period because this facility involves new construction only (UC 1998f). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998f). Hazardous waste generation for this facility is estimated to be 1 percent of the existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on the INEEL hazardous waste management system.

Table H–17. Potential Waste Management Impacts of Construction of New MOX Facility at INEEL

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	11	835	1
Nonhazardous			
Liquid	13,000	2,000,000	1
Solid	820	62,000	1

[a] See definitions in Appendix F.8.
[b] UC 1998f.
[c] From the waste management section in Chapter 3.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite recycling or onsite disposal facilities (UC 1998f). Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Construction debris would be disposed of in the onsite INEEL landfill complex in the CFA. Nonrecyclable solid sanitary waste would be sent off the site for disposal in the Bonneville County landfill. Nonhazardous solid waste generation for this facility is estimated to be 1 percent of existing annual waste generation. Assuming all nonhazardous solid waste was to be disposed of on the site, this additional waste would require 2 percent of the 48,000-m^3/yr (62,800-yd^3/yr) capacity in the CFA landfill complex. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at INEEL.

Nonhazardous liquid waste includes sanitary waste from any sinks, showers and water closets, and wastewater from dewatering (UC 1998f). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at facilities on the site, even though it is likely that most of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for this facility is estimated to be 1 percent of existing annual waste generation, 8 percent of the 166,000-m^3/yr (217,000-yd^3/yr) capacity of the FPF sanitary sewer system, and less than 1 percent of the 3.2 million-m^3/yr (4.2 million-yd^3/yr) capacity of the INTEC Sewage Treatment Plant. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.2.2.2.2 Operation of MOX Facility

The waste management facilities within the MOX facility would process, temporarily store, and ship all wastes generated. Table H–18 compares the expected waste generation rates from operating the new facility at INEEL with the existing site waste generation rates. No HLW would be generated by the MOX facility (UC 1998f). Depending in part on decisions in the ROD for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment,storage and disposal of radioactive, hazardous, and mixed wastes at INEEL are described in the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs EIS* (DOE 1995a).

TRU wastes generated during operations include spent filters, sweepings, used containers and equipment, paper and cloth wipes, analytical and quality control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that

Table H–18. Potential Waste Management Impacts of Operation of New MOX Facility at INEEL

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	46	(e)	NA
LLW	34	2,624	1
Mixed LLW	2	180	1
Hazardous	<1	835	<1
Nonhazardous			
Liquid	25,000	2,000,000	1
Solid	<150	62,000	<1

[a] See definitions in Appendix F.8.
[b] UC 1998f.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
[e] TRU waste is not routinely generated at INEEL, although 39,300 m^3 (51,400 yd^3) of contact-handled TRU waste is currently in storage.
Key: LLW, low-level waste, NA, not applicable; TRU, transuranic.

all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the MOX facility (UC 1998f). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned Waste Characterization Facility at INEEL. TRU waste is not routinely generated at INEEL, although 39,300 m^3 (51,400 yd^3) of contact-handled TRU waste is currently in storage.

TRU waste generated by this facility is estimated to be 46 m^3/yr (60 yd^3/yr) or a total of 460 m^3 (600 yd^3) over the 10-year operation period. This would be 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) capacity of the planned Advanced Mixed Waste Treatment Project and less than 1 percent of the 177,300-m^3 (231,900-yd^3) storage capacity available at the Radioactive Waste Management Complex. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 2,200 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 660 m^2 (790 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.1 ha (0.25 acre) of land at INEEL should not be major.

The 460 m^3 (600 yd^3) of TRU waste generated by this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, and solidified inorganic solutions. It is likely that the LLW generated during operation would originate from activities in the processing areas containing the glove-box lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation (UC 1998f). LLW generation for this facility is estimated to be 1 percent of existing annual waste generation, less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity at the Radioactive Waste Management Complex, and less than 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of the Radioactive Waste Management

Complex. If the LLW were to be treated at the Waste Experimental Reduction Facility, the 34 m^3 (44 yd^3) of annual waste generation would be less than 1 percent of the 49,610 m^3 (64,890 yd^3) annual facility capacity. A total of 340-m^3 (445-yd^3) LLW would be generated over the period of operation. Using the 6,264 m^3/ha (3,315 yd^3/acre) disposal land usage factor for INEEL published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 340 m^3 (445 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space. Therefore, impacts of the management of this additional LLW at INEEL should not be major.

Mixed LLW includes solvents contaminated with plutonium and scintillation vials from the analytical laboratory (UC 1998f). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for INEEL. INEEL currently treats mixed LLW on the site and ships some mixed LLW to Envirocare of Utah. Onsite disposal is planned in a new mixed LLW disposal facility. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for this facility is estimated to be 2 m^3/yr (2.6 yd^3/yr) or 1 percent of existing annual waste generation. The 2 m^3/yr (2.6 yd^3/yr) of mixed LLW would be less than 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project. Over the operating life of this facility, the 20 m^3 (26 yd^3) of mixed LLW generated would be less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity at the Radioactive Waste Management Complex. Therefore, the management of this additional waste at INEEL should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at onsite and offsite permitted facilities (UC 1998f). Hazardous waste generation for this facility is estimated to be less than 1 percent of existing annual waste generation and 1 percent of the 1,600-m^3 (2,090-yd^3) onsite storage capacity. Assuming that all the hazardous waste were to be treated at the Waste Experimental Reduction Facility, this additional waste would be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) capacity of the system. Therefore, impacts on the hazardous waste management system at INEEL should not be major.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998f). The remaining solid sanitary waste would be sent off the site for disposal in the Bonneville County landfill. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be less than 1 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at INEEL.

Nonhazardous liquid waste includes sanitary waste from sinks, showers and water closets, process wastewater from lab sinks and drains, mop water, cooling tower blowdown, boiler blowdown, and treated wastewater from the liquid effluent treatment system. Nonhazardous wastewater would be treated, if necessary, before being discharged to the FPF sanitary sewer that connects to the INTEC wastewater treatment system (UC 1998f). Nonhazardous liquid waste generation for this facility is estimated to be 1 percent of existing annual site waste generation, 15 percent of the 166,000-m^3/yr (217,000-yd^3/yr) capacity of the FPF sanitary sewer system, and 1 percent of the 3.2 million-m^3/yr (4.2 million-yd^3/yr) capacity of the INTEC Sewage Treatment Plant. Therefore, the management of this additional waste should not have a major impact on the system.

H.2.2.3 Pit Conversion and MOX Facilities

H.2.2.3.1 Construction of Pit Conversion and MOX Facilities

Table H–19 compares the expected construction waste generation rates for the facilities that may be constructed at INEEL with the existing site waste generation rates. No radioactive waste would be generated during the 3-year construction period because these facilities involve new construction and modification of uncontaminated buildings only (UC 1998e, 1998f). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Table H–19. Potential Waste Management Impacts of Construction of Pit Conversion Facility in FPF and New MOX Facility at INEEL

	Estimated Waste Generation (m^3/yr)[b]		Site Waste	Percent of Site Waste Generation		
WasteType[a]	Pit Conversion	MOX	Generation (m^3/yr)[c]	Pit Conversion	MOX	Both Facilities
Hazardous	16	11	835	2	1	3
Nonhazardous						
Liquid	2,300	13,000	2,000,000	<1	1	1
Solid	40	820	62,000	<1	1	1

[a] See definitions in Appendix F.8.
[b] UC 1998e, 1998f.
[c] From the waste management section in Chapter 3.
Key: FPF, Fuel Processing Facility.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998e, 1998f). Hazardous waste generation for these facilities is estimated to be 3 percent of existing annual hazardous waste generation. The additional waste load generated during construction should not have a major impact on INEEL hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite recycling or disposal facilities on the site (UC 1998e, 1998f). Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Construction debris would be disposed of in the onsite INEEL landfill complex in the CFA. Nonrecyclable solid sanitary waste would be sent off the site for disposal in the Bonneville County landfill. Nonhazardous solid waste generation for these facilities is estimated to be 1 percent of existing annual waste generation. Assuming all nonhazardous solid waste was to be disposed on the site, this additional waste would require 2 percent of the 48,000-m^3/yr (62,800-yd^3/yr) capacity in the CFA landfill complex. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at INEEL.

Nonhazardous liquid waste includes sanitary waste from any sinks, showers and water closets, and wastewater from dewatering (UC 1998e, 1998f). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at facilities on the site, even though it is likely that most of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for these facilities is estimated to be 1 percent of existing annual waste generation, 9 percent of the 166,000-m^3/yr (217,000-yd^3/yr) capacity of the FPF sanitary sewer system, and less than 1 percent of the 3.2 million-m^3/yr (4.2 million-yd^3/yr) capacity of the INTEC Sewage Treatment Plant. Therefore, the management of this additional waste should not have a major impact on the system during construction.

H.2.2.3.2 Operation of Pit Conversion and MOX Facilities

The waste management facilities within the pit conversion and MOX facilities would process, temporarily store, and ship all wastes generated. Table H–20 compares the expected waste generation rates from operating the new facilities at INEEL with the existing site waste generation rates. No HLW would be generated by the pit conversion and MOX facilities (UC 1998e, 1998f). Depending in part on decisions in the ROD for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage and disposal of radioactive, hazardous, and mixed wastes at INEEL are described in the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs EIS* (DOE 1995a).

Table H–20. Potential Waste Management Impacts of Operation of Pit Conversion Facility in FPF and New MOX Facility at INEEL

	Estimated Waste Generation (m^3/yr)[b]		Site Waste	Percent of Site Waste Generation		
Waste Type[a]	Pit Conversion	MOX	Generation (m^3/yr)[c]	Pit Conversion	MOX	Both Facilities
TRU[d]	18	46	(e)	NA	NA	NA
LLW	60	34	2,624	2	1	4
Mixed LLW	1	2	180	1	1	2
Hazardous	2	<1	835	<1	<1	<1
Nonhazardous						
Liquid	41,000	25,000	2,000,000	2	1	3
Solid	1,800	<150	62,000	3	<1	3

[a] See definitions in Appendix F.8.
[b] UC 1998e, 1998f.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
[e] TRU waste is not routinely generated at INEEL, although 39,300 m^3 (51,400 yd^3) of contact-handled TRU waste is currently in storage.
Key: FPF, Fuel Processing Facility; LLW, low-level waste; NA, not applicable; TRU, transuranic.

TRU wastes generated during operations include spent filters, sweepings, used containers and equipment, paper and cloth wipes, analytical and quality control samples, solidified inorganic solutions, and dirty plutonium oxide scrap (UC 1998e, 1998f). Lead gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste (UC 1998e). TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the pit conversion and MOX facilities (UC 1998e, 1998f). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned Waste Characterization Facility at INEEL (UC 1998e). TRU waste is not routinely generated at INEEL, although 39,300 m^3 (51,400 yd^3) of contact-handled TRU waste is currently in storage.

TRU waste generation for these facilities is estimated to be 64 m^3/yr (84 yd^3/yr) or a total of 640 m^3 (837 yd^3) over the 10-year operation period. This would be 1 percent of the 6,500-m^3 (8,500-yd^3) capacity of the planned Advance Mixed Waste Treatment Project and less than 1 percent of the 177,300-m^3 (231,900-yd^3) storage capacity available at the Radioactive Waste Management Complex. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 3,000 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 900 m^2 (1,100 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.1 ha (0.25 acre) of land at INEEL should not be major.

The 640 m^3 (837 yd^3) of TRU waste generated by these facilities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500- m^3 (220,400-yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operation would originate from activities in the processing areas containing the glove-box lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste (UC 1998e). LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for accumulation (UC 1998e, 1998f). Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998e). LLW generation for these facilities is estimated to be 4 percent of existing annual waste generation, 1 percent of the 112,000-m^3 (147,000-yd^3) storage capacity at the Radioactive Waste Management Complex, and less than 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of the Radioactive Waste Management Complex. If the LLW were to be treated at the Waste Experimental Reduction Facility, the 94 m^3 (123 yd^3) of annual waste generation would be less than 1 percent of the 49,610 m^3 (64,880 yd^3) annual facility capacity. A total of 940-m^3 (1,230-yd^3) LLW would be generated over the operation period. Using the 6,264 m^3/ha (3,315 yd^3/acre) disposal land usage factor for INEEL published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.15 ha (0.37 acre) of disposal space. Therefore, impacts of the management of this additional LLW at INEEL should not be major.

Mixed LLW includes solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998e, 1998f). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for INEEL. INEEL currently treats mixed LLW on the site and ships some mixed LLW to Envirocare of Utah. Onsite disposal is planned in a new mixed LLW disposal facility. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for these facilities is estimated to be 3 m^3/yr (4 yd^3/yr), or 2 percent of existing annual waste generation, and less than 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project. Over the operating life of these facilities, the 30 m^3 (39 yd^3) of mixed LLW generated would be less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity at the Radioactive Waste Management Complex. Therefore, the management of this additional waste at INEEL should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operation includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at onsite and offsite permitted facilities (UC 1998e, 1998f). Hazardous waste generation for these facilities is estimated to be less than 1 percent of existing annual waste generation and 2 percent of the 1,600-m^3 (2,090-yd^3) onsite storage capacity. Assuming that all the hazardous waste would be treated at the Waste Experimental Reduction Facility, this additional waste would be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) capacity of the system. Therefore, impacts on the hazardous waste management system at INEEL should not be major.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998e, 1998f). The remaining solid sanitary waste would be sent off the site for disposal in the Bonneville County landfill. Nonrecyclable, nonhazardous solid waste generated by these facilities is estimated to be 3 percent of existing annual waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at INEEL.

Nonhazardous liquid waste includes sanitary waste from sinks, showers and water closets, process wastewater from lab sinks and drains, mop water, cooling tower blowdown, boiler blowdown, and treated wastewater from the liquid effluent treatment system. Nonhazardous wastewater would be treated, if necessary, before being discharged to the FPF sanitary sewer that connects to the INTEC wastewater treatment system (UC 1998e, 1998f). Nonhazardous liquid waste generation for these facilities is estimated to be 3 percent of existing annual waste generation, 40 percent of the 166,000-m^3/yr (217,000-yd^3/yr) capacity of the FPF sanitary sewer system, and 2 percent of the 3.2 million-m^3/yr (4.2 million-yd^3/yr) capacity of the INTEC Sewage Treatment Plant. Therefore, management of this additional waste should not have a major impact on the system.

H.3 PANTEX

H.3.1 Assessment Data

Impacts on Pantex waste management facilities were estimated using information on existing environmental conditions from Chapter 3 and information on the characteristics of the proposed surplus plutonium disposition facilities from Chapter 2 and the facility data reports. A description of the methods used to evaluate impacts on waste management facilities is presented in Appendix F.8.

H.3.2 Facilities

H.3.2.1 Pit Conversion Facility

H.3.2.1.1 Construction of Pit Conversion Facility

Table H–21 compares the expected construction waste generation rates for the new pit conversion facility that may be constructed at Pantex with the existing generation rates for Pantex waste. No radioactive waste would be generated during the 3-year construction period because this facility involves new construction only (UC 1998g). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Table H–21. Potential Waste Management Impacts of Construction of New Pit Conversion Facility at Pantex

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	50	486	10
Nonhazardous			
Liquid	5,300	473,125	1
Solid	120	8,007	1

[a] See definitions in Appendix F.8.
[b] UC 1998g.
[c] From the waste management section in Chapter 3.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998g). Hazardous waste generation for this facility is estimated to be 10 percent of existing annual site hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Pantex hazardous waste management system.

Nonhazardous solid waste includes office garbage, concrete and steel waste, and other trash from construction of the new facilities and concrete soil, and reinforcing steel from demolition of three existing storage bunkers. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to onsite and offsite disposal and recycling facilities. It was assumed that waste concrete would require disposal, although it is likely that this waste would be stockpiled on the site and crushed for reuse. Waste metals would be sent off the site for recycling and, therefore, were not included in the waste volumes (UC 1998g). Construction debris would be disposed of in the onsite Class 2 construction waste landfill.

Nonrecyclable solid sanitary waste would be sent off the site for disposal in a local landfill such as the Amarillo landfill. Nonhazardous-solid-waste generation for the pit conversion facility is estimated to be 1 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Pantex.

Nonhazardous liquid waste includes sanitary waste from any sinks, showers, and water closets (UC 1998g). To be conservative it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that most of this waste would be collected in portable toilets and treated and disposed of off the site. Nonhazardous liquid waste generation for this facility is estimated to be 1 percent of existing annual site waste generation, and 1 percent of the 946,250-m^3/yr (1,237,700-yd^3/yr) capacity of the sanitary wastewater treatment system. Therefore, impacts during construction should not be major.

H.3.2.1.2 Operation of Pit Conversion Facility

The waste management facilities within the pit conversion facility would process, temporarily store, and ship all wastes generated. Table H–22 compares the expected waste generation rates from operating the new facility at Pantex with the existing generation rates for Pantex waste. No HLW would be generated by the pit conversion facility (UC 1998g). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment and storage of radioactive, hazardous, mixed, and nonhazardous wastes at Pantex are described in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996b).

Table H–22. Potential Waste Management Impacts of Operation of New Pit Conversion Facility at Pantex

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	18	(e)	NA
LLW	60	139	43
Mixed LLW	1	24	4
Hazardous	2	486	<1
Nonhazardous			
Liquid	25,000	473,125	5
Solid	1,800	8,007	22

[a] See definitions in Appendix F.8.
[b] UC 1998g.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
[e] TRU waste is not routinely generated at Pantex.
Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.

TRU wastes generated during operations include spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, and solidified inorganic solutions. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the pit conversion facility (UC 1998g). Liquid TRU wastes would be evaporated or solidified before being packaged for storage.

Because TRU wastes are not routinely generated or stored at Pantex, facilities for longer-term storage, drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP need to be developed.

TRU waste generation for this facility is estimated to be 18 m^3/yr (24 yd^3/yr). Because TRU waste is not currently stored at Pantex, storage capacity would be provided within the pit conversion facility. A maximum of approximately 180 m^3 (235 yd^3) of TRU waste may need to be stored at Pantex. Assuming that the waste were stored in 208-l (55-gal) drums, each with a capacity of 0.21 m^3 (0.27 yd^3), approximately 860 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of approximately 260 m^2 (310 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste in the pit conversion facility at Pantex should not be major.

The 180 m^3 (235 yd^3) of TRU waste generated by this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glove-box lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be packaged, certified, and accumulated at the new facilities before being transferred for treatment and interim storage at existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for storage. Tritium recovered from pit disassembly would be disposed of as LLW. Wastes would be stored on the site on an interim basis before being shipped off the site for disposal (UC 1998g). LLW generation for this facility is estimated to be 43 percent of existing annual waste generation, but only 8 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility. Therefore, impacts of the management of this additional LLW at Pantex should not be major.

Most LLW generated at Pantex is currently sent to DOE's Nevada Test Site (NTS) for disposal, although LLWs could also be sent to commercial disposal facilities or other DOE sites. If the shipment of LLW to offsite disposal were delayed, a maximum of approximately 600-m^3 (780-yd^3) LLW may need to be stored at Pantex. This is about 25 percent of the approximately 2,400 m^3 (3,140 yd^3) of existing storage capacity at Pantex. Assuming that the waste were stored in 208-l (55-gal) drums, each with a capacity of 0.21 m^3 (0.27 yd^3), about 2,900 drums would be required to store the additional waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 860 m^2 (1,000 yd^2) is required. Impacts of the storage of additional quantities of LLW on 0.1 ha (0.25 acre) of land at Pantex should not be major. If it were determined that a new LLW storage facility was needed, appropriate NEPA documentation would be prepared.

As stated above, a total of 600 m^3 (780 yd^3) of LLW would be generated over the operation period. Using the 6,085 m^3/ha (3,221 yd^3/acre) disposal land usage factor for NTS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 m^3 (780 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at NTS or some other similar facility. Impacts at the disposal site from the use of this small area for disposal should not be major. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996c).

Mixed LLW includes solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits. Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Pantex. Pantex currently ships mixed LLW to Envirocare of Utah and Diversified Scientific Services, Inc. of Tennessee. These facilities or other treatment or disposal facilities that meet DOE criteria would be used (UC 1998g). Mixed LLW generation for this facility is estimated to be 1 m^3/yr (1.3 yd^3/yr) or 4 percent of existing annual waste generation and, therefore, should not have a major impact on the mixed LLW management system at Pantex.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998g). Hazardous waste generation for this facility is estimated to be less than 1 percent of existing annual site waste generation and less than 1 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility and, therefore, should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to onsite and offsite disposal and recycling facilities. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998g). The remaining solid sanitary waste would be sent off the site for disposal in a local landfill such as the Amarillo landfill. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be 22 percent of existing annual site waste generation. This additional waste load should have not a major impact on the nonhazardous solid waste management system at Pantex.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, and water closets and process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and boiler blowdown. Nonhazardous wastewater would be treated, if necessary, before being discharged to the Pantex wastewater treatment system (UC 1998g). Nonhazardous liquid waste generation for this facility is estimated to be 5 percent of existing annual site waste generation and 3 percent of the 946,250-m^3/yr (1,237,700-yd^3/yr) capacity to Pantex wastewater treatment system, and therefore should not have a major impact on the system.

H.3.2.2 MOX Facility

H.3.2.2.1 Construction of MOX Facility

Table H–23 compares the expected construction waste generation rates for the new facilities that may be constructed at Pantex with the existing generation rates for Pantex waste. No radioactive waste would be generated during the 3-year construction period because this facility involves new construction only (UC 1998h). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998h). Hazardous waste generation for this facility is estimated to be 2 percent of existing annual site hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Pantex hazardous waste management system.

Table H–23. Potential Waste Management Impacts of Construction of New MOX Facility at Pantex

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	11	486	2
Nonhazardous			
Liquid	13,000	473,125	3
Solid	820	8,007	10

[a] See definitions in Appendix F.8.
[b] UC 1998h.
[c] From the waste management section in Chapter 3.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to onsite and offsite disposal and recycling facilities. It was assumed that waste concrete would require disposal, although it is likely that this waste would be stockpiled on the site and crushed for reuse. Waste metals would be sent off the site for recycling and, therefore, were not included in the waste volumes (UC 1998h). Construction debris would be disposed of in the onsite Class 2 construction waste landfill. Nonrecyclable solid sanitary waste would be sent off the site for disposal in a local landfill such as the Amarillo landfill. Nonhazardous-solid-waste generation for the MOX facility is estimated to be 10 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Pantex.

Nonhazardous liquid waste includes sanitary waste from any sinks, showers, and water closets and wastewater from dewatering (UC 1998h). To be conservative it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that most of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for this facility is estimated to be 3 percent of existing annual site waste generation, and 1 percent of the 946,250-m^3/yr (1,237,700-yd^3/yr) capacity of the sanitary wastewater treatment system. Therefore, impacts during construction should not be major.

H.3.2.2.2 Operation of MOX Facility

The waste management facilities within the MOX facility would process, temporarily store, and ship all wastes generated. Table H–24 compares the expected waste generation rates from operating the new facility at Pantex with the existing generation rates for Pantex waste. No HLW would be generated by the MOX facility (UC 1998h). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated on the site or at other DOE sites or commerical facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment and storage of radioactive, hazardous, mixed, and nonhazardous wastes at Pantex are described in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996b).

TRU wastes generated during operations include spent filters, sweepings, used containers and equipment, paper and cloth wipes, analytical and quality control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the MOX facility (UC 1998h). Liquid TRU wastes would be evaporated

Table H–24. Potential Waste Management Impacts of Operation of New MOX Facility at Pantex

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	46	(e)	NA
LLW	34	139	24
Mixed LLW	2	24	8
Hazardous	<1	486	<1
Nonhazardous			
Liquid	25,000	473,125	5
Solid	<150	8,007	2

[a] See definitions in Appendix F.8.
[b] UC 1998h.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
[e] TRU waste is not routinely generated at Pantex.
Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.

or solidified before being packaged for storage. Because TRU wastes are not routinely generated or stored at Pantex, facilities for longer-term storage, drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP need to be developed.

TRU waste generation for this facility is estimated to be 46 m^3/yr (60 yd^3/yr). Because TRU waste is not currently stored at Pantex, storage capacity would be provided within the MOX facility. A maximum of about 460 m^3 (600 yd^3) of TRU waste may need to be stored at Pantex. Assuming that the waste were stored in 208-l (55-gal) drums, each with a capacity of 0.21 m^3 (0.27 yd^3), about 2,200 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 660 m^2 (790 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste in the MOX facility at Pantex should not be major.

The 460 m^3 (600 yd^3) of TRU waste generated by this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, and solidified inorganic solutions. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glove-box lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be packaged, certified, and accumulated at the new facilities before being transferred for treatment and interim storage at existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for storage. Wastes would be stored on the site on an interim basis before being shipped off the site for disposal (UC 1998h). LLW generation for this facility is estimated to be 24 percent of existing annual waste generation and 5 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility. Therefore, impacts of the management of this additional LLW at Pantex should not be major.

Most LLW generated at Pantex is currently sent to NTS for disposal, although LLWs could also be sent to commercial disposal facilities or other DOE sites. If the shipment of LLW to offsite disposal were delayed, a maximum of about 340-m^3 (445-yd^3) LLW may need to be stored at Pantex. This is about 14 percent of the approximately 2,400 m^3 (3,140 yd^3) of existing storage capacity at Pantex. Assuming that the waste were stored in 208-l (55-gal) drums, each with a capacity of 0.21 m^3 (0.27 yd^3), about 1,600 drums would be required to store the additional waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 490 m^2 (590 yd^2) is required. Impacts of the storage of additional quantities of LLW on 0.1 ha (0.25 acre) of land at Pantex should not be major. If it were determined that a new LLW storage facility was needed, appropriate NEPA documentation would be prepared.

As stated above, a total of 340-m^3 (445-yd^3) LLW would be generated over the operation period. Using the 6,085-m^3/ha (3,221-yd^3/acre) disposal land usage factor for NTS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 340 m^3 (445 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at NTS or some other similar facility. Impacts on the disposal site from the use of this small area for disposal should not be major. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996c).

Mixed LLW includes solvents contaminated with plutonium and scintillation vials from the analytical laboratory (UC 1998h). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Pantex. Pantex currently ships mixed LLW to Envirocare of Utah and Diversified Scientific Services, Inc. of Tennessee. These facilities or other treatment or disposal facilities that meet DOE criteria would be used (UC 1998g). Mixed LLW generation for this facility is estimated to be 2 m^3/yr (2.6 yd^3/yr) or 8 percent of existing annual waste generation, and, therefore, should not have a major impact on the mixed LLW management system at Pantex.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998h). Hazardous waste generation for this facility is estimated to be less than 1 percent of existing annual site waste generation, and less than 1 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility, and, therefore, should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice, and shipped to onsite and offsite disposal and recycling facilities. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998h). The remaining solid sanitary waste would be sent off the site for disposal in a local landfill such as the Amarillo landfill. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be less than 2 percent of existing annual site waste generation. This additional waste load should have not a major impact on the nonhazardous solid waste management system at Pantex.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, and water closets; process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and boiler blowdown; and treated wastewater from the liquid effluent treatment system. Nonhazardous wastewater would be treated, if necessary, before being discharged to the Pantex wastewater treatment system (UC 1998h). Nonhazardous liquid waste generation for this facility is estimated to be 5 percent of existing annual site waste generation and 3 percent of the 946,250-m^3/yr (1,237,700-yd^3) capacity of the Pantex wastewater treatment system. Therefore, impacts on the system should not be major.

H.3.2.3 Pit Conversion and MOX Facilities

H.3.2.3.1 Construction of Pit Conversion and MOX Facilities

Table H–25 compares the expected construction waste generation rates for the new facilities that may be constructed at Pantex with the existing generation rates for Pantex waste. No radioactive waste would be generated during the 3-year construction period because these facilities involve new construction only (UC 1998g, 1998h). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Table H–25. Potential Waste Management Impacts of Construction of New Pit Conversion and MOX Facilities at Pantex

	Estimated Waste Generation (m^3/yr)[b]		Site Waste	Percent of Site Waste Generation		
Waste Type[a]	Pit Conversion	MOX	Generation (m^3/yr)[c]	Pit Conversion	MOX	Both Facilities
Hazardous	50	11	486	10	2	13
Nonhazardous						
Liquid	5,300	13,000	473,125	1	3	4
Solid	120	820	8,007	1	10	12

[a] See definitions in Appendix F.8.
[b] UC 1998g, 1998h.
[c] From the waste management section in Chapter 3.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998g, 1998h). Hazardous waste generation for these facilities is estimated to be 13 percent of existing annual site hazardous waste generation. The additional waste load generated during construction should not have a major impact on the Pantex hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other trash from construction of the new facilities and concrete, soil, and reinforcing steel from demolition of three existing storage bunkers. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to onsite and offsite disposal and recycling facilities. It was assumed that waste concrete would require disposal although it is likely that this waste would be stockpiled on the site and crushed for reuse. Waste metals would be sent off the site for recycling and, therefore, were not included in the waste volumes (UC 1998g, 1998h). Construction debris would be disposed of in the onsite Class 2 construction waste landfill. Nonrecyclable solid sanitary waste would be sent off the site for disposal in a local landfill such as the Amarillo landfill. Nonhazardous-solid-waste generation for these facilities is estimated to be 12 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at Pantex.

Nonhazardous liquid waste includes sanitary waste from any sinks, showers and water closets and wastewater from dewatering (UC 1998g, 1998h). To be conservative it was assumed that all nonhazardous liquid waste generated during construction would be managed at onsite facilities, even though it is likely that most of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generation for these facilities is estimated to be 4 percent of existing annual site waste generation and

2 percent of the 946,250-m^3/yr (1,237,700-yd^3/yr) capacity of the sanitary wastewater treatment system. Therefore, impacts during the construction period should not be major.

H.3.2.3.2 Operation of Pit Conversion and MOX Facilities

The waste management facilities within the pit conversion and MOX facilities would process, temporarily store, and ship all wastes generated. Table H–26 compares the expected waste generation rates from operating the new facilities at Pantex with the existing generation rates for Pantex waste. No HLW would be generated by the pit conversion facility or MOX facility (UC 1998g, 1998h). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment and storage of radioactive, hazardous, mixed, and nonhazardous wastes at Pantex are described in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996b).

Table H–26. Potential Waste Management Impacts of Operation of New Pit Conversion and MOX Facilities at Pantex

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b] Pit Conversion	Estimated Waste Generation (m^3/yr)[b] MOX	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation Pit Conversion	Percent of Site Waste Generation MOX	Percent of Site Waste Generation Both Facilities
TRU[d]	18	46	(e)	NA	NA	NA
LLW	60	34	139	43	24	68
Mixed LLW	1	2	24	4	8	13
Hazardous	2	<1	486	<1	<1	1
Nonhazardous						
Liquid	25,000	25,000	473,125	5	5	11
Solid	1,800	<150	8,007	22	2	24

[a] See definitions in Appendix F.8.
[b] UC 1998g, 1998h.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
[e] TRU waste is not routinely generated at Pantex.
Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.

TRU wastes generated during operations include spent filters, sweepings, used containers and equipment, paper and cloth wipes, analytical and quality control samples, solidified inorganic solutions, and dirty plutonium oxide scrap (UC 1998g, 1998h). Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste (UC 1998h). TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the pit conversion facility and MOX facility (UC 1998g, 1998h). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Because TRU wastes are not routinely generated or stored at Pantex, facilities for longer-term storage, drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would need to be developed.

TRU waste generation for these facilities is estimated to be 64 m^3/yr (84 yd^3/yr). Because TRU waste is not currently stored at Pantex, storage capacity would be provided within the pit conversion and MOX facilities. A maximum of about 640 m^3 (837 yd^3) of TRU waste may need to be stored at Pantex. Assuming that the waste were stored in 208-l (55-gal) drums, each with a capacity of 0.21 m^3 (0.27 yd^3), about 3,000 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 900 m^2 (1,100 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste in the pit conversion and MOX facilites at Pantex should not be major.

The 640 m^3 (837 yd^3) of TRU waste generated by these facilities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for this facility (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glove-box lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste (UC 1998g). LLW would be packaged, certified, and accumulated at the new facilities before being transferred for treatment and interim storage at existing onsite facilities. Liquid LLW would be evaporated or solidified before being packaged for storage (UC 1998g, 1998h). Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998g). Wastes would be stored on the site on an interim basis before being shipped off the site for disposal (UC 1998g, 1998h). LLW generation for these facilities is estimated to be 68 percent of existing annual site waste generation, 13 percent of the 750-m^3/yr (980-m^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility, and 39 percent of the 2,400-m^3 (3,140-yd^3) LLW storage capacity.

Most LLW generated at Pantex is currently sent to NTS for disposal, although LLWs could also be sent to commercial disposal facilities or other DOE sites. If the shipment of LLW to offsite disposal were delayed, a maximum of approximately 940-m^3 (1,230-yd^3) LLW may need to be stored at Pantex. This is approximately 39 percent of the approximately 2,400 m^3 (3,140 yd^3) of existing storage capacity at Pantex. Assuming that the waste were stored in 208-l (55-gal) drums, each with a capacity of 0.21 m^3 (0.27 yd^3), approximately 4,500 drums would be required to store the additional waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of approximately 1,300 m^2 (1,700 yd^2) is required. Impacts of the storage of additional quantities of LLW on 0.13 ha (0.32 acre) of land at Pantex should not be major. If it were determined that a new LLW storage facility was needed, appropriate NEPA documentation would be prepared.

As stated above, a total of 940-m^3 (1,230-yd^3) LLW would be generated over the operation period. Using the 6,085 m^3/ha (3,221 yd^3/acre) disposal land usage factor for NTS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.15 ha (0.37 acre) of disposal space at NTS or some other similar facility. Impacts on the disposal site from the use of this small area for disposal should not be major. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996c).

Mixed LLW includes solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998g, 1998h). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Pantex. Pantex currently ships mixed LLW to Envirocare of Utah and Diversified Scientific Services, Inc of Tennessee. These facilities or other treatment or disposal facilities that meet DOE criteria would be used (UC 1998g). Mixed LLW generation for these facilities is estimated to be 3 m^3/yr (4 yd^3/yr) or 13 percent of existing annual site waste generation and, therefore, should not have a major impact on the mixed LLW management system at Pantex.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (UC 1998g, 1998h). Hazardous waste generation for these facilities is estimated to be 1 percent of existing annual site waste generation and less than 1 percent of the 750-m^3/yr (980-yd^3/yr) capacity of the planned Hazardous Waste Treatment and Processing Facility, and, therefore, should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, machine shop cuttings, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to onsite and offsite disposal and recycling facilities. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998g, 1998h). The remaining solid sanitary waste would be sent off the site for disposal in a local landfill such as the Amarillo landfill. Nonrecyclable, nonhazardous solid waste generated by these facilities is estimated to be less than 24 percent of existing annual site waste generation. This additional waste load should have not a major impact on the nonhazardous solid waste management system at Pantex.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, and water closets; process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and boiler blowdown; and treated wastewater from the liquid effluent treatment system. Nonhazardous wastewater would be treated, if necessary, before being discharged to the Pantex wastewater treatment system (UC 1998g, 1998h). Nonhazardous liquid waste generation for these facilities is estimated to be 11 percent of existing annual site waste generation and 5 percent of the 946,250-m^3/yr (1,237,700-m^3/yr) capacity of the Pantex sanitary wastewater treatment system. Therefore, impacts on the system should not be major.

H.4 SRS

H.4.1 Assessment Data

Impacts on SRS waste management facilities were estimated using information on existing environmental conditions from Chapter 3 and information on the characteristics of the proposed surplus plutonium disposition facilities from Chapter 2 and the facility data reports. A description of the methods used to evaluate impacts on waste management is presented in Appendix F.8.

H.4.2 Facilities

H.4.2.1 Pit Conversion Facility

H.4.2.1.1 Construction of Pit Conversion Facility

Table H–27 compares the expected construction waste generation rates for the facilities that may be constructed at SRS with the existing site waste generation rates. No radioactive waste would be generated during the 3-year construction period because this action involves new construction only (UC 1998i). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Table H–27. Potential Waste Management Impacts of Construction of New Pit Conversion Facility at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	50	74	68
Nonhazardous			
Liquid	5,300	416,100	1
Solid	120	6,670	2

[a] See definitions in Appendix F.8.
[b] UC 1998i.
[c] From the waste management section in Chapter 3.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998i). Hazardous waste generation for construction of this facility is estimated to be 68 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste includes office garbage, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice, and shipped to offsite facilities for recycling or disposal (UC 1998i). Nonrecyclable solid sanitary waste would be sent off the site for disposal. Waste metals would be sent off the site for recycling and, therefore, were not included in the waste volumes. Nonhazardous-solid-waste generation during construction of this facility is estimated to be 2 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets (UC 1998i). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and managed at offsite facilities. Nonhazardous liquid waste generation for construction of this facility is estimated to be 1 percent of existing annual site waste generation, 2 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility and, therefore, should not have a major impact on the system during construction.

H.4.2.1.2 Operation of Pit Conversion Facility

The waste management facilities within the pit conversion facility would process, temporarily store, and ship all wastes generated. Table H–28 compares the expected waste generation rates from operating the new facility at SRS with the existing site waste generation rates. No HLW would be generated by the facility (UC 1998i). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995b).

Table H–28. Potential Waste Management Impacts of Operation of New Pit Conversion Facility at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	18	427	4
LLW	60	10,043	1
Mixed LLW	1	1,135	<1
Hazardous	2	74	3
Nonhazardous			
Liquid	25,000	416,100	6
Solid	1,800	6,670	27

[a] See definitions in Appendix F.8.
[b] UC 1998i.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

TRU wastes generated during operations include spent filters, used containers and equipment, paper and cloth wipes, analytical and quality-control samples, and solidified inorganic solutions. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facility. Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS (UC 1998i).

TRU waste generation for this facility is estimated to be 4 percent of existing annual site waste generation and 1 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 180 m^3 (235 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 3 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and 1 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 860 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 260 m^2 (310 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at SRS should not be major.

The 180 m^3 (235 yd^3) of TRU waste generated by this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities. Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998i). A total of 600 m^3 (780 yd^3) of LLW would be generated over the operation period. LLW generation for this facility is estimated to be 1 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 2 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 m^3 (780 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW includes lead shielding, solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998i). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation for this facility is estimated to be less than 1 percent of existing annual site waste generation, and less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of this facility, the 10 m^3 (13 yd^3) of mixed LLW generated would be 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at a combination of onsite and offsite permitted facilities (UC 1998i). Assuming that all hazardous waste is managed on the site, hazardous waste generation for this facility is estimated to be 3 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and less than 1 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, coal ash, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998i). The remaining solid sanitary waste would be sent off the site for disposal. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be 27 percent of existing annual site waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and steam condensate. Wastewater would be treated, if necessary, before being discharged to the F-Area sanitary sewer system that connects to the Central Sanitary Wastewater Treatment Facility (UC 1998i). Nonhazardous liquid waste generation for this facility is estimated to be 6 percent of the existing annual site waste generation, 9 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 2 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and therefore should not have a major impact on the system.

H.4.2.2 Immobilization Facility

H.4.2.2.1 Construction of Immobilization Facility

Table H–29 compares the expected construction waste generation rates for the facilities that may be constructed at SRS with the existing site waste generation rates. TRU waste and LLW would be generated during the 3-year modification of Building 221–F only because all other construction would involve new buildings. No mixed LLW would be generated (UC 1998j, 1998k, 1998l, 1998m). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies and is the same for the 17-t (19-ton) and 50-t (55-ton) immobilization scenarios, although construction waste generation would be different for modification of Building 221–F and construction of new buildings (UC 1998j, 1998k, 1998l, 1998m).

Table H–29. Potential Waste Management Impacts of Construction of Immobilization Facility in Building 221–F or New Construction at SRS

	Estimated Waste Generation (m^3/yr)[b]		Site Waste	Percent of Site Waste Generation	
Waste Type[a]	Bldg. 221–F	New	Generation (m^3/yr)[c]	Bldg. 221–F	New
TRU[d]	50	0	427	12	NA
LLW	500	0	10,043	5	NA
Hazardous	4	11	74	5	15
Nonhazardous					
Liquid	9,200	9,800	416,100	2	2
Solid	570	1,700	6,670	9	25

a See definitions in Appendix F.8.
b UC 1998j, 1998k, 1998l, 1998m.
c From the waste management section in Chapter 3.
d Includes mixed TRU waste.
Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.

TRU wastes generated during modification of Building 221–F include contaminated equipment and structures, protective clothing, and radiological survey waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be packaged and certified to current WIPP waste acceptance criteria at the construction site (UC 1998i, 1998j). Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for construction of this facility is estimated to be 12 percent of existing annual site waste generation and 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 150 m^3 (196 yd^3) of TRU waste would be generated over the construction period. This would be 2 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and 1 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 710 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 210 m^2 (250 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at SRS should not be major.

The 150 m^3 (196 yd^3) of TRU waste generated by construction of this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW generated during modification of Building 221–F includes demolition debris (e.g., process piping, equipment, and structures), protective clothing, and radiological survey waste. LLW would be packaged, certified, and accumulated at the construction site before being transferred for treatment and/or disposal in existing onsite facilities. Liquid LLW from flushing equipment and decontamination activities would be collected by an existing system in Building 221–F (UC 1998j, 1998k, 1998l, 1998m). A total of 1,500-m^3 (1,960-yd^3) LLW would be generated over the construction period. LLW generation for construction is estimated to be 5 percent of existing annual site waste generation, and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,500 m^3 (1,960 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, lubricants, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998j, 1998k, 1998l, 1998m). Hazardous waste generation for construction of this facility is estimated to be 5 to 15 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998j, 1998k, 1998l, 1998m). Nonrecyclable solid sanitary waste would be sent off the site for disposal. Waste metals would be sent off the site for recycling and, therefore, were not included in the waste volumes. Nonhazardous-solid-waste generation during construction of this facility is estimated to be 9 to 25 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

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Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets (UC 1998j, 1998k, 1998l, 1998m). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and managed at offsite facilities. Nonhazardous liquid waste generation for construction of this facility is estimated to be 2 percent of existing annual site waste generation, 3 to 4 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility and therefore should not have a major impact on the system during construction.

H.4.2.2.2 Operation of Immobilization Facility

The waste management facilities within the immobilization facility would process, temporarily store, and ship all wastes generated. Table H–30 compares the expected waste generation rates from operating the new facility at SRS with the existing site waste generation rates. Although HLW would be used in the immobilization process, no HLW would be generated by the facility (UC 1998j, 1998k, 1998l, 1998m). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Waste generation would be the same for the ceramic and glass immobilization technologies, although the amount of waste generated would vary between the 17-t and the 50-t immobilization cases (UC 1998j, 1998k, 1998l, 1998m). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995b).

Table H–30. Potential Waste Management Impacts of Operation of Immobilization Facility in Building 221–F or New Construction at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b] 17 t	Estimated Waste Generation (m^3/yr)[b] 50 t	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation 17 t	Percent of Site Waste Generation 50 t
TRU[d]	95	126	427	22	30
LLW	60	80	10,043	1	1
Mixed LLW	1	1	1,135	<1	<1
Hazardous	30	30	74	41	41
Nonhazardous					
Liquid	26,000–28,000	28,000–30,000	416,000	6 to 7	7
Solid	230	230	6,670	3	3

[a] See definitions in Appendix F.8.
[b] UC 1998j, 1998k, 1998l, 1998m.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

TRU wastes generated during operations include metal cladding from fuel elements, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality-control samples, and solidified inorganic solutions. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facility (UC 1998j, 1998k, 1998l, 1998m). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for this facility is estimated to be 22 to 30 percent of existing annual site waste generation and 6 to 7 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 950 to 1,260 m^3 (1,240 to 1,648 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 14 to 18 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and 3 to 4 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 4,500 to 6,000 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 1,400 to 1,800 m^2 (1,670 to 2,150 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.14 to 0.18 ha (0.35 to 0.44 acre) of land at SRS should not be major.

The 950 to 1,260 m^3 (1,240 to 1,648 yd^3) of TRU waste generated by this facility would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, and solidified inorganic solutions. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities (UC 1998j, 1998k, 1998l, 1998m). A total of 600- to 800-m^3 (780- to 1,000-yd^3) LLW would be generated over the operation period. LLW generation for this facility is estimated to be 1 percent of existing annual site waste generation, less than 2 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 1 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 600 to 800 m^3 (780 to 1,000 yd^3) of waste would require approximately 0.1 ha (0.25 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW includes leaded shielding, solvents contaminated with plutonium, and scintillation vials from the analytical laboratory (UC 1998j, 1998k, 1998l, 1998m). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation for this facility is estimated to be less than 1 percent of existing annual site waste generation, and less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of this facility, the 10 m^3 (13 yd^3) of mixed LLW generated would be 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, lubricants, oils, film processing fluids, hydraulic fluids, coolants, paints, chemicals, batteries, fluorescent light tubes, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at a combination of onsite and offsite permitted facilities (UC 1998j, 1998k, 1998l, 1998m). Assuming that all hazardous waste is managed on the site, hazardous waste generation for this facility is estimated to be 41 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the

Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, coal ash, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. Ash from the coal-fired steam generating plant would be disposed of in the onsite ash disposal landfills (UC 1998j, 1998k, 1998l, 1998m). The remaining solid sanitary waste would be sent off the site for disposal. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be 3 percent of existing annual site waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from cooling tower blowdown and steam condensate. Nonhazardous wastewater would be treated, if necessary, before being discharged to the F-Area sanitary sewer system that connects to the Central Sanitary Wastewater Treatment Facility (UC 1998j, 1998k, 1998l, 1998m). Nonhazardous liquid waste generation for this facility is estimated to be 6 to 7 percent of the existing annual site waste generation, 9 to 11 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 3 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility and, therefore, should not have a major impact on the system.

H.4.2.3 MOX Facility

H.4.2.3.1 Construction of MOX Facility

Table H–31 compares the expected construction waste generation rates for the facility that may be constructed at SRS with the existing site waste generation rates. No radioactive waste would be generated during the 3-year construction period because this action involves new construction only (UC 1998n). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Table H–31. Potential Waste Management Impacts From Construction of New MOX Facility at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	11	74	15
Nonhazardous			
Liquid	13,000	416,100	3
Solid	820	6,670	12

[a] See definitions in Appendix F.8.
[b] UC 1998n.
[c] From the waste management section in Chapter 3.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998n). Hazardous waste generation for construction of this facility is estimated to be 15 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998n). Nonrecyclable solid sanitary waste would be sent off the site for disposal. Waste metals would be sent off the site for recycling and, therefore, were not included in the waste volumes. Nonhazardous-solid-waste generation during construction of this facility is estimated to be 12 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from dewatering (UC 1998n). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and managed at offsite facilities. Nonhazardous liquid waste generation for construction of this facility is estimated to be 3 percent of existing annual site waste generation, 5 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, impacts on the system during construction should not be major.

H.4.2.3.2 Operation of MOX Facility

The waste management facilities within the MOX facility would process, temporarily store, and ship all wastes generated. Table H–32 compares the expected waste generation rates from operating the new facility at SRS with the existing site waste generation rates. No HLW would be generated by the facility (UC 1998n). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with the current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995b).

TRU wastes generated during operations include spent filters, used containers and equipment, paper and cloth wipes, analytical and quality-control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facility (UC 1998n). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for this combination of facilities is estimated to be 11 percent of existing annual site waste generation and 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 460 m^3 (600 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 7 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and 1 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3),

Table H–32. Potential Waste Management Impacts From Operation of New MOX Facility at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	46	427	11
LLW	34	10,043	<1
Mixed LLW	2	1,135	<1
Hazardous	<1	74	1
Nonhazardous			
Liquid	25,000	416,100	6
Solid	<150	6,670	<2

[a] See definitions in Appendix F.8.
[b] UC 1998n.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

about 2,200 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 660 m^2 (790 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.1 ha (0.25 acre) of land at SRS should not be major.

The 460 m^3 (600 yd^3) of TRU waste generated by this facility would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, and solidified inorganic solutions. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facility before being transferred for additional treatment and/or disposal in existing onsite facilities (UC 1998n). A total of 340 m^3 (445 yd^3) of LLW would be generated over the operation period. LLW generation for this facility is estimated to be less than 1 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 1 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687-m^3/ha (4,598-yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 340 m^3 (440 yd^3) of waste would require less than 0.1 ha (0.25 acre) of disposal space at SRS. Therefore, management of this additional LLW at SRS should have no major impact.

Mixed LLW includes solvents contaminated with plutonium, and scintillation vials from the analytical laboratory (UC 1998n). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation for this facility is estimated to be less than 1 percent of existing annual site waste generation, and less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of this facility, the 20-m^3 (26-yd^3) mixed LLW generated would be 2 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, lubricants, oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at a combination of onsite and offsite permitted facilities (UC 1998n). Assuming that all hazardous waste is managed on the site, hazardous waste generation for this facility is estimated to be 1 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and less than 1 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage building. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998n). The remaining solid sanitary waste would be sent off the site for disposal. Nonrecyclable, nonhazardous solid waste generated by this facility is estimated to be less than 2 percent of existing annual site waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets; process wastewater from lab sinks and drains, mop water, cooling tower blowdown and steam condensate; and treated wastewater from the liquid effluent treatment system. Nonhazardous wastewater would be treated, if necessary, before being discharged to the F-Area sanitary sewer system that connects to the Central Sanitary Wastewater Treatment Facility (UC 1998n). Nonhazardous liquid waste generation for this facility is estimated to be 6 percent of the existing annual site waste generation, 9 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 2 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, impacts on the system should not be major.

H.4.2.4 Pit Conversion and Immobilization Facilities

H.4.2.4.1 Construction of Pit Conversion and Immobilization Facilities

Table H–33 compares the expected construction waste generation rates for the facilities that may be constructed at SRS with the existing site waste generation rates. TRU waste and LLW would be generated during the 3-year modification of Building 221–F only because all other construction would involve new buildings.

No mixed LLW would be generated (UC 1998i, 1998j, 1998k, 1998l, 1998m). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies and the 17-t (19-ton) and 50-t (55-ton) immobilization scenarios, although construction waste generation is different if existing buildings need to be modified versus constructing new buildings (UC 1998j, 1998k, 1998l, 1998m).

TRU wastes generated during modification of Building 221–F include contaminated equipment and structures, protective clothing, and radiological survey waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be packaged and certified to current WIPP waste acceptance

Table H–33. Potential Waste Management Impacts of Construction of Pit Conversion Facility and Immobilization Facility in Building 221–F or New Construction at SRS

	Estimated Waste Generation (m^3/yr)[b]				Percent of Site Waste Generation				
		Immobilization (Ceramic or Glass)				Immobilization (Ceramic or Glass)		Both Facilities	
Waste Type[a]	Pit Conversion	Bldg. 221–F	New	SiteWaste Generation (m^3/yr)[c]	Pit Conversion	Bldg. 221–F	New	Bldg. 221–F	New
TRU[d]	0	50	0	427	NA	12	NA	12	NA
LLW	0	500	0	10,043	NA	5	NA	5	NA
Hazardous	50	4	11	74	68	5	15	73	82
Nonhazardous									
Liquid	5,300	9,200	9,800	416,100	1	2	2	3	4
Solid	120	570	1,700	6,670	2	9	25	10	27

[a] See definitions in Appendix F.8.
[b] UC 1998i, 1998j, 1998k, 1998l, 1998m.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.

criteria at the construction site (UC 1998j, 1998k). Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for this combination of facilities is estimated to be 12 percent of existing annual site waste generation and 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 150 m^3 (196 yd^3) of TRU waste would be generated over the construction period. This would be 2 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and less than 1 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums, each with the capacity of 0.21 m^3 (0.27 yd^3), about 710 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 210 m^2 (250 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at SRS should not be major.

The 150 m^3 (196 yd^3) of TRU waste generated by construction of these facilities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW generated during modification of Building 221–F includes demolition debris (e.g., process piping, equipment, and structures), protective clothing, and radiological survey waste. LLW would be packaged, certified, and accumulated at the construction site before being transferred for treatment and/or disposal in existing onsite facilities. Liquid LLW from flushing equipment and decontamination activities would be collected by an existing system in Building 221–F (UC 1998j, 1998k, 1998l, 1998m). A total of 1,500 m^3 (1,960 yd^3) of LLW would be generated over the construction period. LLW generation for construction is estimated to be 5 percent of existing annual site waste generation, and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,500 m^3 (1,960 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at SRS. Therefore, the management of this additional LLW at SRS should have no major impact.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m). Hazardous waste generation for construction of this combination of facilities is estimated to be 73 to 82 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice, and shipped to offsite facilities for recycling or disposal (UC 1998i, 1998j, 1998k, 1998l, 1998m). Nonrecyclable solid sanitary waste would be sent off the site for disposal. Waste metals would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonhazardous-solid-waste generation during construction of this combination of facilities is estimated to be 10 to 27 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets (UC 1998i, 1998j, 1998k, 1998l, 1998m). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and managed at offsite facilities. Nonhazardous liquid waste generation for construction of this combination of facilities is estimated to be 3 to 4 percent of existing annual site waste generation, 5 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 1 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, impacts on the system during construction should not be major.

H.4.2.4.2 Operation of Pit Conversion and Immobilization Facilities

The waste management facilities within the pit conversion and immobilization facilities would process, temporarily store, and ship all wastes generated. Table H–34 compares the expected waste generation rates from operating the new facilities at SRS with the existing site waste generation rates. Although HLW would be used in the immobilization process, no HLW would be generated by the facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed in accordance with current site practices. Waste generation would be the same for the ceramic and glass immobilization technologies, although the amount of waste generated would vary between the 17-t (19-ton) and 50-t (55-ton) immobilization cases (UC 1998j, 1998k, 1998l, 1998m). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995b).

TRU wastes generated during operations include metal cladding from fuel elements, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality-control samples, and solidified inorganic solutions. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time

Table H–34. Potential Waste Management Impacts of Operation of New Pit Conversion Facility and Immobilization Facility in Building 221–F or New Construction at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b] Pit Conversion	Immobilization 17 t	Immobilization 50 t	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation Pit Conversion	Immobilization 17 t	Immobilization 50 t	Both Facilities
TRU[d]	18	95	126	427	4	22	30	26 to 34
LLW	60	60	80	10,043	1	1	1	1
Mixed LLW	1	1	1	1,135	<1	<1	<1	<1
Hazardous	2	30	30	74	3	41	41	43
Nonhazardous								
Liquid	25,000	26,000–28,000	28,000–30,000	416,100	6	6 to 7	7	12 to 13
Solid	1,800	230	230	6,670	27	3	3	30

[a] See definitions in Appendix F.8.
[b] UC 1998i, 1998j, 1998k, 1998l, 1998m.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for this combination of facilities is estimated to be 26 to 34 percent of existing annual site waste generation and 7 to 8 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,130 to 1,440 m^3 (1,480 to 1,880 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 16 to 21 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and 3 to 4 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 5,400 to 6,900 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 1,600 to 2,100 m^2 (1,910 to 2,510 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.16 to 0.21 ha (0.40 to 0.52 acre) of land at SRS should not be major.

The 1,130 to 1,440 m^3 (1,480 to 1,880 yd^3) of TRU waste generated by these facilities would be approximately 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m). Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998m). A total of 1,200- to 1,400-m^3 (1,570- to 1,830-yd^3) LLW would be generated over the operation period. LLW generation for this combination of facilities is estimated to be 1 percent of existing annual site waste generation, 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 4 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,200 to 1,400 m^3 (1,570 to 1,830 yd^3) of waste would require 0.14 to 0.16 ha (0.35 to 0.40 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW includes leaded shielding, solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998i, 1998j, 1998k, 1998l, 1998m). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation for this combination of facilities is estimated to be less than 1 percent of existing annual site waste generation, and less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of these facilities, the 20 m^3 (26 yd^3) of mixed LLW generated would be 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at a combination of onsite and offsite permitted facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m). Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be 43 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage building. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, coal ash, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998i, 1998j, 1998k, 1998l, 1998m). Ash from the coal-fired steam generating plant would be disposed of in the onsite ash disposal landfills (UC 1998j, 1998k, 1998l, 1998m). The remaining solid sanitary waste would be sent off the site for disposal. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 30 percent of existing annual site waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and steam condensate. Nonhazardous wastewater would be treated, if necessary, before being discharged to the F-Area sanitary sewer system that connects to the Central Sanitary Wastewater Treatment Facility (UC 1998i, 1998j, 1998k, 1998l, 1998m). Nonhazardous liquid waste generation for this combination of facilities is estimated to be 12 to 13 percent of the existing annual site waste generation, 18 to 20 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 5 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, impacts on the system should not be major.

H.4.2.5 Pit Conversion and MOX Facilities

H.4.2.5.1 Construction of Pit Conversion and MOX Facilities

Table H–35 compares the expected construction waste generation rates for the facilities that may be constructed at SRS with the existing site waste generation rates. No radioactive waste would be generated because all construction would involve new buildings (UC 1998i, 1998n). In addition, no soil contaminated

Table H–35. Potential Waste Management Impacts of Construction of New Pit Conversion and MOX Facilities at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b] Pit Conversion	MOX	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation Pit Conversion	MOX	Both Facilities
Hazardous	50	11	74	68	15	82
Nonhazardous						
Liquid	5,300	13,000	416,100	1	3	4
Solid	120	820	6,670	2	12	14

[a] See definitions in Appendix F.8.
[b] UC 1998i, 1998n.
[c] From the waste management section in Chapter 3.

with hazardous or radioactive constituents would be generated during the 3-year construction period. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998i, 1998n). Hazardous waste generation for construction of this combination of facilities is estimated to be 82 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice, and shipped to offsite facilities for recycling or disposal (UC 1998i, 1998n). Nonrecyclable solid sanitary waste would be sent off the site for disposal. Waste metals would be sent off the site for recycling and, therefore, were not included in the waste volumes. Nonhazardous-solid-waste generation during construction of this combination of facilities is estimated to be 14 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from dewatering (UC 1998i, 1998n). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and managed at offsite facilities. Nonhazardous-liquid-waste generation for construction of this combination of facilities is estimated to be 4 percent of existing annual site waste generation, 7 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 2 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, impacts on the system during construction should not be major.

H.4.2.5.2 Operation of Pit Conversion and MOX Facilities

The waste management facilities within the pit conversion and MOX facilities would process, temporarily store, and ship all wastes generated. Table H–36 compares the expected waste generation rates from operating the new facilities at SRS with the existing site waste generation rates. No HLW would be generated by the

Table H–36. Potential Waste Management Impacts of Operation of New Pit Conversion and MOX Facilities at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b] Pit Conversion	MOX	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation Pit Conversion	MOX	Both Facilities
TRU[d]	18	46	427	4	11	15
LLW	60	34	10,043	1	<1	1
Mixed LLW	1	2	1,135	<1	<1	<1
Hazardous	2	<1	74	3	1	4
Nonhazardous						
Liquid	25,000	25,000	416,100	6	6	12
Solid	1,800	<150	6,670	27	2	29

[a] See definitions in Appendix F.8.
[b] UC 1998i, 1998n.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

facilities (UC 1998i, 1998n). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995b).

TRU wastes generated during operations include spent filters, used containers and equipment, paper and cloth wipes, analytical and quality-control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998i, 1998n). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for this combination of facilities is estimated to be 15 percent of existing annual site waste generation, and 4 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 640 m^3 (837 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 9 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and 2 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 3,000 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 900 m^2 (1,100 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.1 ha (0.25 acre) of land at SRS should not be major.

The 640 m^3 (837 yd^3) of TRU waste generated by these facilities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities (UC 1998i, 1998n). Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998m). A total of 940-m^3 (1,230-yd^3) LLW would be generated over the operation period. LLW generation for this combination of facilities is estimated to be 1 percent of existing annual site waste generation, 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 3 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940 m^3 (1,230 yd^3) of waste would require 0.11 ha (0.27 acre) of disposal space at SRS. Therefore, the management of this additional LLW at SRS should have no major impact.

Mixed LLW includes leaded shielding, solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998i, 1998n). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation for this combination of facilities is estimated to be less than 1 percent of existing annual site waste generation, and less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of these facilities, the 30 m^3 (39 yd^3) of mixed LLW generated would be 2 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at a combination of onsite and offsite facilities (UC 1998i, 1998n). Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be 4 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 1 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage building. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, coal ash, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998i, 1998n). The remaining solid sanitary waste would be sent off the site for disposal. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be less than 29 percent of existing annual site waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets; process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and steam condensate; and treated wastewater from the liquid effluent treatment system. Nonhazardous wastewater would be treated, if necessary, before being discharged to the F-Area sanitary sewer system that connects to the Central Sanitary Wastewater Treatment Facility (UC 1998i, 1998n). Nonhazardous liquid waste generation for this combination of facilities is estimated to be 12 percent of the existing annual site waste generation, 18 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 5 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility and, therefore, should not have a major impact on the system. Impacts on the wastewater treatment infrastructure are evaluated in the sections that describe infrastructure impacts.

H.4.2.6 Immobilization and MOX Facilities

H.4.2.6.1 Construction of Immobilization and MOX Facilities

Table H–37 compares the expected construction waste generation rates for the facilities that may be constructed at SRS with the existing site waste generation rates. TRU waste and LLW would be generated during the 3-year modification of Building 221–F only because all other construction would involve new buildings. No mixed LLW would be generated (UC 1998j, 1998k, 1998l, 1998m, 1998n). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies, although construction waste generation is different if existing buildings need to be modified versus constructing new buildings (UC 1998j, 1998k, 1998l, 1998m).

Table H–37. Potential Waste Management Impacts of Construction of Immobilization Facility in Building 221–F or New Construction and New MOX Facility at SRS

	Estimated Waste Generation (m^3/yr)[b]				Percent of Site Waste Generation				
	Immobilization (Ceramic or Glass)			Site Waste Generation (m^3/yr)[c]	Immobilization (Ceramic or Glass)			Both Facilities	
Waste Type[a]	Bldg. 221–F	New	MOX		Bldg. 221–F	New	MOX	Bldg. 221–F	New
TRU[d]	50	0	0	427	12	NA	NA	12	NA
LLW	500	0	0	10,043	5	NA	NA	5	NA
Hazardous	4	11	11	74	5	15	15	20	30
Nonhazardous									
Liquid	9,200	9,800	13,000	416,100	2	2	3	5	5
Solid	570	1,700	820	6,670	9	25	12	21	38

[a] See definitions in Appendix F.8.
[b] UC 1998j, 1998k, 1998l, 1998m, 1998n.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.

TRU wastes generated during modification of Building 221–F include contaminated equipment and structures, protective clothing, and radiological survey waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be packaged and certified to current WIPP waste acceptance criteria at the construction site (UC 1998j, 1998k). Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS. TRU waste generation for this combination of facilities is estimated to be 12 percent of existing annual site waste generation and 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 150 m^3 (196 yd^3) of TRU waste would be generated over the construction period. This would be 2 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and less than 1 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 710 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 210 m^2 (250 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at SRS should not be major.

The 150 m^3 (196 yd^3) of TRU waste generated by construction of these facilities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW generated during modification of Building 221–F includes demolition debris (e.g., process piping, equipment, and structures), protective clothing, and radiological survey waste. LLW would be packaged, certified, and accumulated at the construction site before being transferred for treatment and/or disposal in existing onsite facilities. Liquid LLW from flushing equipment and decontamination activities would be collected by an existing system in Building 221–F (UC 1998j, 1998k, 1998l, 1998m). A total of 1,500-m^3 (1,960-yd^3) LLW would be generated over the construction period. LLW generation during construction is estimated to be 5 percent of existing annual site waste generation, and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,500 m^3 (1,960 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at SRS. Therefore, the management of this additional LLW at SRS should have no major impact.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998j, 1998k, 1998l, 1998m, 1998n). Hazardous waste generation for construction of this combination of facilities is estimated to be 20 to 30 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice, and shipped to offsite facilities for recycling or disposal (UC 1998j, 1998k, 1998l, 1998m, 1998n). Nonrecyclable solid sanitary waste would be sent off the site for disposal. Waste metals would be sent off the site for recycling and, therefore, were not included in the waste volumes. Nonhazardous-solid-waste generation during construction of this combination of facilities is estimated to be 21 to 38 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from dewatering (UC 1998j, 1998k, 1998l, 1998m, 1998n). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and managed at offsite facilities. Nonhazardous liquid waste generation for construction of this combination of facilities is estimated to be 5 percent of existing annual site waste generation, 8 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 2 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, impacts on the system during construction should not be major.

H.4.2.6.2 Operation of Immobilization and MOX Facilities

The waste management facilities within the immobilization and MOX facilities would process, temporarily store, and ship all wastes generated. Table H–38 compares the expected waste generation rates from operating

Table H–38. Potential Waste Management Impacts of Operation of Immobilization Facility in Building 221–F or New Construction and New MOX Facility at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b] Immobilization (Ceramic or Glass)	Estimated Waste Generation (m^3/yr)[b] MOX	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation Immobilization (Ceramic or Glass)	Percent of Site Waste Generation MOX	Percent of Site Waste Generation Both Facilities
TRU[d]	95	46	427	22	11	33
LLW	60	34	10,043	1	<1	1
Mixed LLW	1	2	1,135	<1	<1	<1
Hazardous	30	<1	74	41	1	42
Nonhazardous						
Liquid	26,000–28,000	25,000	416,100	6 to 7	6	12 to 13
Solid	230	<150	6,670	3	2	6

[a] See definitions in Appendix F.8.
[b] UC 1998j, 1998k, 1998l, 1998m, 1998n.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

the new facilities at SRS with the existing site waste generation. Although HLW would be used in the immobilization process, no HLW would be generated by the facilities (UC 1998j, 1998k, 1998l, 1998m, 1998n). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed in accordance with current site practices. Waste generation would be the same for the ceramic and glass immobilization technologies (UC 1998j, 1998k, 1998l, 1998m). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995b).

TRU wastes generated during operations include metal cladding from fuel elements, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality-control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998j, 1998k, 1998l, 1998m, 1998n). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS. TRU waste generation for this combination of facilities is estimated to be 33 percent of existing annual site waste generation and 8 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,410 m^3 (1,840 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 20 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and 4 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 6,700 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 2,000 m^2 (2,400 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.20 ha (0.49 acre) of land at SRS should not be major.

The 1,410 m^3 (1,840 yd^3) of TRU waste generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3

(220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, and solidified inorganic solutions. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities (UC 1998j, 1998k, 1998l, 1998m, 1998n). A total of 940-m^3 (1,230-yd^3) LLW would be generated over the operation period. LLW generation for this combination of facilities is estimated to be 1 percent of existing annual site waste generation, 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 3 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 940-m^3 (1,230-yd^3) waste would require 0.11 ha (0.27 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW includes lead shielding, solvents contaminated with plutonium, and scintillation vials from the analytical laboratory (UC 1998j, 1998k, 1998l, 1998m, 1998n). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation for this combination of facilities is estimated to be less than 1 percent of existing annual site waste generation, and less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of these facilities, the 30-m^3 (39-yd^3) mixed LLW generated would be 2 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, lubricants, oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at a combination of onsite and offsite permitted facilities (UC 1998j, 1998k, 1998l, 1998m, 1998n). Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be 42 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, coal ash, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998j, 1998k, 1998l, 1998m, 1998n). Ash from the coal-fired steam generating plant would be disposed of in the onsite ash disposal landfills (UC 1998j, 1998k, 1998l, 1998m). The remaining solid sanitary waste would be sent off the site for disposal. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be less than 6 percent of existing annual site waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets; process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and steam condensate; and treated wastewater from the liquid effluent treatment system. Nonhazardous wastewater would be treated, if necessary, before being discharged to the F-Area sanitary sewer system that connects to the Central Sanitary Wastewater Treatment Facility (UC 1998j, 1998k, 1998l, 1998m, 1998n). Nonhazardous liquid waste generation for this combination of facilities is estimated to be 12 to 13 percent of the existing annual site waste generation, 18 to 19 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 5 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and therefore should not have a major impact on the system.

H.4.2.7 Pit Conversion, Immobilization, and MOX Facilities

H.4.2.7.1 Construction of Pit Conversion, Immobilization, and MOX Facilities

Table H–39 compares the expected construction waste generation rates for the facilities that may be constructed at SRS with the existing site waste generation rates. TRU waste and LLW would be generated during the 3-year modification of Building 221–F only because all other construction would involve new buildings.

Table H–39. Potential Waste Management Impacts of Construction of New Pit Conversion and MOX Facilities and Immobilization Facility in Building 221–F or New Construction at SRS

	Estimated Waste Generation (m^3/yr)[b]					Percent of Site Waste Generation					
		IF (Ceramic or Glass)			Site Waste Generation		IF (Ceramic or Glass)			All Facilities	
Waste Type[a]	PCF	221–F	New	MOX	(m^3/yr)[c]	PCF	221–F	New	MOX	221–F	New
TRU[d]	0	50	0	0	427	NA	12	NA	NA	12	NA
LLW	0	500	0	0	10,043	NA	5	NA	NA	5	NA
Hazardous	50	4	11	11	74	68	5	15	15	88	97
Nonhazardous											
Liquid	5,300	9,200	9,800	13,000	416,100	1	2	2	3	7	7
Solid	120	570	1,700	820	6,670	2	9	25	12	23	40

[a] See definitions in Appendix F.8.
[b] UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: IF, immobilization facility; LLW, low-level waste; NA, not applicable; PCF, pit conversion facility; TRU, transuranic.

No mixed LLW would be generated (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). In addition, no soil contaminated with hazardous or radioactive constituents would be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and all applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies, although construction waste generation is different if existing buildings need to be modified versus constructing new buildings (UC 1998j, 1998k, 1998l, 1998m).

TRU wastes generated during modification of Building 221–F include contaminated equipment and structures, protective clothing, and radiological survey waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be packaged and certified to current WIPP waste acceptance criteria at the construction site (UC 1998j, 1998k). Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for modification of Building 221–F is estimated to be 12 percent of existing annual site waste generation, and 3 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste

Characterization and Certification Facility. A total of 150 m^3 (196 yd^3) of TRU waste would be generated over the construction period. This would be 2 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled TRU waste currently in storage, and less than 1 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 710 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 210 m^2 (250 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at SRS should not be major.

The 150 m^3 (196 yd^3) of TRU waste generated by construction of these facilities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW generated during modification of Building 221–F includes demolition debris (e.g., process piping, equipment, and structures), protective clothing and radiological survey waste. LLW would be packaged, certified, and accumulated at the construction site before being transferred for treatment and/or disposal in existing onsite facilities. Liquid LLW from flushing equipment and decontamination activities would be collected by an existing system in Building 221–F (UC 1998j, 1998k, 1998l, 1998m). A total of 1,500-m^3 (1,960-yd^3) of LLW would be generated over the construction period. LLW generation for construction is estimated to be 5 percent of existing annual site waste generation, and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,500 m^3 (1,960 yd^3) of waste would require 0.17 ha (0.42 acre) of disposal space at SRS. Therefore, the management of this additional LLW at SRS should have no major impact.

Hazardous waste generated during construction includes liquids such as spent cleaning solutions, lubricants, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials. These wastes are typically generated during construction of an industrial facility. Any hazardous waste generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m). Hazardous waste generation for construction of this combination of facilities is estimated to be 88 to 97 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste includes office garbage, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal (UC 1998i, 1998j, 1998k, 1998l, 1998m). Nonrecyclable solid sanitary waste would be sent off the site for disposal. Waste metals would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonhazardous-solid-waste generation during construction of these facilities is estimated to be 23 to 40 percent of existing annual site waste generation. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets and wastewater from dewatering (UC 1998i, 1998j, 1998k, 1998l, 1998m). To be conservative, it was assumed that all nonhazardous liquid waste generated during construction would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and managed at offsite facilities. Nonhazardous liquid waste generation during construction of these facilities is estimated to be 7 percent of existing annual site waste generation, 10 percent of the 276,000-m^3/yr

(361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 3 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and therefore should not have a major impact on the system during construction.

H.4.2.7.2 Operation of Pit Conversion, Immobilization, and MOX Facilities

The waste management facilities within the pit conversion, immobilization, and MOX facilities would process, temporarily store, and ship all wastes generated. Table H–40 compares the expected waste generation rates from operating the new facilities at SRS with the existing site waste generation rates. Although HLW would be used in the immobilization process, no HLW would be generated by the facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that the LLW, mixed LLW, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Waste generation would be the same for the ceramic and glass immobilization technologies (UC 1998j, 1998k, 1998l, 1998m). Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995b).

Table H–40. Potential Waste Management Impacts of Operation of New Pit Conversion and MOX Facilities and Immobilization Facility in Building 221–F or New Construction at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]: PCF	Estimated Waste Generation (m^3/yr)[b]: Immobilization (Ceramic or Glass)	Estimated Waste Generation (m^3/yr)[b]: MOX	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation: PCF	Percent of Site Waste Generation: Immobilization (Ceramic or Glass)	Percent of Site Waste Generation: MOX	Percent of Site Waste Generation: All Facilities
TRU[d]	18	95	46	427	4	22	11	37
LLW	60	60	34	10,043	1	1	<1	2
Mixed LLW	1	1	2	1,135	<1	<1	<1	<1
Hazardous	2	30	<1	74	3	41	1	45
Nonhazardous								
Liquid	25,000	26,000–28,000	25,000	416,100	6	6 to 7	6	18 to 19
Solid	1,800	230	<150	6,670	27	3	2	33

a See definitions in Appendix F.8.
b UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n.
c From the waste management section in Chapter 3.
d Includes mixed TRU waste.
Key: LLW, low-level waste; NA, not applicable; PCF, pit conversion facility; TRU, transuranic.

TRU wastes generated during operations include metal cladding from fuel elements, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality-control samples, solidified inorganic solutions, and dirty plutonium oxide scrap. Lead-lined gloves are likely to be managed as mixed TRU waste. It is anticipated that all TRU waste would be contact-handled waste. TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for this combination of facilities is estimated to be 37 percent of existing annual site waste generation and 9 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,590 m^3 (2,080 yd^3) of TRU waste would be generated over the 10-year operation period. This would be 23 percent of the 6,977 m^3 (9,126 yd^3) of contact-handled

TRU waste currently in storage, and 5 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS. Assuming that the waste were stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 7,600 drums would be required to store this waste. Assuming that these drums can be stacked two high, that each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space, a storage area of about 2,300 m^2 (2,750 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on 0.23 ha (0.57 acre) of land at SRS should not be major.

The 1,590 m^3 (2,080 yd^3) of TRU waste generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW includes used equipment, wipes, protective clothing, solidified inorganic solutions, and tritium. It is likely that the LLW generated during operations would originate from activities in the processing areas containing the glovebox lines but not from operations within the gloveboxes. Operations within the gloveboxes are likely to generate mostly TRU waste. LLW would be treated, packaged, certified, and accumulated at the new facilities before being transferred for additional treatment and/or disposal in existing onsite facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). Tritium recovered from pit disassembly would be disposed of as LLW (UC 1998i). A total of 1,540-m^3 (2,010-yd^3) LLW would be generated over the operation period. LLW generation for this combination of facilities is estimated to be 2 percent of existing annual site waste generation, 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 5 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha (4,598 yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 1,540 m^3 (2,010 yd^3) of waste would require 0.18 ha (0.42 acre) of disposal space at SRS. Therefore, the management of this additional LLW at SRS should have no major impact.

Mixed LLW includes leaded shielding, solvents contaminated with plutonium, scintillation vials from the analytical laboratory, and hazardous constituents that were introduced as part of the incoming pits (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation for this combination of facilities is estimated to be less than 1 percent of existing annual site waste generation, and less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of these facilities, the 40 m^3 (52 yd^3) of mixed LLW generated would be 2 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations includes spent cleaning solutions, vacuum pump oils, film processing fluids, hydraulic fluids, antifreeze solutions, paints, chemicals, batteries, fluorescent light tubes, lead packaging, and contaminated rags or wipes. Hazardous waste would be packaged for treatment and disposal at a combination of onsite and offsite permitted facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). Assuming that all hazardous waste is managed on the site, hazardous waste generation for this combination of facilities is estimated to be 45 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 6 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste includes office garbage, coal ash, machine shop waste, and other industrial wastes from utility and maintenance operations. Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). Ash from the coal-fired steam generating plant would be disposed of in the onsite ash disposal landfills (UC 1998j, 1998k, 1998l, 1998m). The remaining solid sanitary waste would be sent off the site for disposal. Nonrecyclable, nonhazardous solid waste generated by this combination of facilities is estimated to be 33 percent of existing annual site waste generation. This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets; process wastewater from lab sinks and drains, mop water, cooling tower blowdown, and steam condensate; and treated wastewater from the liquid effluent treatment system. Nonhazardous wastewater would be treated, if necessary, before being discharged to the F-Area sanitary sewer system that connects to the Central Sanitary Wastewater Treatment Facility (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). Nonhazardous liquid waste generation for this combination of facilities is estimated to be 18 to 19 percent of the existing annual site waste generation, 28 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, and 7 to 8 percent of the 1.03 million-m^3/yr (1.35 million-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, impacts on the system should not be major.

Next Section

H.5 LEAD ASSEMBLY FABRICATION

This section describes the impacts on the waste management infrastructure that may occur if lead assembly fabrication were to occur at ANL–W, Hanford, LLNL, LANL, or SRS. For each site, separate sections are presented for construction and operations.

H.5.1 ANL–W

H.5.1.1 Construction

Wastes would be generated during modification of the Fuel Manufacturing Facility (FMF) and the Zero Power Physics Reactor (ZPPR) for lead assembly fabrication. Table H–41 compares the expected waste generation rates for the modification of facilities at ANL–W with the existing generation rates for INEEL waste. LLW would be generated during modification of contaminated areas of FMF and ZPPR, although no TRU waste, mixed waste, or hazardous wastes should be generated (O'Connor et al. 1998a).

Table H–41. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at ANL–W

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
LLW	18	2,624	1
Nonhazardous			
Liquid	37	2,000,000	<1
Solid	11	62,000	<1

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998a.
[c] From the waste management section in Chapter 3; waste generation rates for INEEL.
Key: ANL–W, Argonne National Laboratory–West; LLW, low-level waste.

LLW generated during modification of the FMF and ZPPR buildings would include used equipment, decontamination wastes, and protective clothing (O'Connor et al. 1998a). A total of 36 m^3 (47 yd^3) of LLW would be generated during the 2-year modification period. LLW generation for these activities is estimated to be 1 percent of existing annual waste generation, less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity at the Radioactive Waste Management Complex (RWMC), and less than 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of RWMC. Using the 6,264-m^3/ha (3,315 yd^3/acre) disposal land usage factor for RWMC published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 36 m^3 (47 yd^3) of waste would require less than 0.1 ha (0.25 acre) of disposal space at INEEL. Therefore, impacts of the management of this additional LLW at ANL–W and INEEL should not be major.

Nonhazardous solid waste would include office garbage, construction debris, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice, and would be disposed of in the onsite CFA landfill complex or shipped to offsite facilities for recycling. Nonrecyclable nonhazardous solid waste generated during modification is estimated to be less than 1 percent of existing annual site waste generation and less than 1 percent of the 48,000-m^3/yr (62,800-yd^3/yr) capacity of the CFA landfill complex. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at ANL–W or INEEL.

Nonhazardous liquid waste would include sanitary waste from sinks, showers, urinals, and water closets. To be conservative, it was assumed that all nonhazardous liquid waste generated during modification would be managed at the ANL–W sanitary wastewater treatment facility. Nonhazardous liquid waste generation for modification is estimated to be less than 1 percent of the existing annual waste generation for the INEEL, and 1 percent of the 6,057-m^3/yr (7,923-yd^3/yr) capacity of the ANL–W sanitary wastewater treatment facility. Therefore, this waste load should not have a major impact on the ANL–W sanitary wastewater treatment system.

H.5.1.2 Operations

Table H–42 compares the expected waste generation rates from lead assembly fabrication at ANL–W with the existing INEEL waste generation rates. No HLW would be generated by the proposed activities. Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. This SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at ANL–W and INEEL are described in the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Final EIS* (DOE 1995a).

Table H–42. Potential Waste Management Impacts of Operation of Facilities for Lead Assembly Fabrication at ANL–W

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	41	NA	NA
LLW	200	2,624	8
Mixed LLW	1	180	1
Hazardous	<1	835	<1
Nonhazardous			
Liquid	1,600	2,000,000	<1
Solid	1,300	62,000	2

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998a.
[c] From the waste management section in Chapter 3; waste generation rates for INEEL.
[d] Includes mixed TRU waste.
Key: ANL–W, Argonne National Laboratory–W; LLW, low-level waste; NA, not applicable; TRU, transuranic.

TRU wastes generated during lead assembly fabrication would include glovebox gloves, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, metallography waste, and sludges (O'Connor et al. 1998a). It is anticipated that all TRU waste would be contact-handled waste. Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Long-term storage, drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned Waste Characterization Facility at INEEL. TRU waste is not routinely generated at INEEL.

TRU waste generation for these activities at ANL–W is estimated to be 41 m^3/yr (54 yd^3/yr), or 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) capacity of the planned Advanced Mixed Waste Treatment Project. A total of 132 m^3 (173 yd^3) of waste would be generated over the 3-year operation period. This would be less than 1 percent of the 39,300 m^3 (51,404 yd^3) of contact-handled TRU waste currently in storage, and less than 1 percent of the 177,300-m^3 (231,908-yd^3) storage capacity available at INEEL.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW may include room trash (e.g., blotter paper, wipes, mop heads); protective clothing; solidified sludges; ion exchange resins; metal cans and rods; and wastewater from the laundry, analytical laboratory, and decontamination process (O'Connor et al. 1998a). LLW would be packaged, certified, and accumulated before being transferred for treatment and disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generation for these activities is estimated to be 8 percent of existing annual site waste generation, less than 1 percent of the 49,610-m^3/yr (64,880-yd^3/yr) capacity of the WERF, 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity at the RWMC, and 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of the RWMC. Using the 6,264-m^3/ha (3,315 yd^3/acre) disposal land usage factor for the RWMC published in the *Storage and Disposition Final PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.11 ha (0.27 acre) of disposal space at INEEL. Therefore, impacts of the management of this additional LLW at ANL–W and INEEL should not be major.

Mixed LLW may include sludges, cleaning solvents, and analytical waste (O'Connor et al. 1998a). Mixed LLW will be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for ANL–W. INEEL currently treats mixed LLW onsite and ships some mixed LLW to Envirocare of Utah. Onsite disposal is planned in a new mixed LLW disposal facility. These facilities or other treatment or disposal facilities that meet DOE criteria would be used. Mixed LLW generation for these activities is estimated to be 1 percent of existing annual waste generation and less than 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project. The 4 m^3 (5.2 yd^3) of mixed LLW expected to be generated would be less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity at RWMC. Therefore, the management of this additional waste at ANL–W and INEEL should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations would include small quantities of process ends. Hazardous waste would be packaged for treatment and disposal at onsite and offsite permitted facilities (O'Connor et al. 1998a). Hazardous waste generation for these activities is estimated to be less than 1 percent of existing annual waste generation and less than 1 percent of the 1,600-m^3 (2,090-yd^3) onsite storage capacity. Assuming that all the hazardous waste was to be treated at the Waste Experimental Reduction Facility, this additional waste would be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) capacity of the system, and therefore should not have a major impact on the hazardous waste management system at ANL–W or INEEL.

Nonhazardous solid waste would include office and lunch room garbage, packaging materials, sewage sludges, and other industrial wastes from utility and maintenance operations (O'Connor et al. 1998a). Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent off the site for disposal in the Bonneville County landfill. Nonrecyclable, nonhazardous solid waste generated by these activities is estimated to be 2 percent of existing annual site waste generation. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at ANL–W or INEEL.

Nonhazardous liquid waste would include sanitary waste from sinks, showers, urinals and water closets, and wastewater from cooling tower blowdown (O'Connor et al. 1998a). Nonhazardous liquid waste generation for these activities is estimated to be less than 1 percent of the existing annual waste generation for INEEL and 26 percent of the 6,057-m^3/yr (7,923-yd^3/yr) capacity of the ANL–W sanitary wastewater treatment facility.

Therefore, this additional waste should not have a major impact on the ANL–W sanitary wastewater treatment system.

H.5.2 Hanford

H.5.2.1 Construction

Table H–43 compares the expected waste generation rates for the modification of Hanford facilities for lead assembly fabrication with the existing generation rates for Hanford waste. No radioactive waste would be generated during modification because this action involves modification of uncontaminated buildings only (O'Connor et al. 1998b).

Table H–43. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at Hanford

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Nonhazardous			
Liquid	15	200,000	<1
Solid	50	43,000	<1

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998b.
[c] Taken from the waste management section in Chapter 3.

Nonhazardous solid waste includes office garbage, construction debris, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonrecyclable solid sanitary waste would be sent off the site and would likely be disposed of in the Richland Sanitary Landfill. Nonrecyclable nonhazardous solid waste generated during modification is estimated to be less than 1 percent of existing annual waste generation. The additional waste load generated during the 2-year modification period should not have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets. To be conservative, it was assumed that all nonhazardous liquid waste generated during modification would be managed at onsite facilities. Nonhazardous liquid waste generated during modification is estimated to be less than 1 percent of existing annual site waste generation, less than 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and less than 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, this waste load is unlikely to have a major impact on the system during the modification period.

H.5.2.2 Operations

Table H–44 compares the expected waste generation rates from lead assembly fabrication at Hanford with the existing site waste generation rates. No HLW would be generated during lead assembly fabrication. Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste

Table H–44. Potential Waste Management Impacts of Operation of Facilities for Lead Assembly Fabrication at Hanford

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	41	450	9
LLW	200	3,902	5
Mixed LLW	1	847	<1
Hazardous	<1	560	<1
Nonhazardous			
Liquid	1,600	200,000	1
Solid	1,300	43,000	3

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998b.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste

Key: LLW, low-level waste; TRU, transuranic.

would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford are being evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Programs EIS* that is being prepared by the DOE Richland Operations Office (DOE 1997c).

TRU wastes generated during operations would include glovebox gloves, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, metallography waste, and sludges (O'Connor et al. 1998b). It is anticipated that all TRU waste would be contact-handled waste. Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generation for these activities is estimated to be 9 percent of existing annual site waste generation and 2 percent of the 1,820-m^3/yr (2,380-yd^3/yr) planned capacity of the Waste Receiving and Processing Facility. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. This would be 1 percent of the 11,450 m^3 (14,977 yd^3) of contact-handled TRU waste currently in storage and 1 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW may include room trash (e.g., blotter paper, wipes, mop heads); protective clothing; solidified sludges; ion exchange resins; metal cans and rods; and wastewater from the laundry, analytical laboratory, and decontamination process (O'Connor et al. 1998b). LLW would be packaged, certified, and accumulated before being transferred for treatment and disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generation for these activities is estimated to be 5 percent of existing annual site waste generation, less than 1 percent of the 1,740,000-m^3 (2,280,000-yd^3) disposal capacity of the LLW Burial Grounds, and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Final Storage and Disposition PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.2 ha (0.49 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW may include sludges, cleaning solvents, and analytical waste (O'Connor et al. 1998b). Mixed LLW will be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Mixed LLW generation for these activities is estimated to be less than 1 percent of existing annual waste generation and less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. Over the operating life of this facility, the 4 m^3 (5.2 yd^3) of mixed LLW expected to be generated would be less than 1 percent of the 16,800-m^3 (21,970-yd^3) storage capacity of the Central Waste Complex and less than 1 percent of the 14,200 m^3 (18,600-yd^3) disposal capacity in the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations would include small quantities of process ends. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (O'Connor et al. 1998b). Hazardous waste generation for these activities is estimated to be less than 1 percent of existing annual waste generation. These wastes should not have a major impact on the hazardous waste management system at Hanford.

Nonhazardous solid waste would include office and lunch room garbage, packaging materials, sewage sludges, and other industrial wastes from utility and maintenance operations (O'Connor et al. 1998b). Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent off the site for disposal in the Richland Sanitary Landfill. Nonrecyclable, nonhazardous solid waste generated by these activities is estimated to be 3 percent of existing annual site waste generation. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous liquid waste would include sanitary waste from sinks, showers, urinals and water closets, and wastewater from cooling tower blowdown (O'Connor et al. 1998b). Nonhazardous liquid waste generation for these activities is estimated to be 1 percent of the existing annual site waste generation, 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, and 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the WPPSS Sewage Treatment Facility. Therefore, this additional waste load should not have a major impact on the system.

H.5.3 LLNL

H.5.3.1 Construction

Table H–45 compares the expected waste generation rates for the modification of LLNL facilities for lead assembly fabrication with the existing generation rates for LLNL waste. No radioactive waste would be generated during modification because this action involves modification of uncontaminated buildings only (O'Connor et al. 1998c).

Nonhazardous solid waste includes office garbage, construction debris, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal. Waste metals and other recyclable solid wastes would be sent off the site for recycling, and therefore were not included in the waste volumes. Nonrecyclable solid sanitary waste would be sent off the site and would likely be disposed of in the Vasco

Table H–45. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at LLNL

WasteType[a]	Estimated Waste Generation (m^3/yr) [b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Nonhazardous			
Liquid	17	456,000	<1
Solid	12	4,282	<1

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998c.
[c] From the waste management section in Chapter 3.

Road Landfill. Nonrecyclable nonhazardous solid waste generated during modification is estimated to be 1 percent of existing annual waste generation. The additional waste load generated during the 2-year modification period should not have major impact on the nonhazardous solid waste management system at LLNL.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals, and water closets. To be conservative, it was assumed that all nonhazardous liquid waste generated during modification would be discharged to the LLNL sewer system. Nonhazardous liquid waste generated during modification is estimated to be less than 1 percent of existing annual site waste generation and less than 1 percent of the 2,763,271-m^3/yr (3,614,358-yd^3/yr) capacity of the LLNL sanitary sewer, and therefore is unlikely to have a major impact on the LLNL sewer system or the city of Livermore Water Reclamation Plant during the modification period.

H.5.3.2 Operations

Table H–46 compares the expected waste generation rates from lead assembly fabrication at LLNL with the existing site waste generation rates. No HLW would be generated during lead assembly fabrication. Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment and storage of radioactive, hazardous, and mixed wastes at LLNL are described in the *Final EIS Continued Operation of LLNL and SNL-Livermore* (DOE 1992).

TRU wastes generated during operations would include glovebox gloves, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, metallography waste, and sludges (O'Connor et al. 1998c). It is anticipated that all TRU waste would be contact-handled waste. Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at other as yet unidentified LLNL facilities.

TRU waste generation for these activities is estimated to be 152 percent of existing annual site waste generation. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. This would be 51 percent of the 257 m^3 (336 yd^3) of contact-handled TRU waste currently in storage, and 4 percent of the 3,335 m^3 (4,362 yd^3) of onsite storage capacity. Assuming that the waste is stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 630 drums would be needed to store this waste. Assuming that these drums can be stacked two high, each drum occupies an area of 0.4 m^2 (4 ft^2), and

Table H–46. Potential Waste Management Impacts of Operation of Facilities for Lead Assembly Fabrication at LLNL

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	41	27	152
LLW	200	124	161
Mixed LLW	1	353	<1
Hazardous	<1	579	<1
Nonhazardous			
Liquid	1,600	456,000	<1
Solid	1,300	4,282	30

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998c.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste

Key: LLW, low-level waste; TRU, transuranic.

adding a 50 percent factor for aisle space and shipping and receiving space, a storage area of about 190 m^2 (227 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at LLNL should not be major.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW may include room trash (e.g., blotter paper, wipes, mop heads); protective clothing; solidified sludges; ion exchange resins; metal cans and rods; and wastewater from the laundry, analytical laboratory, and decontamination process (O'Connor et al. 1998c). LLW would be packaged, certified, and accumulated before being transferred for treatment and storage in existing facilities on the site. LLW generation for these activities is estimated to be 161 percent of existing annual site waste generation and 26 percent of the 771-m^3/yr (1,008-yd^3/yr) capacity of the size reduction facility. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. This would be 13 percent of the 5,255-m^3 (6,874-yd^3) onsite storage capacity, and would not be expected to require LLNL to build additional storage capacity because this waste would be shipped to a disposal facility on a routine basis. If additional storage space were required, and assuming that the waste is stored in 208-l (55-gal) drums each with a capacity of 0.21 m^3 (0.27 yd^3), about 3,300 drums would be needed to store this waste. Assuming that these drums can be stacked two high, each drum occupies an area of 0.4 m^2 (4 ft^2), and adding a 50 percent factor for aisle space and shipping and receiving space, a storage area of about 1,000 m^2 (1,196 yd^2) would be required. Impacts of the storage of additional quantities of LLW on 0.1 ha (0.25 acre) of land at LLNL should not be major.

LLW from LLNL is currently shipped to NTS for disposal. The additional LLW from conduct of lead assembly fabrication at LLNL would be 4 percent of the 20,000 m^3 (26,000 yd^3) of LLW disposed at NTS in 1995 and less than 1 percent of the 500,000-m^3 (650,000-yd^3) disposal capacity at NTS. Using the 6,085-m^3/ha (3,221-yd^3/acre) disposal land usage factor for NTS published in the *Final Storage and Disposition PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.12 ha (0.30 acre) of disposal space at NTS or a similar facility. Therefore, impacts of the management of this additional LLW at the disposal site should not be major. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996c).

Mixed LLW may include sludges, cleaning solvents, and analytical waste (O'Connor et al. 1998c). Mixed LLW will be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for LLNL. Mixed LLW disposal would occur off the site. Mixed LLW generation for these activities is estimated to be less than 1 percent of existing annual waste generation and less than 1 percent of the 1,000-m^3/yr (1,310-yd^3/yr) capacity of the Building 513 and 514 Waste Treatment Facility. Over the operating life of this facility, the 4 m^3 (5.2 yd^3) of mixed LLW expected to be generated would be less than 1 percent of the 2,825-m^3 (3,695-yd^3) onsite storage capacity. Therefore, the management of this additional waste at LLNL should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations would include small quantities (< 1 m^3/yr [< 1.3 yd^3/yr]) of process ends. Hazardous waste would be treated and packaged for disposal at offsite permitted commercial facilities (O'Connor et al. 1998c). Hazardous waste generated by these activities is estimated to be less than 1 percent of existing annual waste generation, less than 1 percent of the 1,000-m^3/yr (1,310-yd^3/yr) capacity of the Building 513 and 514 Waste Treatment Facility, and less than 1 percent of the 2,825-m^3 (3,695-yd^3) hazardous waste storage capacity. Because the additional waste load is very small, management of this waste should not have a major impact on the hazardous waste management system at LLNL.

Nonhazardous solid waste would include office and lunch room garbage, packaging materials, sewage sludges, and other industrial wastes from utility and maintenance operations (O'Connor et al. 1998c). Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent off the site for disposal in the Vasco Road Landfill. Nonrecyclable, nonhazardous solid waste generated by these activities is estimated to be 30 percent of existing annual site waste generation. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at LLNL.

Nonhazardous liquid waste would include sanitary waste from sinks, showers, urinals and water closets, and wastewater from cooling tower blowdown (O'Connor et al. 1998c). After monitoring to ensure that the wastewater meets discharge limits, sanitary wastewaters from lead assembly fabrication along with other sanitary wastewaters from LLNL and Sandia National Laboratory–Livermore, would be routed to the city of Livermore Water Reclamation Plant. Nonhazardous liquid waste generation for these activities is estimated to be less than 1 percent of the existing annual site waste generation, and less than 1 percent of the 2,763,271-m^3/yr (3,614,358-yd^3/yr) capacity of the LLNL sanitary sewer and therefore should not have a major impact on LLNL and the city of Livermore sanitary wastewater treatment systems.

H.5.4 LANL

H.5.4.1 Construction

Table H–47 compares the expected waste generation rates for the modification of LANL facilities for lead assembly fabrication with the existing generation rates for LANL waste. TRU waste and LLW would be generated during modification of the glovebox line in Building PF–4, although no mixed waste or hazardous wastes would be generated (O'Connor et al. 1998d).

TRU wastes generated during modification of Building PF–4 would include contaminated equipment and gloveboxes. It is anticipated that all TRU waste would be contact-handled waste. No liquid TRU waste is anticipated. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at other as yet unidentified LANL facilities (O'Connor et al. 1998d).

Table H–47. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at LANL

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	3	262	1
LLW	3	1,585	<1
Nonhazardous			
Liquid	10	692,857	<1

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998d:33.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

TRU waste generation for modification of Building PF–4 is estimated to be 1 percent of existing annual site waste generation, and less than 1 percent of the 1,080-m^3/yr (1,413-yd^3/yr) TRU waste volume reduction capacity. A total of 5 m^3 (6.5 yd^3) of TRU waste would be generated over the 2-year modification period. This would be less than 1 percent of the 11,262 m^3 (14,731 yd^3) of contact-handled TRU waste currently in storage, and less than 1 percent of the 24,355-m^3 (31,856-yd^3) storage capacity available at LANL.

In addition, the 5 m^3 (6.5 yd^3) of TRU waste generated by modification of this building would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW generated during modification of Building PF–4 would include decontamination wastes and protective clothing. It is expected that no radioactive liquid LLW would be generated (O'Connor et al. 1998d). A total of 5 m^3 (6.5 yd^3) of LLW would be generated during the modification period. LLW generation for these activities is estimated to be less than 1 percent of existing annual waste generation, 1 percent of the 663-m^3 (867-yd^3) LLW storage capacity, and less than 1 percent of the 252,000-m^3 (329,616-yd^3) capacity of the TA–54 LLW disposal area. Using the 12,562-m^3/ha (6,649-yd^3/acre) disposal land usage factor for LANL published in the *Final Stockpile Stewardship and Management PEIS* (SSM PEIS) (DOE 1996d:H-9), 5 m^3 (6.5 yd^3) of waste would require less than 0.1 ha (0.25 acre) of disposal space at LANL. Therefore, impacts of the management of this additional LLW at LANL should not be major.

Nonhazardous liquid waste would include sanitary waste from sinks, showers, urinals, and water closets. To be conservative, it was assumed that all nonhazardous liquid waste generated during modification would be managed at the LANL sanitary wastewater treatment plant. Nonhazardous liquid waste generation for modification is estimated to be less than 1 percent of the existing annual waste generation, less than 1 percent of the 1,060,063-m^3/yr (1,386,562-yd^3/yr) capacity of the sanitary wastewater treatment plant, and less than 1 percent of the 567,750-m^3/yr (742,617-yd^3/yr) capacity of the sanitary tile fields. Therefore, this waste load would not have a major impact on the LANL sanitary wastewater treatment system.

H.5.4.2 Operations

Table H–48 compares the expected waste generation rates from lead assembly fabrication at LANL with the existing site waste generation rates. No HLW would be generated during lead assembly fabrication. Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998,

Table H–48. Potential Waste Management Impacts of Operation of Facilities for Lead Assembly Fabrication at LANL

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	41	262	16
LLW	200	1,585	13
Mixed LLW	1	90	1
Hazardous	<1	942	<1
Nonhazardous			
Liquid	1,600	692,857	<1
Solid	1,300	5,453	24

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998d:34.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. The SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of waste at LANL, including expansion of the LLW disposal facility, are evaluated in the *Draft Sitewide EIS for Continued Operation of LANL* (DOE 1998).

TRU wastes generated during operations would include glovebox gloves, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, metallography waste, and sludges (O'Connor et al.1998d). It is anticipated that all TRU waste would be contact-handled waste. Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at other as yet unidentified LANL facilities.

TRU waste generation for these activities is estimated to be 16 percent of existing annual site waste generation and 4 percent of the 1,080-m^3/yr (1,413-yd^3/yr) TRU waste volume reduction capacity. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. This would be 1 percent of the 11,262 m^3 (14,731 yd^3) of contact-handled TRU waste currently in storage, and less than 1 percent of the 24,355-m^3 (31,856-yd^3) storage capacity available at LANL.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and within the 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts from disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW may include room trash (e.g., blotter paper, wipes, mop heads); protective clothing; solidified sludges; ion exchange resins; metal cans and rods; and wastewater from the laundry, analytical laboratory, and decontamination process (O'Connor et al. 1998d). LLW would be packaged, certified, and accumulated before being transferred for treatment and disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generation for these activities is estimated to be 13 percent of existing annual site waste generation, 106 percent of the 663-m^3 (867-yd^3) LLW storage capacity, and less than 1 percent of the 252,000-m^3 (329,616-yd^3) capacity of the TA–54 LLW disposal area. Because the waste would be sent for disposal on a regular basis, storage should not be a problem. Using the 12,562-m^3/ha (6,649-yd^3/acre) disposal land usage factor for LANL published in the SSM PEIS

(DOE 1996d:H-9), 700 m^3 (916 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at LANL. It is estimated that without any waste contribution from lead assembly fabrication, the existing disposal space in the TA–54 LLW disposal facility will be exahausted within the next 10 years. Expansion of the LLW disposal capacity at LANL is evaluated in the *Draft Sitewide EIS for Continued Operation of LANL* (DOE 1998). Impacts from the management of the additional SPD LLW at LANL should not be major.

Mixed LLW may include sludges, cleaning solvents, and analytical waste (O'Connor et al. 1998d). Mixed LLW will be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for LANL. Mixed LLW disposal would occur off the site. Mixed LLW generation for these activities is estimated to be 1 percent of existing annual waste generation, and 1 percent of the 583-m^3 (762.6-yd^3) mixed LLW storage capacity. Therefore, the management of this additional waste at LANL should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations would include small quantities of process ends. Hazardous waste would be packaged for treatment and disposal at offsite permitted commercial facilities (O'Connor et al. 1998d). Hazardous waste generation for these activities is estimated to be less than 1 percent of existing annual waste generation and less than 1 percent of the 1,864-m^3 (2,438-yd^3) hazardous waste storage capacity. These wastes should not have a major impact on the hazardous waste management system at LANL.

Nonhazardous solid waste would include office and lunch room garbage, packaging materials, sewage sludges, and other industrial wastes from utility and maintenance operations (O'Connor et al. 1998d). Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be disposed of in the Los Alamos County Landfill. Nonrecyclable, nonhazardous solid waste generated by these activities is estimated to be 24 percent of existing annual site waste generation. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at LANL.

Nonhazardous liquid waste would include sanitary waste from sinks, showers, urinals and water closets, and wastewater from cooling tower blowdown (O'Connor et al. 1998d). Nonhazardous liquid waste generation for these activities is estimated to be less than 1 percent of the existing annual site waste generation, less than 1 percent of the 1,060,063-m^3/yr (1,386,562-yd^3/yr) capacity of the sanitary wastewater treatment plant, and less than 1 percent of the 567,750-m^3/yr (742,617-yd^3/yr) capacity of the sanitary tile fields, and therefore should not have a major impact on the system.

H.5.5 SRS

H.5.5.1 Construction

Table H–49 compares the expected waste generation rates for the modification of facilities at SRS with the existing generation rates for SRS waste. No radioactive or mixed waste would be generated during modification because the areas of the buildings that will be modified are uncontaminated.

The small amount of hazardous waste generated during building modification would include batteries, fluorescent light tubes, and liquids such as cleaning solutions, lubricants, oils, and hydraulic fluids (O'Connor et al. 1998e). These wastes are typical of those generated during construction of an industrial facility. Any hazardous waste generated during modification would be packaged in DOT-approved containers and shipped off the site to permitted commercial treatment and disposal facilities. Hazardous waste generation

Table H–49. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
Hazardous	1	74	1
Nonhazardous			
Liquid	2,350	416,100	1
Solid	19	6,670	<1

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998e:35.
[c] From the waste management section in Chapter 3.

for modification of this facility is estimated to be 1 percent of existing annual site waste generation. The additional waste load generated during the 2-year modification period should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste would include office garbage, construction debris, scrap lumber, concrete and steel waste, and other construction trash. Nonhazardous solid waste would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or disposal. Waste metals would be sent off the site for recycling, and therefore, were not included in the waste volumes. Nonrecyclable, solid sanitary waste would be sent off the site for disposal. Nonhazardous-solid-waste generation during modification of this facility is estimated to be less than 1 percent of existing annual site waste generation. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste would include sanitary waste from any sinks, showers, urinals, and water closets. To be conservative, it was assumed that all nonhazardous liquid waste generated during modification would be managed at the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generation for modification of this facility is estimated to be 1 percent of existing annual site waste generation, 2 percent of the 136,274-m^3/yr (178,246-yd^3/yr) capacity of the H-Area sanitary sewer, and less than 1 percent of the 1,030,000-m^3/yr (1,347,240-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and therefore, should not have a major impact on the system during the modification period.

H.5.5.2 Operations

Table H–50 compares the expected waste generation rates from lead assembly fabrication at SRS with the existing site waste generation rates. No HLW would be generated during lead assembly fabrication. Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. Per the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. This EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts from treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995b).

TRU wastes generated during operations would include glovebox gloves, spent filters, used containers and equipment, paper and cloth wipes, analytical and quality control samples, metallography waste, and sludges (O'Connor et al. 1998e). It is anticipated that all TRU waste would be contact-handled waste. Liquid TRU wastes would be evaporated or solidified before being packaged for storage. Drum-gas testing, real-time

Table H–50. Potential Waste Management Impacts of Operation of Facilities for Lead Assembly Fabrication at SRS

Waste Type[a]	Estimated Waste Generation (m^3/yr)[b]	Site Waste Generation (m^3/yr)[c]	Percent of Site Waste Generation
TRU[d]	41	427	10
LLW	200	10,043	2
Mixed LLW	1	1,135	<1
Hazardous	<1	74	<1
Nonhazardous			
Liquid	1,600	416,100	<1
Solid	1,300	6,670	19

[a] See definitions in Appendix F.8.
[b] O'Connor et al. 1998e:38.
[c] From the waste management section in Chapter 3.
[d] Includes mixed TRU waste.
Key: LLW, low-level waste; TRU, transuranic.

radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generation for these activities is estimated to be 10 percent of existing annual site waste generation, and 2 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. This would be 2 percent of the 6,977 m^3 (9,125 yd^3) of contact-handled TRU waste currently in storage, and less than 1 percent of the 34,400-m^3 (44,995-yd^3) storage capacity available at SRS.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP, and within the 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997d:3-3). Impacts from disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997d).

LLW may include room trash (e.g., blotter paper, wipes, mop heads); protective clothing; solidified sludges; ion exchange resins; metal cans and rods; and wastewater from the laundry, analytical laboratory, and decontamination process (O'Connor et al. 1998e). LLW would be packaged, certified, and accumulated before being transferred for treatment and disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generation for these activities is estimated to be 2 percent of existing annual site waste generation, 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 2 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687-m^3/ha (4,598-yd^3/acre) disposal land usage factor for SRS published in the *Final Storage and Disposition PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at SRS. Therefore, impacts from the management of this additional LLW at SRS should not be major.

Mixed LLW may include sludges, cleaning solvents, and analytical waste (O'Connor et al. 1998e). Mixed LLW will be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generation for these activities is estimated to be less than 1 percent of existing annual site waste generation and less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of this facility, the 4 m^3 (5.2 yd^3) of mixed LLW expected to be generated would be less than 1 percent of the 1,900-m^3

(23,320-yd^3/yr) capacity of the Consolidated Incineration Facility. Over the operating life of this facility, the 4 m^3 (5.2 yd^3) of mixed LLW expected to be generated would be less than 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste generated during operations would include small quantities of process ends (O'Connor et al. 1998e). Hazardous waste would be packaged for treatment and disposal at a combination of onsite and offsite permitted facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generation for these activities is estimated to be less than 1 percent of existing annual site waste generation, less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and less than 1 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system.

Nonhazardous solid waste would include office and lunch room garbage, packaging materials, sewage sludges, and other industrial wastes from utility and maintenance operations (O'Connor et al. 1998e). Nonhazardous solid waste would be packaged in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent off the site to a commercial facility for disposal. Nonrecyclable, nonhazardous solid waste generated by these activities is estimated to be 19 percent of existing annual site waste generation. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous liquid waste includes sanitary waste from sinks, showers, urinals and water closets, and wastewater from cooling tower blowdown (O'Connor et al. 1998e). Nonhazardous liquid waste generation for these activities is estimated to be less than 1 percent of the existing annual site waste generation, 1 percent of the 136,274-m^3/yr (178,246-yd^3/yr) capacity of the H-Area sanitary sewer, and less than 1 percent of the 1,030,000-m^3/yr (1,347,240-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility. Therefore, impacts on the system should not be major.

H.6 REFERENCES

DOE (U.S. Department of Energy), 1992, *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories-Livermore*, DOE/EIS-0157, San Francisco Field Office, Oakland, CA, August.

DOE (U.S. Department of Energy), 1995a, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, Office of Environmental Management, Idaho Operations Office, Idaho, Falls, ID, April.

DOE (U.S. Department of Energy), 1995b, *Savannah River Site Waste Management Final Environmental Impact Statement*, DOE/EIS-0217, Savannah River Operations Office, Aiken, SC, July.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*, DOE/EIS-0225, Albuquerque Operations Office, Albuquerque, NM, November.

DOE (U.S. Department of Energy), 1996c, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, NV, August.

DOE (U.S. Department of Energy), 1996d, *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236, Office of Fissile Materials Disposition, Washington, DC, September.

DOE (U.S. Department of Energy), 1997a, *The National TRU Waste Management Plan*, rev. 1, DOE/NTP-96-1204, Carlsbad Area Office, Carlsbad, NM, December.

DOE (U.S. Department of Energy), 1997b, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1997c, *Notice of Intent to Prepare a Hanford Site Solid (Radioactive and Hazardous) Waste Program, Environmental Impact Statement*, Richland, WA, 62 FR 55615–55621, Office of the Federal Register, Washington, DC, October 27.

DOE (U.S. Department of Energy), 1997d, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, NM, September.

DOE (U.S. Department of Energy), 1998, *Draft Sitewide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, DOE/EIS-0238, Albuquerque Operations Office, Albuquerque, NM, April.

O'Connor, D.G., et al., 1998a, *ANL–W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13478, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998b, *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13481, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998c, *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13480, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998d, *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13482, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998e, *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13483, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

UC (Regents of the University of California), 1998a, *Pit Conversion Facility, Environmental Impact Statement Data Report—Hanford Site*, LA-UR-97-2907, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998b, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford*, UCRL-ID-128275, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998c, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Hanford*, UCRL-ID-128276, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998d, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Hanford Site*, LA-UR-97-2064, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998e, *Pit Conversion Facility, Environmental Impact Statement Data Report—Idaho National Engineering and Environmental Laboratory*, LA-UR-97-2908, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998f, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Idaho National Engineering and Environmental Laboratory*, LA-UR-97-2065, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998g, *Pit Conversion Facility, Environmental Impact Statement Data Report—Pantex Plant*, LA-UR-97-2909, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998h, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Pantex Plant*, LA-UR-97-2067, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998i, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Savannah River Site,* LA-UR-97-2910, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998j, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Savannah River Site*, UCRL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998k, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Savannah River Site*, UCRL-ID-128272, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998l, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in New Facilities at Savannah River Site*, UCRL-ID-128273, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998m, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site*, UCRL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998n, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Savannah River Site*, LA-UR-97-2066, Los Alamos National Laboratory, Los Alamos, NM.

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Appendix I
Socioeconomics

This appendix presents detailed information on the potential socioeconomic impacts associated with the influx of construction workers during the construction of the three new surplus plutonium disposition facilities as well as the workers needed to operate the facilities as described in the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS). This information supports the socioeconomic assessments described in Chapter 4. Site-specific input data used in the evaluation of these socioeconomic impacts are provided or referenced where appropriate, including projections for employment, unemployment, population, housing units, student enrollment, teachers employed, police officers, firefighters, hospital beds, and doctors. Tables I–1 through I–40 present data for the four candidate sites: Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), Pantex Plant (Pantex), and Savannah River Site (SRS).

I.1 Hanford

Table I–1. Hanford Projected Site Employment

Year	Employment	Change From Previous (%)	Change From 1997 (%)
1997	12,900	–	–
2000	10,800	-16.28	-16.28
2005	11,000	1.85	-14.73
2010	20,600	87.27	59.69
2015	12,100	-41.26	-6.20
2020	11,900	-1.65	-7.75

Source: Mecca 1997:Teal memo.

Table I–2. Hanford Regional Economic Area Projected Employment and Economy, 1996–2010

Regional Economic Area	1996	2000	2005	2010
Civilian labor force	342,941	369,150	392,726	417,868
Total employment	304,710	328,081	349,068	371,451
Unemployment rate (%)	11.1	11.1	11.1	11.1

Source: DOL 1997; Washington State Office of Financial Management 1995.

Table I–3. Hanford Region of Influence Projected Population, 1996–2010

County	1996	2000	2005	2010
Benton	134,359	149,100	157,549	166,476
Franklin	45,590	50,683	54,562	58,738
ROI total	179,949	199,783	212,111	225,214

Source: DOC 1997; Washington State Office of Financial Management 1995.

Table I–4. Hanford Region of Influence Projected Number of Owner and Renter Housing Units, 1990–2010

County	1990	1996	2000	2005	2010
Benton	44,877	50,101	55,597	58,748	62,076
Franklin	13,664	16,016	17,806	19,168	20,635
ROI total	58,541	66,117	73,403	77,916	82,712

Source: DOC 1994; Washington State Office of Financial Management 1995.

Table I–5. Hanford Region of Influence Projected Student Enrollment, 1997–2010

County	1997	Capacity (%)	2000	2005	2010
Benton County	28,142	90.7	30,427	32,151	33,973
Findley	1,130	100.0	1,222	1,291	1,364
Kennewick	13,462	83.0	14,555	15,380	16,251
Kiona-Benton	1,701	100.0	1,839	1,943	2,053
Patterson	73	80.0	79	83	88
Prosser	2,794	98.0	3,021	3,192	3,373
Richland	8,982	99.5	9,711	10,262	10,843
Franklin County	10,064	97.7	10,896	11,730	12,628
Kahlotus	98	85.0	106	114	123
North Franklin	1,905	90.0	2,062	2,220	2,390
Pasco	8,048	100.0	8,713	9,380	10,098
Star School	13	65.0	14	15	16
ROI total	38,206	92.5	41,323	43,881	46,601

Source: Nemeth 1997a; Washington State Office of Financial Management 1995.

Table I–6. Hanford Region of Influence Projected Number of Teachers, 1997–2010

County	1997	Student/Teacher Ratio	2000	2005	2010
Benton County	1,785	15.8	1,929	2,039	2,154
Findley	76	14.9	82	87	92
Kennewick	822	16.4	889	939	992
Kiona-Benton	94	18.1	102	107	113
Patterson	4.5	16.2	5	5	5
Prosser	164	17.0	177	187	198
Richland	624	14.4	675	713	753
Franklin County	598	16.8	647	697	750
Kahlotus	14	7.0	15	16	18
North Franklin	132	14.4	143	154	166
Pasco	450	17.9	487	524	565
Star School	2	6.5	2	2	3
ROI total	2,383	16.0	2,577	2,736	2,905

Source: Nemeth 1997a; Washington State Office of Financial Management 1995.

Table I–7. Hanford Region of Influence Projected Number of Sworn Police Officers, 1997–2010

County	1997	2000	2005	2010
Benton	208	225	238	251
Franklin	73	79	85	92
ROI total	281	304	323	343

Source: Nemeth 1997b; Washington State Office of Financial Management 1995.

Table I–8. Hanford Region of Influence Projected Number of Firefighters, 1997–2010

County	1997	2000	2005	2010
Benton	369	399	422	445
Franklin	247	267	288	310
ROI total	616	666	710	755

Source: Nemeth 1997b; Washington State Office of Financial Management 1995.

Table I–9. Hanford Region of Influence Projected Number of Hospital Beds, 1997–2010

County	1997	2000	2005	2010
Benton	251	271	287	303
Franklin	132	143	154	166
ROI total	383	414	441	469

Source: Nemeth 1997c; Washington State Office of Financial Management 1995.

Table I–10. Hanford Region of Influence Projected Number of Doctors, 1996–2010

County	1996	2000	2005	2010
Benton	208	225	238	251
Franklin	49	53	57	61
ROI total	257	278	295	313

Source: Randolph 1997; Washington State Office of Financial Management 1995.

I.2 INEEL

Table I–11. INEEL Projected Site Employment

Year	Employment	Change From Previous (%)	Change From 1997 (%)
1997	8,300	–	–
2000	7,250	-12.65	-12.65
2005	7,250	0.00	-12.65
2010	7,250	0.00	-12.65
2015	7,250	0.00	-12.65
2020	7,050	-2.76	-15.06

Source: Abbott et al. 1997.

Table I–12. INEEL Regional Economic Area Projected Employment and Economy, 1996–2010

Regional Economic Area	1996	2000	2005	2010
Civilian labor force	150,835	162,183	170,088	178,402
Total employment	143,616	154,437	161,959	169,945
Unemployment rate (%)	4.8	4.8	4.8	4.7

Source: DOL 1997; Idaho Power 1996; State of Wyoming, Administration and Information 1996.

Table I–13. INEEL Region of Influence Projected Population, 1996–2010

County	1996	2000	2005	2010
Bannock	73,608	78,578	81,785	85,123
Bingham	41,366	44,464	46,275	48,160
Bonneville	79,670	85,695	89,202	92,852
Jefferson	18,903	20,607	21,644	22,734
ROI total	213,547	229,345	238,906	248,869

Source: DOC 1997; Idaho Power 1996; State of Wyoming, Administration and Information 1996.

Table I–14. INEEL Region of Influence Projected Number of Owner and Renter Housing Units, 1990–2010

County	1990	1996	2000	2005	2010
Bannock	25,694	28,340	30,254	31,488	32,773
Bingham	12,664	14,113	15,170	15,788	16,431
Bonneville	26,049	29,059	31,257	32,536	33,867
Jefferson	5,353	6,093	6,642	6,977	7,328
ROI total	69,760	77,605	83,323	86,788	90,399

Source: DOL 1994; Idaho Power 1996; State of Wyoming, Administration and Information 1996.

Table I–15. INEEL Region of Influence Projected Student Enrollment, 1997–2010

County	1997	Capacity (%)	2000	2005	2010
Bannock County	14,673	86.5	15,410	16,039	16,693
Marsh Valley	1,609	74.0	1,690	1,759	1,831
Pocatello	13,064	88.3	13,720	14,280	14,863
Bingham County	11,248	84.7	11,874	12,358	12,861
Aberdeen	1,019	90.0	1,076	1,120	1,165
Blackfoot	4,510	90.0	4,761	4,955	5,157
Firth	1,044	88.0	1,102	1,147	1,194
Shelley	2,300	100.0	2,428	2,527	2,630
Snake River	2,375	65.0	2,507	2,609	2,716
Bonneville County	18,737	91.8	19,790	20,600	21,443
Bonneville	7,750	95.0	8,186	8,521	8,869
Idaho Falls	10,927	90.0	11,541	12,013	12,505
Swan Valley	60	50.0	63	66	69
Jefferson County	5,510	90.6	5,878	6,174	6,485
Jefferson	4,033	90.0	4,303	4,519	4,747
Ririe	750	97.0	800	840	883
West Jefferson	727	88.0	776	815	856
ROI total	50,168	88.4	52,953	55,171	57,482

Source: Idaho Power 1996; Nemeth 1997a; State of Wyoming, Administration and Information 1996.

Table I–16. INEEL Region of Influence Projected Number of Teachers, 1997–2010

County	1997	Student/Teacher Ratio	2000	2005	2010
Bannock County	822	17.9	863	899	935
Marsh Valley	113	14.2	119	124	129
Pocatello	709	18.4	745	775	807
Bingham County	619	18.2	653	680	708
Aberdeen	61	16.7	64	67	70
Blackfoot	240	18.8	253	264	274
Firth	65	16.1	69	71	74
Shelley	121	19.0	128	133	138
Snake River	132	18.0	139	145	151
Bonneville County	930	20.1	982	1,022	1,064
Bonneville	425	18.2	449	467	486
Idaho Falls	500	21.9	528	550	572
Swan Valley	5	12.0	5	5	6
Jefferson County	299	18.4	319	335	352
Jefferson	212	19.0	226	238	250
Ririe	41	18.3	44	46	48
West Jefferson	46	15.8	49	52	54
ROI total	2,670	18.8	2,818	2,936	3,059

Source: Idaho Power 1996; Nemeth 1997a; State of Wyoming, Administration and Information 1996.

Table I–17. INEEL Region of Influence Projected Number of Sworn Police Officers, 1997–2010

County	1997	2000	2005	2010
Bannock	214	225	234	243
Bingham	53	56	58	61
Bonneville	181	191	199	207
Jefferson	27	29	31	32
ROI total	475	501	522	544

Source: Idaho Power 1996; Nemeth 1997b; State of Wyoming, Administration and Information 1996.

Table I–18. INEEL Region of Influence Projected Number of Firefighters, 1997–2010

County	1997	2000	2005	2010
Bannock	179	188	196	204
Bingham	144	152	158	165
Bonneville	149	157	164	171
Jefferson	88	94	99	104
ROI total	560	591	616	642

Source: Idaho Power 1996; Nemeth 1997b; State of Wyoming, Administration and Information 1996.

Table I–19. INEEL Region of Influence Projected Number of Hospital Beds, 1997–2010

County	1997	2000	2005	2010
Bannock	413	434	451	470
Bingham	254	268	279	290
Bonneville	312	330	343	357
Jefferson	–	–	–	–
ROI total	979	1,031	1,074	1,117

Source: Idaho Power 1996; Nemeth 1997c; State of Wyoming, Administration and Information 1996.

Table I–20. INEEL Region of Influence Projected Number of Doctors, 1996–2010

County	1996	2000	2005	2010
Bannock	139	146	152	158
Bingham	22	23	24	25
Bonneville	163	172	179	187
Jefferson	5	5	6	6
ROI total	329	347	361	376

Source: Idaho Power 1996; Randolph 1997; State of Wyoming, Administration and Information 1996.

I.3 Pantex

Table I–21. Pantex Projected Site Employment

Year	Employment	Change From Previous (%)	Change From 1997 (%)
1997	2,900	–	–
2000	2,500	-13.79	-13.79
2005	1,750	-30.00	-39.66
2010	1,750	0.00	-39.66
2015	1,750	0.00	-39.66
2020	1,750	0.00	-39.66

Source: Mason & Hanger Corporation 1997.

Table I–22. Pantex Regional Economic Area Projected Employment and Economy, 1996–2010

Regional Economic Area	1996	2000	2005	2010
Civilian labor force	250,847	259,619	269,074	278,991
Total employment	239,039	247,407	256,448	265,932
Unemployment rate (%)	4.6	4.6	4.6	4.6

Source: DOC 1997; DOL 1997; Texas State Data Center 1996; University of New Mexico 1997.

Table I–23. Pantex Region of Influence Projected Population, 1996–2010

County	1996	2000	2005	2010
Carson	6,714	6,758	6,843	6,929
Potter	108,636	112,247	115,253	118,339
Randall	97,379	102,841	108,810	115,126
ROI total	212,729	221,846	230,906	240,393

Source: DOC 1997; Texas State Data Center 1996; University of New Mexico 1997.

Table I–24. Pantex Region of Influence Projected Number of Owner and Renter Housing Units, 1990–2010

County	1990	1996	2000	2005	2010
Carson	2,856	2,884	2,903	2,939	2,976
Potter	42,927	45,085	46,584	47,831	49,112
Randall	37,807	41,032	43,333	45,849	48,510
ROI total	83,590	89,001	92,820	96,619	100,598

Source: DOC 1994, 1997; Texas State Data Center 1996; University of New Mexico 1997.

Table I–25. Pantex Region of Influence Projected Student Enrollment, 1997–2010

County	1997	Capacity (%)	2000	2005	2010
Carson County	860	76.4	864	875	886
Groom	195	55.7	196	198	201
Panhandle	125	85.0	126	127	129
White Deer	540	86.0	543	549	556
Potter County	31,707	98.8	32,494	33,364	34,258
Amarillo	29,023	100.0	29,744	30,540	31,358
Bushland	447	85.1	458	470	483
Highland Park	787	85.0	807	828	850
River Road	1,450	90.0	1,486	1,526	1,567
Randall County	7,249	100.0	7,552	7,990	8,454
Canyon	7,249	100.0	7,552	7,990	8,454
ROI total	39,816	98.4	40,910	42,230	43,598

Source: DOC 1997; Nemeth 1997a; Texas State Data Center 1996; University of New Mexico 1997.

Table I–26. Pantex Region of Influence Projected Number of Teachers, 1997–2010

County	1997	Student/Teacher Ratio	2000	2005	2010
Carson County	106	8.1	107	108	109
Groom	20	9.8	20	20	21
Panhandle	59	2.1	59	60	61
White Deer	27	20.0	27	27	28
Potter County	2,122	14.9	2,175	2,233	2,293
Amarillo	1,913	15.2	1,960	2,013	2,067
Bushland	35	12.8	36	37	38
Highland Park	54	14.6	55	57	58
River Road	120	12.1	123	126	130
Randall County	436	16.6	454	481	508
Canyon	436	16.6	454	481	508
ROI total	2,664	14.9	2,735	2,821	2,910

Source: DOC 1997; Nemeth 1997a; Texas State Data Center 1996; University of New Mexico 1997.

Table I–27. Pantex Region of Influence Projected Number of Sworn Police Officers, 1997–2010

County	1997	2000	2005	2010
Carson	16	16	16	16
Potter	445	456	468	481
Randall	81	84	89	94
ROI total	542	557	574	592

Source: DOC 1997; Nemeth 1997b; Texas State Data Center 1996; University of New Mexico 1997.

Table I–28. Pantex Region of Influence Projected Number of Firefighters, 1997–2010

County	1997	2000	2005	2010
Carson	88	88	90	91
Potter	288	295	303	311
Randall	111	116	122	129
ROI total	487	499	515	531

Source: DOC 1997; Nemeth 1997b; Texas State Data Center 1996; University of New Mexico 1997.

Table I–29. Pantex Region of Influence Projected Number of Hospital Beds, 1997–2010

County	1997	2000	2005	2010
Carson	–	–	–	–
Potter	1,208	1,238	1,271	1,305
Randall	52	54	57	61
ROI total	1,260	1,292	1,328	1,366

Source: DOC 1997; Nemeth 1997c; Texas State Data Center 1996; University of New Mexico 1997.

Table I–30. Pantex Region of Influence Projected Number of Doctors, 1996–2010

County	1996	2000	2005	2010
Carson	–	–	–	–
Potter	515	528	542	556
Randall	16	17	18	19
ROI total	531	544	560	575

Source: DOC 1997; Randolph 1997; Texas State Data Center 1996; University of New Mexico 1997.

I.4 SRS

Table I–31. SRS Projected Employment

Year	Employment	Change From Previous (%)	Change From 1997 (%)
1997	15,000	–	–
2000	14,000	-6.67	-6.67
2005	12,000	-14.29	-20.00
2010	10,000	-16.67	-33.33
2015	10,000	0.00	-33.33
2020	10,000	0.00	-33.33

Source: Knox 1997.

Table I–32. SRS Regional Economic Area Projected Employment and Economy, 1996–2010

Regional Economic Area	1996	2000	2005	2010
Civilian labor force	259,174	272,497	287,161	302,768
Total employment	239,686	252,092	265,750	280,287
Unemployment rate (%)	7.5	7.5	7.5	7.5

Source: DOC 1997; DOL 1997; Georgia Institute of Technology 1997; South Carolina Budget & Control Board 1997.

Table I–33. SRS Region of Influence Projected Population, 1996–2010

County	1996	2000	2005	2010
Aiken	133,130	142,649	154,404	167,128
Barnwell	21,640	22,362	22,953	23,560
Columbia	86,173	89,953	96,107	102,682
Edgefield	19,051	19,516	20,040	20,579
Richmond	193,784	207,980	218,937	230,472
ROI total	453,778	482,460	512,441	544,421

Source: DOC 1997; Georgia Institute of Technology 1997; South Carolina Budget & Control Board 1997.

Table I–34. SRS Region of Influence Projected Number of Owner and Renter Housing Units, 1990–2010

County	1990	1996	2000	2005	2010
Aiken	49,266	54,941	59,083	63,952	69,222
Barnwell	7,854	8,334	8,669	8,899	9,134
Columbia	23,745	28,769	32,697	34,933	37,323
Edgefield	7,290	7,716	8,014	8,229	8,450
Richmond	77,288	82,540	86,238	90,781	95,564
ROI total	165,433	182,300	194,701	206,795	219,694

Source: DOC 1990, 1997; Georgia Institute of Technology 1997; South Carolina Budget & Control Board 1997.

Table I–35. SRS Region of Influence Projected Student Enrollment, 1997–2010

County	1997	Capacity (%)	2000	2005	2010
Aiken County	24,830	100.0	26,150	28,305	30,637
Barnwell County	5,055	92.6	5,220	5,358	5,959
District 45	2,770	98.9	2,861	2,936	3,265
District 19	1,230	85.0	1,270	1,304	1,450
District 29	1,055	87.0	1,090	1,118	1,244
Columbia County	18,178	100.0	18,631	19,905	19,629
Edgefield County	4,100	95.0	4,323	4,439	4,791
Richmond County	36,841	125.0	37,514	39,490	39,556
ROI total	89,004	92.4	91,838	97,498	100,573

Source: DOC 1997; Georgia Institute of Technology 1997; Nemeth 1997a; South Carolina Budget & Control Board 1997.

Table I–36. SRS Region of Influence Projected Number of Teachers, 1997–2010

County	1997	Student/Teacher Ratio	2000	2005	2010
Aiken County	1,343	18.5	1,414	1,531	1,657
Barnwell County	304	16.6	314	322	358
District 45	115	24.1	119	122	136
District 19	82	15.0	85	87	97
District 29	107	9.9	111	113	126
Columbia County	1,085	16.8	1,112	1,188	1,172
Edgefield County	312	13.1	329	338	365
Richmond County	2,159	17.1	2,198	2,314	2,318
ROI total	5,203	17.1	5,368	5,693	5,870

Source: DOC 1997; Georgia Institute of Technology 1997; Nemeth 1997a; South Carolina Budget & Control Board 1997.

Table I–37. SRS Region of Influence Projected Number of Sworn Police Officers, 1997–2010

County	1997	2000	2005	2010
Aiken	243	256	277	300
Barnwell	45	46	47	49
Columbia	170	176	188	200
Edgefield	43	44	45	46
Richmond	472	498	524	552
ROI total	973	1,019	1,081	1,147

Source: DOC 1997; Georgia Institute of Technology 1997; Nemeth 1997b; South Carolina Budget & Control Board 1997.

Table I–38. SRS Region of Influence Projected Number of Firefighters, 1997–2010

County	1997	2000	2005	2010
Aiken	875	922	997	1,080
Barnwell	130	133	137	140
Columbia	245	253	270	289
Edgefield	150	153	157	161
Richmond	312	329	346	365
ROI total	1,712	1,789	1,908	2,034

Source: DOC 1997; Georgia Institute of Technology 1997; Nemeth 1997b; South Carolina Budget & Control Board 1997.

Table I–39. SRS Region of Influence Projected Number of Hospital Beds, 1997–2010

County	1997	2000	2005	2010
Aiken	225	237	256	278
Barnwell	53	54	56	57
Columbia	–	–	–	–
Edgefield	40	41	42	43
Richmond	3,190	3,364	3,541	3,727
ROI total	3,508	3,696	3,895	4,105

Source: DOC 1997; Georgia Institute of Technology 1997; Nemeth 1997c; South Carolina Budget & Control Board 1997.

Table I–40. SRS Region of Influence Projected Number of Doctors, 1996–2010

County	1996	2000	2005	2010
Aiken	179	189	204	221
Barnwell	11	11	12	12
Columbia	297	307	328	350
Edgefield	13	13	14	14
Richmond	1,222	1,289	1,356	1,428
ROI total	1,722	1,808	1,913	2,025

Source: DOC 1997; Georgia Institute of Technology 1997; Randolph 1997; South Carolina Budget & Control Board 1997.

I.5 REFERENCES

Abbott, D.G., A.B. Crockett, and K.S. Moor, 1997, *INEEL Affected Environment: Supplemental Data Report in Support of the Preparation of the Surplus Plutonium Disposition Environmental Impact Statement (Predecisional Draft)*, Idaho National Engineering Laboratory, Spent Fuel High-Level Waste and Related Programs Directorate, Idaho Falls, ID, June.

DOC (U.S. Department of Commerce), 1994, *County and City Data Book: 1994, Washington, DC*, Bureau of the Census, Washington, DC.

DOC (U.S. Department of Commerce), 1997, *Estimates of the Population of Counties and Demographic Components of Population Change: Annual Time Series, July 1, 1990 to July 1, 1996*, CO-96-01, Bureau of the Census, Population Estimates Program, Population Division, Washington, DC.

DOL (U.S. Department of Labor), 1997, *Local Area Unemployment Statistics, 1996*, Bureau of Labor Statistics, Office of Employment and Unemployment Statistics, Local Area Unemployment Statistics Division, Washington, DC.

Georgia Institute of Technology, 1997, *Total Population, 1980I, 1990I, 1996 Estimates, 2000 and 2010 Projections*, State Data and Research Center.

Idaho Power, 1996, *1997 County Economic Forecast (1996–2015)*, Idaho Power Co., November.

Knox, J., 1997, U.S. Department of Energy, Savannah River Operations Office, EAD, Savannah River, SC, facsimile to K. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Site Figures for DOE-HQ, Surplus Pu Disposition EIS*, July 1.

Mason & Hanger Corporation, 1997, *Pantex Plant Affected Environment Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, June 12.

Mecca, J.E., 1997, U.S. Department of Energy, Richland Operations Office, Richland, WA, memorandum to K.R. Gandee, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, *Affected Environment Data Reports for the Surplus Plutonium Disposition*, July 31.

Nemeth, D.M., 1997a, *List of School Districts Contacted for Current Operating Capacities, Student Enrollment, and Number of Teachers Employed within the Hanford, INEEL, Pantex and SRS ROIs*, Memorandum to SPD EIS Administrative Record, December 15.

Nemeth, D.M., 1997b, *List of Sheriff Offices, Police Departments, and Fire Departments Contacted for Number of Sworn Police Officers Employed and Firefighters (both Employed and Volunteer) in the Hanford, INEEL, Pantex and SRS ROIs*, Memorandum to SPD EIS Administrative Record, December 15.

Nemeth, D.M., 1997c, *List of Hospitals and Hospital Associations Contacted for Current Number of Hospital Beds Located in the Hanford, INEEL, Pantex and SRS ROIs*, Memorandum to SPD EIS Administrative Record, December 17.

Randolph, L., 1997, American Medical Association, Chicago, IL, personal communication to D. Nemeth, Science Applications International Corporation, Germantown, MD, *Information on Physicians by State and County, 1996*, August.

South Carolina Budget & Control Board, 1997, *SC Population Projections: 2005–2015*, Office of Research and Statistics.

State of Wyoming, Administration and Information, 1996, *Wyoming and County Population Estimates and Projections*, Economic Analysis Division, November.

Texas State Data Center (Texas Agricultural Experiment Station, Texas A&M University System), 1996, *Projections of the Population of Texas and Counties in Texas by Age, Sex, and Race/Ethnicity for 1990-2030*, Population Estimates and Projections Program, The Center for Demographic and Socioeconomic Research and Education, Department of Rural Sociology, February.

University of New Mexico, 1997, *New Mexico Population Projections by County,* Bureau of Business & Economic Research, April.

Washington State Office of Financial Management, 1995, *Washington State County Population Projections by Age and Sex: 1990–2020*, Forecasting Division, Olympia, WA.

Appendix J
Human Health Risks

This appendix presents detailed information on the potential impacts to humans associated with incident-free (normal) releases of radioactivity from the proposed surplus plutonium disposition facilities. This information supports the human health assessments described in Chapter 4. In addition, site-specific input data used in the evaluation of these human health impacts are also provided or referenced where appropriate. The surplus plutonium disposition facilities would be at one or more of four U.S. Department of Energy (DOE) candidate sites: the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), the Pantex Plant (Pantex), and the Savannah River Site (SRS). Information is also presented on the human health impacts of mixed oxide (MOX) fuel lead assembly fabrication activities at five potential DOE sites: Argonne National Laboratory–West (ANL–W) at INEEL, Hanford, Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), and SRS.

J.1 HANFORD

J.1.1 Assessment Data

To perform the dose assessments for the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), different types of data were collected and generated. In addition, calculational assumptions were made. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessments.

J.1.1.1 Meteorological Data

The meteorological data used for the Hanford dose assessments was in the form of a joint frequency data (JFD) file. A JFD file is a table that lists the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operation. Table J–1 presents the JFD used in the dose assessments for Hanford.

J.1.1.2 Population Data

The Hanford population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2010 (about midlife of operations) for areas within 80 km (50 mi) of the locations for the proposed surplus plutonium disposition facilities. The site population in 2010 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at the Fuels and Materials Examination Facility (FMEF) in the 400 Area, the location from which radionuclides are assumed to be released during incident-free operations. Table J–2 presents the population data used for the dose assessments at Hanford.

J.1.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distribution described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each

Table J–1. Hanford 1983–1991 Joint Frequency Distributions at 61-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.12	0.1	0.08	0.11	0.14	0.15	0.1	0.08	0.14	0.08	0.05	0.06	0.07	0.05	0.05	0.07
	B	0.05	0.05	0.05	0.05	0.06	0.05	0.04	0.03	0.07	0.03	0.02	0.02	0.03	0.02	0.03	0.03
	C	0.06	0.04	0.04	0.04	0.06	0.04	0.07	0.05	0.04	0.04	0.03	0.01	0.05	0.03	0.04	0.04
	D	0.32	0.23	0.2	0.18	0.25	0.26	0.24	0.28	0.36	0.26	0.19	0.15	0.22	0.19	0.22	0.21
	E	0.19	0.14	0.1	0.1	0.13	0.13	0.14	0.19	0.37	0.22	0.18	0.17	0.23	0.19	0.19	0.19
	F	0.22	0.14	0.1	0.09	0.13	0.11	0.15	0.2	0.34	0.2	0.2	0.12	0.2	0.14	0.16	0.16
	G	0.13	0.08	0.06	0.03	0.06	0.07	0.07	0.18	0.22	0.13	0.09	0.07	0.12	0.09	0.12	0.09
2.7	A	0.32	0.28	0.28	0.28	0.39	0.37	0.37	0.34	0.55	0.32	0.16	0.09	0.17	0.13	0.13	0.15
	B	0.12	0.09	0.08	0.06	0.12	0.07	0.1	0.11	0.15	0.12	0.05	0.05	0.05	0.04	0.06	0.07
	C	0.13	0.08	0.08	0.05	0.09	0.08	0.1	0.11	0.16	0.08	0.04	0.03	0.05	0.03	0.06	0.08
	D	0.58	0.41	0.37	0.26	0.38	0.33	0.46	0.59	0.85	0.49	0.25	0.15	0.33	0.36	0.47	0.41
	E	0.32	0.2	0.19	0.12	0.21	0.21	0.25	0.45	0.68	0.46	0.31	0.24	0.37	0.29	0.38	0.33
	F	0.35	0.23	0.15	0.07	0.12	0.09	0.18	0.36	0.64	0.31	0.23	0.16	0.18	0.18	0.23	0.22
	G	0.18	0.12	0.06	0.03	0.04	0.04	0.08	0.2	0.3	0.16	0.1	0.04	0.08	0.1	0.15	0.16
4.7	A	0.39	0.31	0.21	0.1	0.13	0.13	0.15	0.19	0.77	0.51	0.17	0.13	0.19	0.15	0.16	0.17
	B	0.14	0.09	0.06	0.04	0.04	0.04	0.04	0.07	0.2	0.16	0.06	0.04	0.03	0.02	0.06	0.06
	C	0.1	0.1	0.06	0.03	0.03	0.03	0.04	0.06	0.16	0.16	0.04	0.02	0.05	0.04	0.06	0.07
	D	0.59	0.38	0.26	0.14	0.16	0.14	0.32	0.55	0.97	0.75	0.27	0.15	0.34	0.46	0.63	0.55
	E	0.41	0.21	0.15	0.09	0.1	0.11	0.28	0.6	1.02	0.71	0.37	0.27	0.5	0.53	0.6	0.43
	F	0.37	0.22	0.11	0.06	0.07	0.06	0.17	0.48	0.73	0.44	0.21	0.11	0.16	0.2	0.37	0.29
	G	0.19	0.11	0.05	0.02	0.02	0.01	0.04	0.19	0.26	0.14	0.06	0.02	0.04	0.07	0.19	0.13
7.2	A	0.22	0.17	0.08	0.02	0.02	0.01	0.03	0.05	0.32	0.63	0.28	0.17	0.23	0.11	0.19	0.15
	B	0.07	0.05	0.01	0.01	0	0	0.02	0.01	0.1	0.22	0.06	0.05	0.05	0.03	0.07	0.03
	C	0.04	0.05	0.02	0.01	0	0.01	0.02	0.02	0.07	0.18	0.06	0.04	0.03	0.03	0.05	0.04
	D	0.27	0.19	0.09	0.04	0.02	0.04	0.1	0.25	0.65	0.86	0.37	0.2	0.29	0.5	0.75	0.4
	E	0.27	0.18	0.07	0.02	0.02	0.04	0.15	0.43	0.73	0.74	0.34	0.2	0.39	0.73	0.94	0.44
	F	0.21	0.14	0.06	0.02	0.02	0.01	0.09	0.33	0.52	0.39	0.14	0.07	0.09	0.16	0.45	0.26
	G	0.13	0.08	0.04	0.01	0.01	0.01	0.03	0.11	0.19	0.13	0.04	0.02	0.01	0.04	0.14	0.13

Table J-1. Hanford 1983–1991 Joint Frequency Distributions at 61-m Height (Continued)

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
9.8	A	0.05	0.05	0.03	0.01	0	0	0	0.01	0.08	0.29	0.21	0.12	0.12	0.08	0.12	0.04
	B	0.02	0.01	0.01	0	0	0	0	0	0.02	0.08	0.04	0.04	0.04	0.02	0.03	0.02
	C	0.02	0.02	0.01	0	0	0	0	0.01	0.02	0.08	0.06	0.03	0.03	0.03	0.03	0.01
	D	0.09	0.08	0.02	0.01	0	0.01	0.03	0.04	0.24	0.58	0.32	0.16	0.19	0.33	0.57	0.14
	E	0.1	0.12	0.04	0.01	0	0.01	0.06	0.17	0.37	0.51	0.26	0.13	0.17	0.43	0.73	0.22
	F	0.1	0.11	0.03	0.01	0.01	0	0.03	0.14	0.21	0.2	0.07	0.02	0.03	0.08	0.23	0.16
	G	0.05	0.04	0.02	0	0	0	0.01	0.07	0.09	0.05	0.03	0	0	0.02	0.1	0.07
13.0	A	0.01	0.02	0	0	0	0	0	0	0.02	0.09	0.1	0.1	0.08	0.03	0.07	0.01
	B	0	0.01	0	0	0	0	0	0	0.01	0.03	0.04	0.04	0.02	0.01	0.03	0.01
	C	0	0.01	0	0	0	0	0	0	0.01	0.02	0.04	0.02	0.02	0.01	0.02	0.01
	D	0.03	0.03	0.01	0	0	0	0.01	0.02	0.07	0.27	0.24	0.12	0.09	0.19	0.32	0.05
	E	0.04	0.08	0.03	0.01	0	0	0.02	0.05	0.13	0.32	0.25	0.1	0.07	0.2	0.33	0.07
	F	0.04	0.05	0.02	0.01	0	0	0.02	0.06	0.08	0.13	0.05	0.01	0.01	0.02	0.1	0.06
	G	0.01	0.01	0	0	0	0	0	0.02	0.02	0.03	0.01	0	0	0.01	0.05	0.04
16.0	A	0	0.01	0	0	0	0	0	0	0	0.02	0.06	0.03	0.02	0.01	0.01	0
	B	0	0.01	0	0	0	0	0	0	0	0.01	0.02	0.01	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01	0.01	0	0.01	0
	D	0.02	0.03	0.01	0.01	0	0	0	0.01	0.01	0.11	0.19	0.06	0.03	0.06	0.1	0.01
	E	0.01	0.04	0.03	0	0	0	0.01	0.02	0.05	0.16	0.16	0.04	0.02	0.04	0.09	0.01
	F	0.01	0.03	0	0	0	0	0	0.03	0.04	0.05	0.02	0	0.01	0	0.01	0.02
	G	0	0	0	0	0	0	0	0.02	0.02	0.02	0	0	0	0	0.02	0
19.0	A	0.02	0.03	0	0	0	0	0	0	0	0.01	0.05	0.01	0.01	0	0.01	0
	B	0	0.03	0	0	0	0	0	0	0	0	0.02	0	0	0	0	0
	C	0.01	0.02	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0
	D	0.03	0.09	0	0	0	0	0	0	0	0.09	0.22	0.04	0.03	0.01	0.02	0
	E	0.03	0.1	0.02	0	0	0	0	0.02	0.02	0.1	0.14	0.02	0.01	0.01	0.01	0
	F	0.02	0.04	0.01	0	0	0	0	0.03	0.03	0.04	0.02	0	0	0	0.01	0
	G	0	0.01	0	0	0	0	0	0.02	0.02	0.02	0	0	0	0	0.01	0

Source: Neitzel 1996.

county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the Hanford population from the ingestion pathway. The consumption rates used in the dose assessments were those for the maximally exposed individual (MEI) and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. Hanford food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

Table J–2. Projected Hanford Population Surrounding FMEF for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	4,265	44,747	1,141	7,041	19,608	**76,802**
SSW	0	0	0	0	2	1,515	2,758	438	2,976	3,951	**11,640**
SW	0	0	0	0	42	1,388	4,788	316	227	2,047	**8,808**
WSW	0	0	0	0	0	54	2,387	17,154	3,588	325	**23,508**
W	0	0	0	0	0	0	766	6,201	28,142	15,966	**51,075**
WNW	0	0	0	0	0	0	5	879	1,233	9,074	**11,191**
NW	0	0	0	0	0	0	0	645	411	178	**12,34**
NNW	0	0	0	0	0	0	0	1,097	1,437	1,491	**4,025**
N	0	0	0	0	0	0	0	1,153	3,773	2,749	**7,675**
NNE	0	0	0	0	0	18	468	5,523	1,514	25,879	**33,402**
NE	0	0	0	0	0	95	827	7,348	3,019	1,256	**12,545**
ENE	0	0	0	0	0	345	1,544	3,737	423	446	**6,495**
E	0	0	0	0	0	425	948	451	351	327	**2,502**
ESE	0	0	0	0	0	434	655	347	266	326	**2,028**
SE	0	0	0	0	0	419	1,313	1,736	396	1,459	**5,323**
SSE	0	0	0	0	0	6,989	87,249	33,689	608	986	**129,521**
Total	**0**	**0**	**0**	**0**	**44**	**15,947**	**148,455**	**81,855**	**55,405**	**86,068**	**387,774**

Key: FMEF, Fuels and Materials Examination Facility.
Source: DOC 1992.

J.1.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are provided in the data reports for the pit conversion, immobilization, and MOX facilities (UC 1998a, 1998b, 1998c, 1998d).

J.1.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the proposed surplus plutonium disposition facilities at Hanford, the following additional assumptions and factors were considered, in accordance with the guidelines established in U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).
- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

- Reported stack heights were used for atmospheric releases. The resultant doses were conservative as use of the actual stack height instead of the effective stack height negates plume rise.

- The calculated doses are 50-year committed doses from 1 year of intake.

J.1.2 Facilities

The following sections present all viable radiological impact scenarios that could be associated with different combinations of incident-free facility operations at Hanford.

J.1.2.1 Pit Conversion Facility

J.1.2.1.1 Construction of Pit Conversion Facility

No radiological risk would be incurred by members of the public from construction and modification of a pit conversion facility at Hanford. According to recent surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.1.2 Operation of Pit Conversion Facility

Tables J–3 and J–4 present the incident-free radiological impacts of the operation of a pit conversion facility at Hanford.

Table J–3. Potential Radiological Impacts on the Public of Operation of Pit Conversion Facility in FMEF at Hanford

Population within 80 km for year 2010	
Dose (person-rem)	6.9
Percent of natural background[a]	5.9×10^{-3}
10-year latent fatal cancers	0.034
Maximally exposed individual	
Annual dose (mrem)	0.017
Percent of natural background[a]	5.7×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	0.017
10-year latent fatal cancer risk	8.5×10^{-8}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).

Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–4. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion Facility in FMEF at Hanford

Number of badged workers	383
Total dose (person-rem/yr)	192
10-year latent fatal cancers	0.77
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

J.1.2.2 Immobilization Facility

J.1.2.2.1 Construction of Immobilization Facility

No radiological risk would be incurred by members of the public from the construction and modification of an immobilization (ceramic or glass) facility at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.2.2 Operation of Immobilization Facility

Tables J–5 and J–6 present all possible incident-free radiological impact scenarios for the operation of a ceramic or glass immobilization facility at Hanford.

Table J–5. Potential Radiological Impacts on the Public of Operation of Immobilization Facility in FMEF at Hanford

	17 t		50 t	
Impact	**Ceramic**	**Glass**	**Ceramic**	**Glass**
Population within 80 km for year 2010				
Dose (person-rem)	7.8×10^{-3}	7.1×10^{-3}	0.016	0.015
Percent of natural background[a]	6.7×10^{-6}	6.1×10^{-6}	1.4×10^{-5}	1.3×10^{-5}
10-year latent fatal cancers	3.9×10^{-5}	3.6×10^{-5}	8.0×10^{-5}	7.5×10^{-5}
Maximally exposed individual				
Annual dose (mrem)	1.1×10^{-4}	9.7×10^{-5}	2.2×10^{-4}	2.0×10^{-4}
Percent of natural background[a]	3.7×10^{-5}	3.2×10^{-5}	7.3×10^{-5}	6.7×10^{-5}
10-year latent fatal cancer risk	5.5×10^{-10}	4.9×10^{-10}	1.1×10^{-9}	1.0×10^{-9}
Average exposed individual within 80 km[b]				
Annual dose (mrem)	2.0×10^{-5}	1.8×10^{-5}	4.1×10^{-5}	3.9×10^{-5}
10-year latent fatal cancer risk	1.0×10^{-10}	9.0×10^{-11}	2.1×10^{-10}	2.0×10^{-10}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–6. Potential Radiological Impacts on Involved Workers of Operation of Immobilization Facility in FMEF at Hanford

Impact	17 t		50 t	
	Ceramic	Glass	Ceramic	Glass
Number of badged workers	258	258	290	290
Total dose (person-rem/yr)	194	194	218	218
10-year latent fatal cancers	0.77	0.77	0.87	0.87
Average worker dose (mrem/yr)	750	750	750	750
10-year latent fatal cancer risk	3.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}

Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998b, 1998c.

J.1.2.3 MOX Facility

J.1.2.3.1 Construction of MOX Facility

No radiological risk would be incurred by members of the public from the construction and modification of a MOX facility at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.3.2 Operation of MOX Facility

Tables J–7 and J–8 present the incident-free radiological impacts of the operation of a MOX facility at Hanford. The facility would either be located within the existing FMEF or a new facility would be built adjacent to FMEF.

Table J–7. Potential Radiological Impacts on the Public of Operation of MOX Facility in FMEF or New Construction at Hanford

Impact	FMEF[a]	New[a]
Population dose within 80 km for year 2010		
Dose (person-rem)	0.051	0.11
Percent of natural background[b]	4.4×10^{-5}	9.5×10^{-5}
10-year latent fatal cancers	2.6×10^{-4}	5.5×10^{-4}
Maximally exposed individual		
Annual dose (mrem)	6.9×10^{-4}	1.8×10^{-3}
Percent of natural background[b]	2.3×10^{-4}	6.0×10^{-4}
10-year latent fatal cancer risk	3.5×10^{-9}	9.0×10^{-9}
Average exposed individual within 80 km[c]		
Annual dose (mrem)	1.3×10^{-4}	2.8×10^{-4}
10-year latent fatal cancer risk	6.5×10^{-10}	1.4×10^{-9}

[a] The difference in impacts is attributable to different stack heights.
[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–8. Potential Radiological Impacts on Involved Workers of Operation of MOX Facility in FMEF or New Construction at Hanford

Number of badged workers	350
Total dose (person-rem/yr)	175
10-year latent fatal cancers	0.70
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998d.

J.1.2.4 Pit Conversion and Immobilization Facilities

J.1.2.4.1 Construction of Pit Conversion and Immobilization Facilities

No radiological risk would be incurred by members of the public from the construction and modification of pit conversion and immobilization (ceramic or glass) facilities at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.4.2 Operation of Pit Conversion and Immobilization Facilities

Tables J–9 and J–10 present all possible incident-free radiological impact scenarios for the operation of the pit conversion and immobilization facilities at Hanford.

Table J–9. Potential Radiological Impacts on the Public of Operation of Pit Conversion and Immobilization Facilities in FMEF at Hanford

Impact	Pit Conversion	Immobilization (50 t) Ceramic	Immobilization (50 t) Glass	Total[a]
Population within 80 km for year 2010				
Dose (person-rem)	6.9	0.016	0.015	6.9
Percent of natural background[b]	5.9×10^{-3}	1.4×10^{-5}	1.3×10^{-5}	5.9×10^{-3}
10-year latent fatal cancers	0.034	8.0×10^{-5}	7.5×10^{-5}	0.034
Maximally exposed individual				
Annual dose (mrem)	0.017	2.2×10^{-4}	2.0×10^{-4}	0.017
Percent of natural background[b]	5.7×10^{-3}	7.3×10^{-5}	6.7×10^{-5}	5.8×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	1.1×10^{-9}	1.0×10^{-9}	8.6×10^{-8}
Average exposed individual within 80 km[c]				
Annual dose (mrem)	0.017	4.1×10^{-5}	3.9×10^{-5}	0.017
10-year latent fatal cancer risk	8.5×10^{-8}	2.1×10^{-10}	2.0×10^{-10}	8.5×10^{-8}

[a] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–10. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion and Immobilization Facilities in FMEF at Hanford

Impact	Pit Conversion	Immobilization (50 t) Ceramic	Immobilization (50 t) Glass	Total
Number of badged workers	383	290	290	673
Total dose (person-rem/yr)	192	218	218	410
10-year latent fatal cancers	0.77	0.87	0.87	1.6
Average worker dose (mrem/yr)	500	750	750	608[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.
Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998a, 1998b, 1998c.

J.1.2.5 Pit Conversion and MOX Facilities

J.1.2.5.1 Construction of Pit Conversion and MOX Facilities

No radiological risk would be incurred by members of the public from the modification of FMEF for pit disassembly and conversion and MOX fuel fabrication or construction of new MOX facility at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.5.2 Operation of Pit Conversion and MOX Facilities

Tables J–11 and J–12 present the incident-free radiological impacts of the operation of the pit conversion and MOX facilities at Hanford.

Table J–11. Potential Radiological Impacts on the Public of Operation of Pit Conversion and MOX Facilities in FMEF or New MOX Facility at Hanford

Impact	Pit Conversion	MOX: FMEF	MOX: New	Total[a]
Population within 80 km for year 2010				
Dose (person-rem)	6.9	0.051	0.11	7.0
Percent of natural background[b]	5.9×10^{-3}	4.4×10^{-5}	9.5×10^{-5}	6.0×10^{-3}
10-year latent fatal cancers	0.034	2.6×10^{-4}	5.5×10^{-4}	0.035
Maximally exposed individual				
Annual dose (mrem)	0.017	6.9×10^{-4}	1.8×10^{-3}	0.019
Percent of natural background[b]	5.7×10^{-3}	2.3×10^{-4}	6.0×10^{-4}	6.3×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	3.5×10^{-9}	9.0×10^{-9}	9.4×10^{-8}
Average exposed individual within 80 km[c]				
Annual dose (mrem)	0.017	1.3×10^{-4}	2.8×10^{-4}	0.017
10-year latent fatal cancer risk	8.5×10^{-8}	6.5×10^{-10}	1.4×10^{-9}	8.6×10^{-8}

[a] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–12. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion and MOX Facilities in FMEF or New MOX Facility at Hanford

Impact	Pit Conversion	MOX (FMEF or New)	Total
Number of badged workers	383	350	733
Total dose (person-rem/yr)	192	175	367
10-year latent fatal cancers	0.77	0.70	1.5
Average worker dose (mrem/yr)	500	500	500[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}

[a] Represents an average of the doses for both facilities.
Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998a, 1998d.

J.1.2.6 Immobilization and MOX Facilities

J.1.2.6.1 Construction of Immobilization and MOX Facilities

No radiological risk would be incurred by members of the public from the modification of FMEF for collocating plutonium conversion and immobilization (ceramic or glass) and MOX fuel fabrication or construction of a new MOX facility at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.6.2 Operation of Immobilization and MOX Facilities

Tables J–13 and J–14 present the incident-free radiological impacts of the operation of the immobilization and MOX facilities at Hanford.

Table J–13. Potential Radiological Impacts on the Public of Operation of Collocating Immobilization and MOX Facilities in FMEF or New MOX Facility at Hanford

Impact	Immobilization (17 t)		MOX		Total[a]
	Ceramic	Glass	FMEF	New	
Population within 80 km for year 2010					
Dose (person-rem)	7.8×10^{-3}	7.1×10^{-3}	0.051	0.11	0.12
Percent of natural background[b]	6.7×10^{-6}	6.1×10^{-6}	4.4×10^{-5}	9.5×10^{-5}	1.0×10^{-4}
10-year latent fatal cancers	3.9×10^{-5}	3.6×10^{-5}	2.6×10^{-4}	5.5×10^{-4}	5.9×10^{-4}
Maximally exposed individual					
Annual dose (mrem)	1.1×10^{-4}	9.7×10^{-5}	6.9×10^{-4}	1.8×10^{-3}	1.9×10^{-3}
Percent of natural background[b]	3.7×10^{-5}	3.2×10^{-5}	2.3×10^{-4}	6.0×10^{-4}	6.4×10^{-4}
10-year latent fatal cancer risk	5.5×10^{-10}	4.9×10^{-10}	3.5×10^{-9}	9.0×10^{-9}	9.5×10^{-9}
Average exposed individual within 80 km[c]					
Annual dose (mrem)	2.0×10^{-5}	1.8×10^{-5}	1.3×10^{-4}	2.8×10^{-4}	3.0×10^{-4}
10-year latent fatal cancer risk	1.0×10^{-10}	9.0×10^{-11}	6.5×10^{-10}	1.4×10^{-9}	1.5×10^{-9}

[a] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–14. Potential Radiological Impacts on Involved Workers of Operation of Collocating Immobilization and MOX Facilities in FMEF or New MOX Facility at Hanford

Impact	Immobilization (17 t)		MOX	Total
	Ceramic	Glass	(FMEF or New)	
Number of badged workers	258	258	350	608
Total dose (person-rem/yr)	194	194	175	369
10-year latent fatal cancers	0.77	0.77	0.70	1.5
Average worker dose (mrem/yr)	750	750	500	606[a]
10-year latent fatal cancer risk	3.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.4×10^{-3}

[a] Represents an average of the doses for both facilities.
Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998b, 1998c, 1998d.

J.1.2.7 Pit Conversion, Immobilization, and MOX Facilities

J.1.2.7.1 Construction of Pit Conversion, Immobilization, and MOX Facilities

No radiological risk would be incurred by members of the public from the modification of FMEF for pit disassembly and conversion and plutonium conversion and immobilization (ceramic or glass) and construction of a new MOX facility at Hanford. According to recent radiation surveys conducted at the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.7.2 Operation of Pit Conversion, Immobilization, and MOX Facilities

Tables J–15 and J–16 present all possible incident-free radiological impact scenarios for operating all three facilities at Hanford.

Table J–15. Potential Radiological Impacts on the Public of Operation of Pit Conversion and Immobilization Facilities in FMEF and New MOX Facility at Hanford

Impact	Pit Conversion	Immobilization (17 t) Ceramic	Immobilization (17 t) Glass	MOX FMEF	MOX New	Total[a]
Population within 80 km for year 2010						
Dose (person-rem)	6.9	7.8×10^{-3}	7.1×10^{-3}	0.051	0.11	7.0
Percent of natural background[b]	5.9×10^{-3}	6.7×10^{-6}	6.1×10^{-6}	4.4×10^{-5}	9.5×10^{-5}	6.0×10^{-3}
10-year latent fatal cancers	0.034	3.9×10^{-5}	3.6×10^{-5}	2.6×10^{-4}	5.5×10^{-4}	0.035
Maximally exposed individual						
Annual dose (mrem)	0.017	1.1×10^{-4}	9.7×10^{-5}	6.9×10^{-4}	1.8×10^{-3}	0.019
Percent of natural background[b]	5.7×10^{-3}	3.7×10^{-5}	3.2×10^{-5}	2.3×10^{-4}	6.0×10^{-4}	6.3×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	5.5×10^{-10}	4.9×10^{-10}	3.5×10^{-9}	9.0×10^{-9}	9.5×10^{-8}
Average exposed individual within 80 km[c]						
Annual dose (mrem)	0.017	2.0×10^{-5}	1.8×10^{-5}	1.3×10^{-4}	2.8×10^{-4}	0.017
10-year latent fatal cancer risk	8.5×10^{-8}	1.0×10^{-10}	9.0×10^{-11}	6.5×10^{-10}	1.4×10^{-9}	8.7×10^{-8}

a Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from all three facilities.

b The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

c Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).

Key: FMEF, Fuels and Materials Examination Facility.

Source: Model results.

Table J–16. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion and Immobilization Facilities in FMEF and New MOX Facility at Hanford

Impact	Pit Conversion	Immobilization (17 t) Ceramic	Immobilization (17 t) Glass	MOX (FMEF or New)	Total
Number of badged workers	383	258	258	350	991
Total dose (person-rem/yr)	192	194	194	175	561
10-year latent fatal cancers	0.77	0.77	0.77	0.70	2.2
Average worker dose (mrem/yr)	500	750	750	500	565[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.3×10^{-3}

[a] Represents an average of the doses for all three facilities.

Key: FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998a, 1998b, 1998c, 1998d.

J.2 INEEL

J.2.1 Assessment Data

To perform the dose assessments for the SPD EIS, different types of data were collected and generated. In addition, calculational assumptions were made. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) that were used for the assessments.

J.2.1.1 Meteorological Data

The meteorological data used for the INEEL dose assessments was in the form of JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operation. Table J–17 presents the JFD used in the dose assessments for INEEL.

J.2.1.2 Population Data

The INEEL population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2010 (about midlife of operations) for areas within 80 km (50 mi) of the locations for the proposed surplus plutonium disposition facilities. The site population in 2010 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at the Idaho Nuclear Technology and Engineering Center (INTEC), the location from which radionuclides are assumed to be released during incident-free operations. Table J–18 presents the population data used for the dose assessments at INEEL.

J.2.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distribution described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII–leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the INEEL population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. INEEL food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

J.2.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are provided in the data reports for the pit conversion and MOX facilities (UC 1998e, 1998f).

Table J–17. INEEL 1987–1991 Joint Frequency Distributions at 61-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1.0	A	0.2	0.31	0.28	0.21	0.2	0.19	0.24	0.22	0.17	0.16	0.11	0.11	0.1	0.11	0.09	0.15
	B	0.04	0.06	0.03	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.01	0.01	0.01	0	0	0.01
	C	0.04	0.07	0.07	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
	D	0.15	0.26	0.15	0.08	0.03	0.05	0.04	0.07	0.07	0.07	0.04	0.05	0.05	0.05	0.05	0.08
	E	0.14	0.17	0.15	0.08	0.07	0.07	0.04	0.06	0.05	0.07	0.06	0.04	0.04	0.05	0.06	0.06
	F	0.4	0.46	0.44	0.3	0.23	0.2	0.16	0.18	0.13	0.16	0.15	0.16	0.17	0.16	0.18	0.27
2.5	A	0.25	0.45	0.58	0.49	0.4	0.34	0.31	0.49	0.63	0.66	0.57	0.32	0.24	0.14	0.18	0.18
	B	0.06	0.18	0.21	0.11	0.03	0.02	0.02	0.05	0.08	0.12	0.08	0.05	0.03	0.01	0.01	0.02
	C	0.15	0.35	0.4	0.09	0.02	0.01	0.02	0.05	0.11	0.1	0.12	0.03	0.04	0.02	0.01	0.03
	D	0.55	1.78	1.05	0.2	0.07	0.04	0.08	0.1	0.17	0.3	0.32	0.2	0.1	0.07	0.08	0.12
	E	0.32	0.75	0.52	0.15	0.07	0.04	0.06	0.09	0.09	0.17	0.15	0.18	0.07	0.06	0.07	0.09
	F	0.77	1.65	1.38	0.67	0.34	0.24	0.21	0.27	0.31	0.51	0.47	0.48	0.35	0.32	0.34	0.38
4.5	A	0.02	0.05	0.05	0.03	0.02	0.01	0.02	0.04	0.08	0.1	0.09	0.08	0.02	0.02	0.02	0.01
	B	0.07	0.12	0.16	0.09	0.04	0.03	0.04	0.12	0.2	0.39	0.4	0.2	0.1	0.05	0.08	0.06
	C	0.07	0.19	0.33	0.13	0.02	0.02	0.02	0.08	0.14	0.33	0.58	0.21	0.07	0.05	0.03	0.06
	D	0.45	2.59	2.36	0.33	0.07	0.05	0.08	0.22	0.36	0.91	1.18	0.7	0.22	0.12	0.12	0.21
	E	0.34	1.26	0.93	0.17	0.04	0.03	0.06	0.11	0.21	0.34	0.49	0.38	0.15	0.08	0.12	0.17
	F	0.35	1.2	1.25	0.37	0.12	0.06	0.04	0.15	0.17	0.33	0.43	0.34	0.18	0.08	0.12	0.16
6.9	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
	C	0.06	0.07	0.08	0.03	0.02	0.01	0.02	0.07	0.1	0.23	0.46	0.27	0.1	0.04	0.05	0.04
	D	0.67	1.47	1.6	0.35	0.06	0.03	0.08	0.26	0.4	1.28	2.95	1.78	0.44	0.16	0.08	0.4
	E	0.15	0.8	0.8	0.16	0.03	0.01	0.06	0.13	0.13	0.33	0.88	0.69	0.11	0.02	0.01	0.08
	F	0.05	0.2	0.25	0.07	0.01	0.01	0	0.02	0.02	0.01	0.1	0.11	0.01	0.01	0	0.01
9.6	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0	0	0
	D	0.64	0.61	0.74	0.16	0.02	0.01	0.04	0.16	0.29	1.1	3.53	1.98	0.38	0.12	0.07	0.26
	E	0.03	0.12	0.17	0.07	0	0	0.01	0.03	0.03	0.06	0.37	0.28	0.04	0.01	0	0
	F	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
13.2	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0.25	0.25	0.18	0.05	0	0	0.02	0.08	0.16	0.55	2.88	2.13	0.18	0.11	0.01	0.05
	E	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Next Section

Table J–17. INEEL 1987–1991 Joint Frequency Distributions at 61-m Height (Continued)

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
19.0	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0.01	0.05	0.01	0.01	0	0	0	0	0	0.04	0.47	0.48	0.01	0.01	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25.0	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Sagendorf 1992.

Table J–18. Projected INEEL Population Surrounding INTEC for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	32	204	340	1,222	3,624	**5,422**
SSW	0	0	0	0	0	22	92	182	335	445	**1,076**
SW	0	0	0	0	0	22	87	117	163	304	**693**
WSW	0	0	0	0	0	0	87	136	149	262	**634**
W	0	0	0	0	0	0	87	180	392	280	**939**
WNW	0	0	0	0	0	0	269	519	445	311	**1,544**
NW	0	0	0	0	0	6	384	620	772	720	**2,502**
NNW	0	0	0	0	0	6	96	97	315	173	**687**
N	0	0	0	0	0	0	25	45	77	100	**247**
NNE	0	0	0	0	0	0	25	48	170	161	**404**
NE	0	0	0	0	0	0	0	285	652	342	**1,279**
ENE	0	0	0	0	0	0	0	332	575	1,057	**1,964**
E	0	0	0	0	0	0	0	506	1,203	12,055	**13,764**
ESE	0	0	0	0	0	0	208	947	1,536	103,127	**105,818**
SE	0	0	0	0	0	0	219	374	16,764	11,931	**29,288**
SSE	0	0	0	0	0	20	212	346	7,427	8,500	**16,505**
Total	**0**	**0**	**0**	**0**	**0**	**108**	**1,995**	**5,074**	**32,197**	**143,392**	**182,766**

Key: INTEC, Idaho Nuclear Technology and Engineering Center.
Source: DOC 1992.

Next Section

J.2.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the proposed surplus plutonium disposition facilities at INEEL, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).
- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).
- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.
- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.
- Reported stack heights were used for atmospheric releases. The resultant doses were conservative as use of the actual stack height instead of the effective stack height negates plume rise.
- The calculated doses are 50-year committed doses from 1 year of intake.

J.2.2 Facilities

The following sections present all viable radiological impact scenarios that could be associated with different combinations of incident-free facility operations at INEEL.

J.2.2.1 Pit Conversion Facility

J.2.2.1.1 Construction of Pit Conversion Facility

No radiological risk would be incurred by members of the public from construction and modification of a pit conversion facility in the Fuel Processing Facility (FPF) at INEEL. According to a recent radiation survey (Mitchell et al. 1997) conducted in the INTEC area, a construction worker could receive about 5 mrem/yr above natural background levels from exposure to radiation deriving from other activities, past or present, at the site. Construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

J.2.2.1.2 Operation of Pit Conversion Facility

Tables J–19 and J–20 present the incident-free radiological impacts of the operation of a pit conversion facility at INEEL.

Table J–19. Potential Radiological Impacts on the Public of Operation of Pit Conversion Facility in FPF at INEEL

Population within 80 km for year 2010	
Dose (person-rem)	2.2
Percent of natural background[a]	3.3×10^{-3}
10-year latent fatal cancers	0.011
Maximally exposed individual	
Annual dose (mrem)	0.015
Percent of natural background[a]	4.2×10^{-3}
10-year latent fatal cancer risk	7.5×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	0.012
10-year latent fatal cancer risk	6.0×10^{-8}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2010 (182,800).
Key: FPF, Fuel Processing Facility.
Source: Model results.

Table J–20. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion Facility in FPF at INEEL

Number of badged workers	341
Total dose (person-rem/yr)	170
10-year latent fatal cancers	0.68
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Key: FPF, Fuel Processing Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998e.

J.2.2.2 MOX Facility

J.2.2.2.1 Construction of MOX Facility

No radiological risk would be incurred by members of the public from the construction of a new MOX facility at INEEL. According to a recent radiation survey (Mitchell et al. 1997) conducted in the INTEC area, a construction worker could receive about 5 mrem/yr above natural background levels from exposure to radiation deriving from other activities, past or present, at the site. Construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

J.2.2.2.2 Operation of MOX Facility

Tables J–21 and J–22 present the incident-free radiological impacts of the operation of a MOX facility at INEEL.

Table J–21. Potential Radiological Impacts on the Public of Operation of New MOX Facility at INEEL

Population within 80 km for year 2010	
Dose (person-rem)	0.014
Percent of natural background[a]	2.1×10^{-5}
10-year latent fatal cancers	7.0×10^{-5}
Maximally exposed individual	
Annual dose (mrem)	1.2×10^{-3}
Percent of natural background[a]	3.3×10^{-4}
10-year latent fatal cancer risk	6.0×10^{-9}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	7.7×10^{-5}
10-year latent fatal cancer risk	3.9×10^{-10}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2010 (182,800).
Source: Model results.

Table J–22. Potential Radiological Impacts on Involved Workers of Operation of New MOX Facility at INEEL

Number of badged workers	350
Total dose (person-rem/yr)	175
10-year latent fatal cancers	0.70
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998f.

J.2.2.3 Pit Conversion and MOX Facilities

J.2.2.3.1 Construction of Pit Conversion and MOX Facilities

No radiological risk would be incurred by members of the public from the construction and modification of a pit conversion facility in FPF and construction of a new MOX facility at INEEL. According to a recent radiation survey (Mitchell et al. 1997) conducted in the INTEC area, a construction worker could receive about 5 mrem/yr above natural background levels from exposure to radiation deriving from other activities, past or present, at the site. Construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

J.2.2.3.2 Operation of Pit Conversion and MOX Facilities

Tables J–23 and J–24 present the incident-free radiological impacts of operation of pit conversion and MOX facilities at INEEL.

Table J–23. Potential Radiological Impacts on the Public of Operation of Pit Conversion Facility in FPF and New MOX Facility at INEEL

Impact	Pit Conversion	MOX	Total[a]
Population within 80 km for year 2010			
Dose (person-rem)	2.2	0.014	2.2
Percent of natural background[b]	3.3×10^{-3}	2.1×10^{-5}	3.3×10^{-3}
10-year latent fatal cancers	0.011	7.0×10^{-5}	0.011
Maximally exposed individual			
Annual dose (mrem)	0.015	1.2×10^{-3}	0.016
Percent of natural background[b]	4.2×10^{-3}	3.3×10^{-4}	4.5×10^{-3}
10-year latent fatal cancer risk	7.5×10^{-8}	6.0×10^{-9}	8.0×10^{-8}
Average exposed individual within 80 km[c]			
Annual dose (mrem)	0.012	7.7×10^{-5}	0.012
10-year latent fatal cancer risk	6.0×10^{-8}	3.9×10^{-10}	6.0×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.

[b] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem.

[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2010 (182,800).

Key: FPF, Fuel Processing Facility.

Source: Model results.

Table J–24. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion Facility in FPF and New MOX Facility at INEEL

Impact	Pit Conversion	MOX	Total
Number of badged workers	341	350	691
Total dose (person-rem/yr)	170	175	345
10-year latent fatal cancers	0.68	0.70	1.4
Average worker dose (mrem/yr)	500	500	500[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: FPF, Fuel Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998e, 1998f.

J.3 PANTEX

J.3.1 Assessment Data

To perform the dose assessments for the SPD EIS, different types of data were collected and generated. In addition, calculational assumptions were made. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) that were used for the assessments.

J.3.1.1 Meteorological Data

The meteorological data used for the Pantex dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operation. Table J–25 presents the JFD used in the dose assessments for Pantex.

J.3.1.2 Population Data

The Pantex population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2010 (about midlife of operations) for areas within 80 km (50 mi) of the locations for the proposed plutonium disposition facilities. The site population in 2010 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at Zone 4, the location from which radionuclides are assumed to be released during incident-free operations. Table J–26 presents the population data used for the dose assessments at Pantex.

J.3.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distribution described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the Pantex population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. Pantex food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

J.3.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are provided in the data reports for pit conversion and MOX facilities (UC 1998g, 1998h).

Table J–25. 1985–1989 Joint Frequency Distributions at 7-m Height for Pantex[a]

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.02	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
	B	0.02	0.01	0.01	0.02	0.03	0.02	0.02	0.02	0.05	0.01	0.03	0.02	0.04	0.02	0.03	0.02
	C	0.02	0	0.01	0.01	0.01	0	0.01	0	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
	D	0.03	0.01	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.03	0.02	0.02	0.03
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0.12	0.04	0.04	0.05	0.04	0.04	0.07	0.08	0.17	0.11	0.16	0.09	0.13	0.13	0.11	0.08
2.5	A	0.03	0.01	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.01	0.03	0.02	0.02	0.02	0.01
	B	0.12	0.06	0.08	0.06	0.14	0.06	0.07	0.05	0.13	0.06	0.09	0.05	0.11	0.09	0.11	0.07
	C	0.12	0.05	0.07	0.07	0.06	0.05	0.04	0.05	0.12	0.11	0.09	0.11	0.13	0.13	0.15	0.09
	D	0.22	0.12	0.13	0.14	0.18	0.12	0.12	0.16	0.19	0.16	0.12	0.14	0.18	0.13	0.16	0.16
	E	0.23	0.1	0.09	0.1	0.12	0.14	0.16	0.14	0.31	0.21	0.23	0.18	0.21	0.15	0.19	0.12
	F	0.41	0.16	0.13	0.14	0.18	0.2	0.25	0.23	0.62	0.49	0.64	0.39	0.48	0.49	0.43	0.28
4.5	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0.08	0.04	0.07	0.07	0.07	0.06	0.06	0.09	0.17	0.13	0.13	0.09	0.1	0.08	0.07	0.08
	C	0.45	0.21	0.18	0.2	0.27	0.16	0.22	0.22	0.63	0.45	0.54	0.39	0.47	0.37	0.48	0.32
	D	1.14	0.72	0.64	0.59	0.72	0.66	1.02	1.1	2.19	1.21	1	0.5	0.41	0.32	0.6	0.5
	E	0.72	0.33	0.28	0.27	0.41	0.39	0.79	1.16	2.75	1.85	1.83	0.93	0.55	0.56	0.79	0.38
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.9	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.13	0.1	0.07	0.05	0.04	0.04	0.05	0.13	0.52	0.5	0.39	0.22	0.16	0.08	0.05	0.04
	D	3.07	1.76	1	0.67	0.9	0.83	1.73	2.59	7.3	4.2	3.32	1.83	1.19	0.57	0.89	0.95
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.6	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.03	0.02	0.03	0.01	0	0.01	0.01	0.03	0.18	0.19	0.09	0.04	0.03	0.01	0	0.01
	D	1.49	0.82	0.29	0.13	0.11	0.13	0.33	0.48	2.24	1.48	1.01	0.76	0.49	0.12	0.15	0.34
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.1	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.01	0.01	0	0	0	0	0	0	0.04	0.01	0.01	0.02	0.01	0	0	0
	D	0.73	0.32	0.05	0.03	0.01	0.02	0.05	0.1	0.41	0.22	0.2	0.25	0.24	0.05	0.09	0.2
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a]Joint frequency distribution data was compiled by the National Weather Service Station at Amarillo Airport; it was assumed that this data satisfactorily represented the atmospheric conditions at the Pantex site.
Source: NWS 1997.

Table J–26. Projected Pantex Population Surrounding Zone 4 for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	4	5	41	100	96	104	268	**618**
SSW	0	0	0	0	5	117	441	1,095	361	1,013	**3,032**
SW	0	0	0	3	3	901	18,330	14,816	13,199	1,137	**48,389**
WSW	0	0	3	2	3	49	88,209	65,959	1,189	528	**15,5942**
W	0	0	2	2	3	25	3,372	683	227	897	**5,211**
WNW	0	0	3	2	3	25	148	360	517	834	**1,892**
NW	0	2	3	3	3	25	98	253	547	542	**1,476**
NNW	0	2	3	4	5	30	88	344	519	16,924	**17,919**
N	0	2	3	4	5	41	151	5,476	176	225	**6,083**
NNE	0	2	3	4	5	41	162	18,764	2,998	233	**22,212**
NE	0	2	3	4	5	41	163	396	295	165	**1,074**
ENE	0	2	3	4	5	41	324	724	22,852	176	**24,131**
E	0	2	3	4	5	961	2,016	884	372	1,085	**5,332**
ESE	0	2	3	4	5	41	273	512	248	401	**1,489**
SE	0	0	3	4	5	41	303	370	115	2,182	**3,023**
SSE	0	0	0	4	5	41	677	311	69	109	**1,216**
Total	**0**	**16**	**35**	**52**	**70**	**2,461**	**114,855**	**111,043**	**43,788**	**26,719**	**299,039**

Source: DOC 1992.

J.3.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the proposed surplus plutonium disposition facilities at Pantex, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).
- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).
- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.
- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases were to the air.

- Reported stack heights were used for atmospheric releases. The resultant doses were conservative as use of the actual stack height instead of the effective sack height negates plume rise.

- The calculated doses are 50-year committed doses from 1 year of intake.

J.3.2 Facilities

The following sections present all viable radiological impact scenarios that could be associated with different combinations of incident-free facility operations at Pantex.

J.3.2.1 Pit Conversion Facility

J.3.2.1.1 Construction of Pit Conversion Facility

No radiological risk would be incurred by members of the public from the construction of a new pit conversion facility at Pantex. According to a recent radiation survey (DOE 1997a) conducted in Zone 4, a construction worker would not be expected to receive any additional radiation exposure above natural background levels in the area. Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

J.3.2.1.2 Operation of Pit Conversion Facility

Tables J–27 and J–28 present the incident-free radiological impacts of the operation of a pit conversion facility at Pantex.

Table J–27. Potential Radiological Impacts on the Public of Operation of New Pit Conversion Facility at Pantex

Population within 80 km for year 2010	
Dose (person-rem)	0.58
Percent of natural background[a]	5.8×10^{-4}
10-year latent fatal cancers	2.9×10^{-3}
Maximally exposed individual	
Annual dose (mrem)	0.062
Percent of natural background[a]	0.019
10-year latent fatal cancer risk	3.1×10^{-7}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	1.9×10^{-3}
10-year latent fatal cancer risk	9.5×10^{-9}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex in 2010 (299,000).
Source: Model results.

Table J–28. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion Facility at Pantex

Number of badged workers	383
Total dose (person-rem/yr)	192
10-year latent fatal cancers	0.77
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998g.

J.3.2.2 MOX Facility

J.3.2.2.1 Construction of MOX Facility

No radiological risk would be incurred by members of the public from construction of a new MOX facility at Pantex . According to a recent radiation survey (DOE 1997a) conducted in Zone 4, a construction worker would not be expected to receive any additional radiation exposure above natural background levels in the area. Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

J.3.2.2.2 Operation of MOX Facility

Tables J–29 and J–30 present the incident-free radiological impacts of the operation of a MOX facility at Pantex.

Table J–29. Potential Radiological Impacts on the Public of Operation of New MOX Facility at Pantex

Population within 80 km for year 2010	
Dose (person-rem)	0.010
Percent of natural background[a]	1.0×10^{-5}
10-year latent fatal cancers	5.0×10^{-5}
Maximally exposed individual	
Annual dose (mrem)	5.5×10^{-3}
Percent of natural background[a]	1.7×10^{-3}
10-year latent fatal cancer risk	2.8×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	3.3×10^{-5}
10-year latent fatal cancer risk	1.7×10^{-10}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex in 2010 (299,000).
Source: Model results.

Table J–30. Potential Radiological Impacts on Involved Workers of Operation of New MOX Facility at Pantex

Number of badged workers	350
Total dose (person-rem/yr)	175
10-year latent fatal cancers	0.70
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998h.

J.3.2.3 Pit Conversion and MOX Facilities

J.3.2.3.1 Construction of Pit Conversion and MOX Facilities

No radiological risk would be incurred by members of the public from the construction of new pit conversion and MOX facilities at Pantex. According to a recent radiation survey (DOE 1997a) conducted in Zone 4, a construction worker would not be expected to receive any additional radiation exposure above natural background levels in the area. Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

J.3.2.3.2 Operation of Pit Conversion and MOX Facilities

Tables J–31 and J–32 present the incident-free radiological impacts of operation of the pit conversion and MOX facilities at Pantex.

Table J–31. Potential Radiological Impacts on the Public of Operation of New Pit Conversion and MOX Facilities at Pantex

Impact	Pit Conversion	MOX	Total[a]
Population within 80 km for year 2010			
Dose (person-rem)	0.58	0.010	0.59
Percent of natural background[b]	5.8×10^{-4}	1.0×10^{-5}	5.9×10^{-4}
10-year latent fatal cancers	2.9×10^{-3}	5.0×10^{-5}	3.0×10^{-3}
Maximally exposed individual			
Annual dose (mrem)	0.062	5.5×10^{-3}	0.068
Percent of natural background[b]	0.019	1.7×10^{-3}	0.021
10-year latent fatal cancer risk	3.1×10^{-7}	2.8×10^{-8}	3.4×10^{-7}
Average exposed individual within 80 km[c]			
Annual dose (mrem)	1.9×10^{-3}	3.3×10^{-5}	1.9×10^{-3}
10-year latent fatal cancer risk	9.5×10^{-9}	1.7×10^{-10}	9.7×10^{-9}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[b] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex in 2010 (299,000).
Source: Model results.

Table J–32. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion and MOX Facilities at Pantex

Impact	Pit Conversion	MOX	Total
Number of badged workers	383	350	733
Total dose (person-rem/yr)	192	175	367
10-year latent fatal cancers	0.77	0.70	1.5
Average worker dose (mrem/yr)	500	500	500[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998g, 1998h.

J.4 SRS

J.4.1 Assessment Data

To perform the dose assessments for the SPD EIS, different types of data were collected and generated. In addition, calculational assumptions were made. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) that were used for the assessments.

J.4.1.1 Meteorological Data

The meteorological data used for the SRS dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD data file was based on measurements taken over a period of several years at a specific location (F-Area) and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operation. Table J–33 presents the JFD data used in the dose assessments for SRS.

J.4.1.2 Population Data

The SRS population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2010 (about midlife of operations) for areas within 80 km (50 mi) of the locations for the proposed surplus plutonium disposition facilities. The site population in 2010 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at the Actinide Packaging and Storage Facility and Building 221–F in F-Area, the locations from which radionuclides are assumed to be released during incident-free operations. Tables J–34 and J–35 present the population data used for the dose assessments at SRS.

J.4.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII (leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs). Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels are then used in the assessment of doses to the SRS population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. SRS food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

J.4.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are provided in the data reports for pit conversion, immobilization, and MOX facilities (UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n).

Table J–33. SRS 1987–1991 Joint Frequency Distributions at 61-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
2.0	A	0.27	0.35	0.39	0.42	0.34	0.31	0.28	0.31	0.31	0.3	0.32	0.34	0.5	0.32	0.29	0.26
	B	0.04	0.05	0.06	0.08	0.05	0.05	0.04	0.05	0.05	0.04	0.06	0.07	0.06	0.06	0.06	0.04
	C	0.02	0.03	0.1	0.07	0.02	0.04	0.03	0.06	0.05	0.05	0.07	0.07	0.09	0.06	0.03	0.02
	D	0.01	0.03	0.07	0.02	0.02	0.03	0.05	0.05	0.04	0.04	0.05	0.05	0.03	0.02	0.04	0.03
	E	0	0	0.02	0	0	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02
	F	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
4.0	A	0.64	0.63	0.7	0.77	0.76	0.63	0.54	0.66	0.58	0.64	0.73	1.15	1	0.69	0.52	0.44
	B	0.22	0.3	0.33	0.4	0.33	0.26	0.21	0.22	0.28	0.26	0.51	0.67	0.59	0.3	0.16	0.2
	C	0.08	0.52	0.57	0.77	0.51	0.37	0.33	0.39	0.44	0.45	0.7	0.77	0.69	0.33	0.28	0.15
	D	0.06	0.52	1.49	1.12	0.5	0.51	0.62	0.78	0.77	0.62	0.7	0.75	0.77	0.47	0.31	0.15
	E	0.04	0.2	0.8	0.35	0.18	0.28	0.42	0.55	0.57	0.43	0.51	0.42	0.49	0.33	0.25	0.15
	F	0.02	0.02	0.1	0.05	0.03	0.03	0.07	0.09	0.06	0.07	0.09	0.06	0.06	0.07	0.06	0.04
6.0	A	0.49	0.15	0.1	0.09	0.1	0.09	0.08	0.14	0.11	0.14	0.17	0.17	0.19	0.18	0.1	0.21
	B	0.12	0.22	0.17	0.22	0.19	0.09	0.08	0.15	0.17	0.2	0.3	0.42	0.37	0.28	0.11	0.08
	C	0.08	0.4	0.42	0.63	0.35	0.18	0.19	0.34	0.38	0.43	0.6	0.77	0.64	0.39	0.17	0.11
	D	0.06	0.8	2.28	1.39	0.62	0.44	0.67	1.31	1.21	0.75	0.94	0.87	1.01	0.66	0.29	0.18
	E	0.06	0.51	1.36	1.07	0.56	0.48	0.64	1.25	1.29	0.97	1.08	1.14	1.22	0.77	0.38	0.21
	F	0.02	0.04	0.18	0.28	0.23	0.21	0.2	0.23	0.23	0.26	0.25	0.26	0.21	0.19	0.1	0.08
8.0	A	0.11	0.03	0.01	0.01	0.01	0.01	0	0.02	0.01	0.04	0.02	0.02	0.03	0.03	0.02	0.03
	B	0	0.06	0.02	0.01	0	0	0	0.01	0.03	0.04	0.08	0.06	0.04	0.08	0.03	0.01
	C	0.01	0.11	0.11	0.13	0.06	0.04	0.05	0.07	0.13	0.17	0.27	0.28	0.33	0.29	0.06	0.01
	D	0.04	0.3	0.6	0.41	0.08	0.03	0.1	0.25	0.21	0.15	0.2	0.24	0.63	0.35	0.05	0.02
	E	0.02	0.29	0.25	0.16	0.06	0.02	0.02	0.06	0.08	0.05	0.16	0.12	0.15	0.06	0.02	0.02
	F	0	0.01	0.04	0.06	0.04	0.01	0.02	0.02	0.04	0.05	0.02	0.01	0.01	0	0	0
12.0	A	0.01	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0.01	0	0.01
	B	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0
	C	0	0.01	0	0	0	0	0	0.02	0.03	0.03	0.04	0.06	0.2	0.18	0.01	0
	D	0.01	0.06	0.08	0.08	0.01	0.01	0.01	0.03	0.05	0.03	0.06	0.03	0.39	0.2	0.01	0
	E	0	0.01	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.1	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0.01	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Simpkins 1997.

Table J–34. Projected SRS Population Surrounding APSF for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	0	600	2,109	3,312	3,447	**9,468**
SSW	0	0	0	0	0	36	935	1,853	4,732	2,501	**10,057**
SW	0	0	0	0	0	73	1,239	8,333	2,023	4,318	**15,986**
WSW	0	0	0	0	0	228	3,762	4,014	3,742	7,194	**18,940**
W	0	0	0	0	0	355	7,786	47,484	21,880	18,192	**95,697**
WNW	0	0	0	0	0	2,439	11,335	205,958	53,232	6,694	**279,658**
NW	0	0	0	0	0	1,455	18,694	38,351	2,884	3,123	**64,507**
NNW	0	0	0	0	0	3,279	40,843	20,468	9,466	5,766	**79,822**
N	0	0	0	0	0	1,012	7,787	6,010	5,928	20,994	**41,731**
NNE	0	0	0	0	0	145	1,934	2,959	6,794	20,775	**32,607**
NE	0	0	0	0	0	0	3,168	3,786	5,985	11,236	**24,175**
ENE	0	0	0	0	0	0	3,077	5,828	7,625	33,477	**50,007**
E	0	0	0	0	0	0	6,188	5,442	7,342	3,952	**22,924**
ESE	0	0	0	0	0	0	996	3,497	4,455	7,253	**16,201**
SE	0	0	0	0	0	0	572	2,555	4,695	7,667	**15,489**
SSE	0	0	0	0	0	0	390	648	4,122	2,975	**8,135**
Total	**0**	**0**	**0**	**0**	**0**	**9,022**	**109,306**	**359,295**	**148,217**	**159,564**	**785,404**

Key: APSF, Actinide Packaging and Storage Facility.
Source: DOC 1992.

Table J–35. Projected SRS Population Surrounding Building 221–F for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	0	633	2,091	3,211	3,454	**9389**
SSW	0	0	0	0	0	42	956	1,864	4,687	2,505	**10054**
SW	0	0	0	0	0	89	1,305	8,226	1,998	4,066	**15684**
WSW	0	0	0	0	0	217	3,609	3,800	3,722	7,423	**18,771**
W	0	0	0	0	0	350	8,055	42,946	21,251	18,227	**90,829**
WNW	0	0	0	0	0	2,368	11,097	208,470	53,641	6,842	**282,418**
NW	0	0	0	0	0	1,433	18,409	40,744	2,753	3,100	**66,439**
NNW	0	0	0	0	0	3,066	38,304	23,053	9,350	5,800	**79,573**
N	0	0	0	0	0	1,183	7,960	6,441	5,868	20,878	**42,330**
NNE	0	0	0	0	0	121	1,944	2,906	6,766	20,085	**31,822**
NE	0	0	0	0	0	0	3,137	3,822	5,911	11,229	**24,099**
ENE	0	0	0	0	0	0	2,944	5,943	7,826	30,933	**47,646**
E	0	0	0	0	0	0	6,026	5,429	7,087	3,935	**22,477**
ESE	0	0	0	0	0	0	957	4,122	5,203	7,494	**17,776**
SE	0	0	0	0	0	0	569	1,925	3,889	7,412	**13,795**
SSE	0	0	0	0	0	0	404	671	4,361	2,969	**8,405**
TOTAL	**0**	**0**	**0**	**0**	**0**	**8,869**	**106,309**	**362,453**	**147,524**	**156,352**	**781,507**

Source: DOC 1992.

J.4.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the facilities at SRS, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).
- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).
- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.
- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.
- Reported stack heights were used for atmospheric releases. The resultant doses were conservative as use of the actual stack height instead of the effective stack height negates plume rise.
- The calculated doses are 50-year committed doses from 1 year of intake.

J.4.2 Facilities

The following sections present all viable radiological impact scenarios that could be associated with different combinations of incident-free facility operations at SRS.

J.4.2.1 Pit Conversion Facility

J.4.2.1.1 Construction of Pit Conversion Facility

No radiological risk would be incurred by members of the public from the construction of a new pit conversion facility at SRS. Construction worker exposures to radiation that derives from other activities at the site, past and present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–36 for workers at risk.

Table J–36. Potential Radiological Impacts on Construction Workers of New Pit Conversion Facility at SRS

Annual average number of workers	316
Total dose (person-rem/yr)	1.3
Annual latent fatal cancers[a]	5.2×10^{-4}
Average worker dose (mrem/yr)	4
Annual latent fatal cancer risk	1.6×10^{-6}

[a] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.

Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: ICRP 1991; NAS 1990; UC 1998i.

J.4.2.1.2 Operation of Pit Conversion Facility

Tables J–37 and J–38 present the incident-free radiological impacts of the operation of a new pit conversion facility at SRS.

Table J–37. Potential Radiological Impacts on the Public of Operation of New Pit Conversion Facility at SRS

Population within 80 km for year 2010	
Dose (person-rem)	1.6
Percent of natural background[a]	6.9×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}
Maximally exposed individual	
Annual dose (mrem)	3.7×10^{-3}
Percent of natural background[a]	1.3×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}

[a] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2010 (about 785,400).

Source: Model results.

Table J–38. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion Facility at SRS

Number of badged workers	383
Total dose (person-rem/yr)	192
10-year latent fatal cancers	0.77
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998i.

J.4.2.2 Immobilization Facility

J.4.2.2.1 Construction of Immobilization Facility

No radiological risk would be incurred by members of the public from the modification of Building 221–F or new construction for plutonium conversion and immobilization (ceramic or glass) at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–39 for workers at risk.

Table J–39. Potential Radiological Impacts on Construction Workers of Immobilization Facility in Building 221–F or New Construction at SRS

Impact	Bldg. 221–F[a]	New[a]
Annual average number of workers	315	347
Total dose (person-rem/yr)	4.7	1.4
Annual latent fatal cancers[b]	1.9×10^{-3}	5.6×10^{-4}
Average worker dose (mrem/yr)	15	4
Annual latent fatal cancer risk	6.0×10^{-6}	1.6×10^{-6}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.

Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998j, 1998k, 1998l, 1998m.

J.4.2.2.2 Operation of Immobilization Facility

Tables J–40 and J–41 present all possible incident-free radiological impact scenarios of the operation of an immobilization facility at SRS.

Table J–40. Potential Radiological Impacts on the Public of Operation of Immobilization Facility in Building 221–F or New Construction at SRS[a]

Impact	17 t		50 t	
	Ceramic	Glass	Ceramic	Glass
Population within 80 km for year 2010				
Dose (person-rem)	2.3×10^{-3}	2.2×10^{-3}	4.9×10^{-3}	4.5×10^{-3}
Percent of natural background[b]	1.0×10^{-6}	1.0×10^{-6}	2.1×10^{-6}	1.9×10^{-6}
10-year latent fatal cancers	1.2×10^{-5}	1.1×10^{-5}	2.5×10^{-5}	2.3×10^{-5}
Maximally exposed individual				
Annual dose (mrem)	2.4×10^{-5}	2.2×10^{-5}	5.0×10^{-5}	4.6×10^{-5}
Percent of natural background[b]	8.1×10^{-6}	7.5×10^{-6}	1.7×10^{-5}	1.6×10^{-5}
10-year latent fatal cancer risk	1.2×10^{-10}	1.1×10^{-10}	2.5×10^{-10}	2.3×10^{-10}
Average exposed individual within 80 km[c]				
Annual dose (mrem)	2.9×10^{-6}	2.8×10^{-6}	6.3×10^{-6}	5.7×10^{-6}
10-year latent fatal cancer risk	1.5×10^{-11}	1.4×10^{-11}	3.2×10^{-11}	2.9×10^{-11}

[a] Impacts were assessed to be essentially identical for operations at either Building 221-F or the new facility.
[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 231,000 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS facilities in 2010 (about 783,000).
Source: Model results.

Table J–41. Potential Radiological Impacts on Involved Workers of Operation of Immobilization Facility in Building 221–F or New Construction at SRS[a]

Impact	17 t		50 t	
	Bldg. 221–F	New	Bldg. 221–F	New
Number of badged workers	258	232	290	257
Total dose (person-rem/yr)	194	174	218	193
10-year latent fatal cancers	0.77	0.70	0.87	0.77
Average worker dose (mrem/yr)	750	750	750	750
10-year latent fatal cancer risk	3.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}

[a] The values would be the same for immobilization in either ceramic or glass.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998j, 1998k, 1998l, 1998m.

J.4.2.3 MOX Facility

J.4.2.3.1 Construction of MOX Facility

No radiological risk would be incurred by members of the public from the construction of a new MOX facility at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–42 for workers at risk.

Table J–42. Potential Radiological Impacts on Construction Workers of New MOX Facility at SRS

Annual average number of workers	292
Total dose (person-rem/yr)	1.2
Annual latent fatal cancers[a]	4.8×10^{-4}
Average worker dose (mrem/yr)	4
Annual latent fatal cancer risk	1.6×10^{-6}

[a] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.

Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: ICRP 1991; NAS 1990; UC 1998n.

J.4.2.3.2 Operation of MOX Facility

Tables J–43 and J–44 present the incident-free radiological impacts of the operation of a MOX facility at SRS.

Table J–43. Potential Radiological Impacts on the Public of Operation of New MOX Facility at SRS

Population within 80 km for year 2010	
Dose (person-rem)	0.029
Percent of natural background[a]	1.3×10^{-5}
10-year latent fatal cancers	1.5×10^{-4}
Maximally exposed individual	
Annual dose (mrem)	3.1×10^{-4}
Percent of natural background[a]	1.1×10^{-4}
10-year latent fatal cancer risk	1.6×10^{-9}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	3.7×10^{-5}
10-year latent fatal cancer risk	1.9×10^{-10}

[a] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2010 (785,400).

Source: Model results.

Table J–44. Potential Radiological Impacts on Involved Workers of Operation of New MOX Facility at SRS

Number of badged workers	350
Total dose (person-rem/yr)	175
10-year latent fatal cancers	0.70
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998n.

J.4.2.4 Pit Conversion and Immobilization Facilities

J.4.2.4.1 Construction of Pit Conversion and Immobilization Facilities

No radiological risk would be incurred by members of the public from construction of a new pit conversion facility and modification of Building 221–F or new construction for plutonium conversion and immobilization (ceramic or glass) at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–45 for workers at risk.

Table J–45. Potential Radiological Impacts on Construction Workers of New Pit Conversion Facility and Immobilization Facility in Building 221–F or New Construction at SRS

Impact	Pit Conversion	Immobilization[a]		Total	
		Bldg. 221–F	New	With Bldg. 221–F	With New
Annual average number of workers	316	315	347	631	663
Total dose (person-rem/yr)	1.3	4.7	1.4	6.9	2.7
Annual latent fatal cancers[b]	5.2×10^{-4}	1.9×10^{-3}	5.6×10^{-4}	2.8×10^{-3}	1.1×10^{-3}
Average worker dose (mrem/yr)	4	15	4	11[c]	4[c]
Annual latent fatal cancer risk	1.6×10^{-6}	6.0×10^{-6}	1.6×10^{-6}	4.2×10^{-6}	1.6×10^{-6}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[c] Represents an average of the doses for both facilities.
Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998i, 1998j, 1998k, 1998l, 1998m.

J.4.2.4.2 Operation of Pit Conversion and Immobilization Facilities

Tables J–46 and J–47 present all possible incident-free radiological impact scenarios of operation of the pit conversion and immobilization facilities at SRS.

Table J–46. Potential Radiological Impacts on the Public of Operation of New Pit Conversion Facility and Immobilization Facility in Building 221–F or New Construction at SRS

Impact	Pit Conversion	Immobilization (50 t)[a] Ceramic	Immobilization (50 t)[a] Glass	Total[b]
Population within 80 km for year 2010				
Dose (person-rem)	1.6	4.9×10^{-3}	4.5×10^{-3}	1.6
Percent of natural background[c]	6.9×10^{-4}	2.1×10^{-6}	1.9×10^{-6}	6.9×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	2.5×10^{-5}	2.3×10^{-5}	8.0×10^{-3}
Maximally exposed individual				
Annual dose (mrem)	3.7×10^{-3}	5.0×10^{-5}	4.6×10^{-5}	3.8×10^{-3}
Percent of natural background[c]	1.3×10^{-3}	1.7×10^{-5}	1.6×10^{-5}	1.3×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	2.5×10^{-10}	2.3×10^{-10}	1.9×10^{-8}
Average exposed individual within 80 km[d]				
Annual dose (mrem)	2.0×10^{-3}	6.3×10^{-6}	5.7×10^{-6}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	3.2×10^{-11}	2.9×10^{-11}	1.0×10^{-8}

a Impacts were assessed to be essentially identical for operations at either Building 221–F or the new facility.
b Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
c The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 231,000 person-rem.
d Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS facilities in 2010 (about 783,000).
Source: Model results.

Table J–47. Radiological Impacts on Involved Workers of Operation of New Pit Conversion Facility and Immobilization Facility in Building 221–F or New Construction at SRS

Impact	Pit Conversion	Immobilization (50 t)[a] Bldg. 221–F	Immobilization (50 t)[a] New	Total With Bldg. 221–F	Total With New
Number of badged workers	383	290	257	673	640
Total dose (person-rem/yr)	192	218	193	410	385
10-year latent fatal cancers	0.77	0.87	0.77	1.6	1.5
Average worker dose (mrem/yr)	500	750	750	608[b]	600[b]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	2.4×10^{-3}	2.4×10^{-3}

a The values would be the same for immobilization in either ceramic or glass.
b Represents an average of the doses for both facilities.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved with operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998i, 1998j, 1998k, 1998l, 1998m.

J.4.2.5 Pit Conversion and MOX Facilities

J.4.2.5.1 Construction of Pit Conversion and MOX Facilities

No radiological risk would be incurred by members of the public from the construction of new pit conversion and MOX facilities at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table 4–48 for workers at risk.

Table J–48. Potential Radiological Impacts on Construction Workers of New Pit Conversion and MOX Facilities at SRS

Impact	Pit Conversion	MOX	Total
Annual average number of workers	316	292	608
Total dose (person-rem/yr)	1.3	1.2	2.5
Annual latent fatal cancers[a]	5.2×10^{-4}	4.8×10^{-4}	1.0×10^{-3}
Average worker dose (mrem/yr)	4	4	4[b]
Annual latent fatal cancer risk	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[b] Represents an average of the doses for both facilities.
Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998i, 1998n.

J.4.2.5.2 Operation of Pit Conversion and MOX Facilities

Tables J–49 and J–50 present the incident-free radiological impacts of operation of the pit conversion and MOX facilities at SRS.

Table J–49. Potential Radiological Impacts on the Public of Operation of New Pit Conversion and MOX Facilities at SRS

Impact	Pit Conversion	MOX	Total[a]
Population within 80 km for year 2010			
Dose (person-rem)	1.6	0.029	1.6
Percent of natural background[b]	6.9×10^{-4}	1.3×10^{-5}	7.0×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	1.5×10^{-4}	8.2×10^{-3}
Maximally exposed individual			
Annual dose (mrem)	3.7×10^{-3}	3.1×10^{-4}	4.0×10^{-3}
Percent of natural background[b]	1.3×10^{-3}	1.1×10^{-4}	1.4×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	1.6×10^{-9}	2.1×10^{-8}
Average exposed individual within 80 km[c]			
Annual dose (mrem)	2.0×10^{-3}	3.7×10^{-5}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	1.9×10^{-10}	1.0×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 231,700 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2010 (785,400).
Source: Model results.

Table J–50. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion and MOX Facilities at SRS

Impact	Pit Conversion	MOX	Total
Number of badged workers	383	350	733
Total dose (person-rem/yr)	192	175	367
10-year latent fatal cancers	0.77	0.70	1.5
Average worker dose (mrem/yr)	500	500	500[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}

[a] Represents an average of the doses for both facilities.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998i, 1998n.

J.4.2.6 Immobilization and MOX Facilities

J.4.2.6.1 Construction of Immobilization and MOX Facilities

No radiological risk would be incurred by members of the public from the modification of Building 221–F or new construction for plutonium conversion and immobilization (ceramic or glass) and construction of a new MOX facility at SRS. Construction worker exposures to radiation deriving from other activities, past or present, at the site would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–51 for workers at risk.

Table J–51. Potential Radiological Impacts on Construction Workers of Immobilization Facility in Building 221–F or New Construction and New MOX Facility at SRS

	Immobilization[a]			Total	
Impact	Bldg. 221–F	New	MOX	With Bldg. 221–F	With New
Annual average number of workers	315	347	292	607	639
Total dose (person-rem/yr)	4.7	1.4	1.2	5.9	2.6
Annual latent fatal cancers[b]	1.9×10^{-3}	5.6×10^{-4}	4.8×10^{-4}	2.4×10^{-3}	1.0×10^{-3}
Average worker dose (mrem/yr)	15	4	4	9.7[c]	4[c]
Annual latent fatal cancer risk	6.0×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	3.9×10^{-6}	1.6×10^{-6}

[a] The values would be the same for immobilization in either ceramic or glass.

[b] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.

[c] Represents an average of the doses for both facilities.

Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: ICRP 1991; NAS 1990; UC 1998j, 1998k, 1998l, 1998m, 1998n.

J.4.2.6.2 Operation of Immobilization and MOX Facilities

Tables J–52 and J–53 present the incident-free radiological impacts of operation of the immobilization and MOX facilities at SRS.

Table J–52. Potential Radiological Impacts on the Public of Operation of Immobilization Facility in Building 221–F or New Construction and New MOX Facility at SRS

Impact	Immobilization (17 t)[a] Ceramic	Immobilization (17 t)[a] Glass	MOX	Total[b]
Population within 80 km for year 2010				
Dose (person-rem)	2.3×10^{-3}	2.2×10^{-3}	0.029	0.031
Percent of natural background[c]	1.0×10^{-6}	1.0×10^{-6}	1.3×10^{-5}	1.4×10^{-5}
10-year latent fatal cancers	1.2×10^{-5}	1.1×10^{-5}	1.5×10^{-4}	1.6×10^{-4}
Maximally exposed individual				
Annual dose (mrem)	2.4×10^{-5}	2.2×10^{-5}	3.1×10^{-4}	3.3×10^{-4}
Percent of natural background[c]	8.1×10^{-6}	7.5×10^{-6}	1.1×10^{-4}	1.2×10^{-4}
10-year latent fatal cancer risk	1.2×10^{-10}	1.1×10^{-10}	1.6×10^{-9}	1.7×10^{-9}
Average exposed individual within 80 km[d]				
Annual dose (mrem)	2.9×10^{-6}	2.8×10^{-6}	3.7×10^{-5}	4.0×10^{-5}
10-year latent fatal cancer risk	1.5×10^{-11}	1.4×10^{-11}	1.9×10^{-10}	2.1×10^{-10}

a Impacts were assessed to be essentially identical for operations at either Building 221–F or the new facility.
b Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
c The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 231,000 person-rem.
d Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS facilities in 2010 (about 783,000).
Source: Model results.

Table J–53. Potential Radiological Impacts on Involved Workers of Operation of Immobilization Facility in Building 221–F or New Construction and New MOX Facility at SRS

Impact	Immobilization (17 t)[a] Bldg. 221–F	Immobilization (17 t)[a] New	MOX	Total With Bldg. 221–F	Total With New
Number of badged workers	258	232	350	608	582
Total dose (person-rem/yr)	194	174	175	369	349
10-year latent fatal cancers	0.77	0.70	0.70	1.5	1.4
Average worker dose (mrem/yr)	750	750	500	606[b]	600[b]
10-year latent fatal cancer risk	3.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.4×10^{-3}	2.4×10^{-3}

a The values would be the same for immobilization in either ceramic or glass.
b Represents an average of the doses for both facilities.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998j, 1998k, 1998l, 1998m, 1998n.

J.4.2.7 Pit Conversion, Immobilization, and MOX Facilities

J.4.2.7.1 Construction of Pit Conversion, Immobilization, and MOX Facilities

No radiological risk would be incurred by members of the public from the construction of new pit conversion and MOX facilities and modification of Building 221–F or new construction for plutonium conversion and immobilization (ceramic or glass) at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–54 for workers at risk.

Table J–54. Potential Radiological Impacts on Construction Workers of New Pit Conversion and MOX Facilities and Immobilization Facility in Building 221–F or New Construction at SRS

Impact	Pit Conversion	Immobilization[a] Bldg. 221–F	Immobilization[a] New	MOX	Total With Bldg. 221–F	Total With New
Annual average number of workers	316	315	347	292	923	955
Total dose (person-rem/yr)	1.3	4.7	1.4	1.2	7.6	3.8
Annual latent fatal cancers[b]	5.2×10^{-4}	1.9×10^{-3}	5.6×10^{-4}	4.8×10^{-4}	3.0×10^{-3}	1.5×10^{-3}
Average worker dose (mrem/yr)	4	15	4	4	8.2[c]	4[c]
Annual latent fatal cancer risk	1.6×10^{-6}	6.0×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	3.3×10^{-6}	1.6×10^{-6}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[c] Represents an average of the doses for all three facilities.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n.

J.4.2.7.2 Operation of Pit Conversion, Immobilization, and MOX Facilities

Tables J–55 and J–56 present all possible incident-free radiological impact scenarios of operation of all three facilities at SRS.

Table J–55. Potential Radiological Impacts on the Public of Operation of New Pit Conversion and MOX Facilities and Immobilization Facility in Building 221–F or New Construction at SRS

Impact	Pit Conversion	Immobilization (17 t)[a] Ceramic	Immobilization (17 t)[a] Glass	MOX	Total[b]
Population within 80 km for year 2010					
Dose (person-rem)	1.6	2.3×10^{-3}	2.2×10^{-3}	0.029	1.6
Percent of natural background[c]	6.9×10^{-4}	1.0×10^{-6}	1.0×10^{-6}	1.3×10^{-5}	7.0×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	1.2×10^{-5}	1.1×10^{-5}	1.5×10^{-4}	8.2×10^{-3}
Maximally exposed individual					
Annual dose (mrem)	3.7×10^{-3}	2.4×10^{-5}	2.2×10^{-5}	3.1×10^{-4}	4.0×10^{-3}
Percent of natural background[c]	1.3×10^{-3}	8.1×10^{-6}	7.5×10^{-6}	1.1×10^{-4}	1.4×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	1.2×10^{-10}	1.1×10^{-10}	1.6×10^{-9}	2.1×10^{-8}
Average exposed individual within 80 km[d]					
Annual dose (mrem)	2.0×10^{-3}	2.9×10^{-6}	2.8×10^{-6}	3.7×10^{-5}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	1.5×10^{-11}	1.4×10^{-11}	1.9×10^{-10}	1.0×10^{-8}

[a] Impacts were assessed to be essentially identical for operations at either Building 221–F or the new facility.
[b] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from all three facilities.
[c] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in the year 2010 receives about 231,000 person-rem.
[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS facilities in 2010 (about 783,000).
Source: Model results.

Table J–56. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion and MOX Facilities and Immobilization Facility in Building 221–F or New Construction at SRS

Impact	Pit Conversion	Immobilization (17 t)[a] Bldg. 221–F	Immobilization (17 t)[a] New	MOX	Total With Bldg. 221–F	Total With New
Number of badged workers	383	258	232	350	991	965
Total dose (person-rem/yr)	192	194	174	175	561	541
10-year latent fatal cancers	0.77	0.77	0.70	0.70	2.2	2.2
Average worker dose (mrem/yr)	500	750	750	500	565[b]	560[b]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.3×10^{-3}	2.2×10^{-3}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Represents an average of the doses for all three facilities.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr. An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998i, 1998j, 1998k, 1998l, 1998m, 1998n.

Next Section

J.5 LEAD ASSEMBLY FABRICATION

J.5.1 ANL–W

J.5.1.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at ANL–W at INEEL. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.1.1.1 Meteorological Data

The meteorological data used for the ANL–W dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operation. Table J–17 presents the JFD used in the dose assessments for ANL–W.

J.5.1.1.2 Population Data

The INEEL population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at ANL–W, the location from which radionuclides are assumed to be released during incident-free operations. Table J–57 presents the population data used for the lead assembly dose assessments at ANL–W.

J.5.1.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. ANL–W food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

J.5.1.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are provided in the Oak Ridge National Laboratory (ORNL) *ANL-W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998a).

Table J–57. Projected INEEL Population Surrounding ANL–W for Year 2005

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	0	277	2,086	6,173	30,883	**39,419**
SSW	0	0	0	0	0	0	273	323	906	3,267	**4,769**
SW	0	0	0	0	0	0	246	247	224	334	**1,051**
WSW	0	0	0	0	0	0	0	238	177	181	**596**
W	0	0	0	0	0	0	0	179	224	528	**931**
WNW	0	0	0	0	0	0	35	474	824	467	**1,800**
NW	0	0	0	0	0	0	36	57	280	929	**1,302**
NNW	0	0	0	0	0	0	0	81	76	76	**233**
N	0	0	0	0	0	0	0	254	140	146	**540**
NNE	0	0	0	0	0	0	252	450	266	158	**1,126**
NE	0	0	0	0	0	0	252	443	515	98	**1,308**
ENE	0	0	0	0	0	0	253	706	1,411	5,196	**7,566**
E	0	0	0	0	0	0	367	1,405	18,570	32,506	**52,848**
ESE	0	0	0	0	0	103	509	4,197	90,875	756	**96,440**
SE	0	0	0	0	17	80	589	3,523	11,502	411	**16,122**
SSE	0	0	0	0	17	52	279	4,816	19,230	1,068	**25,462**
Total	**0**	**0**	**0**	**0**	**34**	**235**	**3,368**	**19,479**	**151,393**	**77,004**	**251,513**

Key: ANL–W, Argonne National Laboratory–West.
Source: DOC 1992.

J.5.1.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the lead assembly facility at ANL–W, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).
- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).
- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.
- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

- Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative because use of the actual stack height negates plume rise.

- The calculated doses are 50-year committed doses from 1 year of intake.

J.5.1.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.1.4. Potential impacts on postirradiation examination facility workers are presented in Section 4.27.6.2.

J.5.2 Hanford

J.5.2.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at Hanford. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.2.1.1 Meteorological Data

The meteorological data used for the Hanford dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operation. Table J–1 presents the JFD used in the dose assessments for Hanford.

J.5.2.1.2 Population Data

The Hanford population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at FMEF in the 400 Area, the location from which radionuclides are assumed to be released during incident-free operations. Table J–58 presents the population data used for lead assembly dose assessments at Hanford.

J.5.2.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food

Table J–58. Projected Hanford Population Surrounding FMEF for Year 2005

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	3,886	40,763	1,039	7,050	19,641	**72379**
SSW	0	0	0	0	2	1,380	2,513	399	2,888	3,828	**11,010**
SW	0	0	0	0	38	1,265	4,361	288	207	1,923	**8,082**
WSW	0	0	0	0	0	50	2,175	15,734	3,338	300	**21,597**
W	0	0	0	0	0	0	698	5,764	26,190	14,858	**47,510**
WNW	0	0	0	0	0	0	5	813	1,147	8,446	**10,411**
NW	0	0	0	0	0	0	0	592	377	163	**1,132**
NNW	0	0	0	0	0	0	0	1,034	1,317	1,362	**3,713**
N	0	0	0	0	0	0	0	1,224	3,458	2,520	**7,202**
NNE	0	0	0	0	0	16	425	5,074	1,388	23,720	**30,623**
NE	0	0	0	0	0	86	751	6,743	2,769	1,153	**11,502**
ENE	0	0	0	0	0	313	1,401	3,391	385	410	**5,900**
E	0	0	0	0	0	386	861	410	319	300	**2,276**
ESE	0	0	0	0	0	393	595	315	245	302	**1,850**
SE	0	0	0	0	0	381	1,191	1,604	366	1,364	**4,906**
SSE	0	0	0	0	0	6,366	79,333	30,715	565	979	**117,958**
Total	**0**	**0**	**0**	**0**	**40**	**14,522**	**135,072**	**75,139**	**52,009**	**81,269**	**358,051**

Key: FMEF, Fuels and Materials Examination Facility.
Source: DOC 1992.

grown in that area. Hanford food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

J.5.2.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are reported in the ORNL *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998b).

J.5.2.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the lead assembly facility at Hanford, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).
- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.
- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.
- Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative because use of the actual stack height negates plume rise.
- The calculated doses are 50-year committed doses from 1 year of intake.

J.5.2.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.2.4.

J.5.3 LLNL

J.5.3.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at LLNL. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.3.1.1 Meteorological Data

The meteorological data used for the LLNL dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken at a specific location and height. Annual meteorological conditions were used for normal operation. Table J–59 presents the JFD used in the dose assessments for LLNL.

J.5.3.1.2 Population Data

The LLNL population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at Building 332, the location from which radionuclides are assumed to be released during incident-free operations. Table J–60 presents the population data that were used for lead assembly dose assessments at LLNL.

Table J–59. LLNL 1993 Joint Frequency Distributions at 10-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
	A	0.45	0.41	0.4	0.33	0.27	0.17	0.14	0.11	0.13	0.34	0.62	1.14	1.53	0.78	0.57	0.45
	B	0.22	0.11	0.1	0.11	0.1	0.03	0.03	0.01	0.07	0.05	0.27	0.41	0.17	0.17	0.14	0.09
	C	0.13	0.09	0.15	0.03	0.02	0.01	0	0.03	0.08	0.14	0.16	0.22	0.16	0.09	0.08	0.07
0.89	D	0.17	0.33	0.45	0.53	0.65	0.67	0.23	0.34	1.05	1.86	1.21	0.7	0.27	0.13	0.05	0.03
	E	0.18	0.33	0.86	0.99	1.01	1.13	0.39	0.48	1.07	1.7	0.74	0.41	0.25	0.06	0.09	0.03
	F	0.11	0.16	0.61	0.93	0.8	0.63	0.55	0.31	0.35	0.38	0.39	0.14	0.1	0.08	0.11	0.07
	G	0.62	0.74	1.06	1.64	1.97	1.78	1.53	0.97	0.73	0.75	0.49	0.48	0.34	0.27	0.35	0.37
	A	0.3	0.37	0.24	0.18	0.03	0.02	0.02	0.01	0	0.02	0.26	0.81	0.89	0.31	0.21	0.16
	B	0.4	0.39	0.77	0.16	0	0.03	0.02	0.01	0.02	0.08	0.39	1.26	1.15	0.22	0.07	0.21
	C	0.07	0.59	1.21	0	0	0	0	0.01	0.02	0.09	0.7	1.28	1.17	0.23	0.01	0.03
2.86	D	0.03	0.82	1.04	0.03	0	0	0.03	0.09	0.25	1.14	4.88	2.71	1.81	0.21	0.02	0
	E	0.07	0.13	0.27	0.07	0	0	0.05	0.06	0.63	1.91	0.93	0.16	0.03	0	0	0.02
	F	0.03	0.03	0.16	0.1	0.01	0.02	0.01	0.02	0.03	0.02	0.06	0.02	0.01	0.02	0.01	0.01
	G	0.01	0.05	0.07	0.06	0.05	0.02	0.03	0.02	0.05	0.03	0.06	0	0	0	0.01	0.01
	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.34	0.71	0.23	0.02	0	0.02	0	0.05	0.01	0.03	0.3	1.22	1.62	0.16	0.01	0
4.71	D	0.08	0.72	0.56	0	0	0	0	0.06	0.09	0.61	3.64	1.51	2.04	0.11	0.01	0.02
	E	0	0.02	0	0	0	0	0	0	0	0.15	0.17	0.01	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.69	D	0.15	0.24	0.02	0	0	0	0	0	0.03	0.45	1.25	0.32	0.13	0.03	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.68	D	0.07	0.08	0	0	0	0	0	0	0.02	0.07	0.02	0	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table J–59. LLNL 1993 Joint Frequency Distributions at 10-m Height (Continued)

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.5	D	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Key: LLNL, Lawrence Livermore National Laboratory.
Source: Gouveia 1997.

Table J–60. Projected LLNL Population Surrounding Building 332 for Year 2005

Direction	Distance (miles)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	5	14	6	8	10	84	178	157	15,286	56,124	**71,872**
SSW	5	15	13	8	10	47	1,080	301,887	190,271	27,874	**521,210**
SW	31	538	25	18	16	91	42,723	589,979	350,562	52,017	**1,036,000**
WSW	228	1,283	660	982	1,885	644	146,903	239,224	184,580	4,845	**581,234**
W	302	1,316	3,338	6,379	9,931	24,309	112,488	123,480	333,290	64,111	**678,944**
WNW	311	1,316	4,567	6,337	8,349	20,051	92,859	476,610	570,787	545,627	**1,726,814**
NW	272	1,316	1,770	2,274	212	677	78,366	170,569	454,881	135,688	**846,025**
NNW	109	1,423	2,850	2,109	53	404	8,150	275,850	117,234	154,923	**563,105**
N	5	49	1,094	324	39	367	4,555	139,309	1,444	230,332	**377,518**
NNE	5	15	25	35	45	283	13,831	24,535	7,317	5,523	**51,614**
NE	5	15	16	25	21	127	8,403	12,091	128,594	36,124	**185,421**
ENE	5	11	6	8	10	111	2,218	130,249	211,561	11,360	**355,539**
E	5	14	8	8	10	249	54,523	86,577	30,047	47,622	**219,063**
ESE	5	15	17	8	10	103	1,898	7,484	230,939	242,714	**483,193**
SE	5	15	10	8	10	91	512	902	18,290	23,344	**43,187**
SSE	5	12	6	8	10	85	314	83	26	1,063	**1,612**
Total	**1,303**	**7,367**	**14,411**	**18,539**	**20,621**	**47,723**	**569,001**	**2,578,986**	**2,845,109**	**1,639,291**	**7,742,351**

Key: LLNL, Lawrence Livermore National Laboratory.
Source: DOC 1992.

J.5.3.1.3 Agricultural Data

The 1992 Census of Agriculture (DOC 1992) was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. LLNL food production and consumption data used for the dose assessments in the SPD EIS were obtained from the 1992 Census data for LLNL (DOC 1992).

J.5.3.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are provided in the ORNL *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998c).

J.5.3.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the lead assembly facility at LLNL, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).
- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).
- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.
- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.
- Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative because use of the actual stack height negates plume rise.
- The calculated doses are 50-year committed doses from 1 year of intake.

J.5.3.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.3.4.

J.5.4 LANL

J.5.4.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at LANL. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.4.1.1 Meteorological Data

The meteorological data used for the LANL dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken at a specific location and height. Annual meteorological conditions were used for normal operation. Table J–61 presents the JFD used in the dose assessments for LANL.

J.5.4.1.2 Population Data

The LANL population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at Technical Area 55 (TA–55), the location from which radionuclides are assumed to be released during incident-free operations. Table J–62 presents the population data used for lead assembly dose assessments at LANL.

J.5.4.1.3 Agricultural Data

The 1992 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-m (50-mi) assessment area were assumed to consume only food grown in that area. LANL food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Draft Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (DOE 1997b).

J.5.4.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are provided in the ORNL *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998d).

Table J–61. LANL 1993–1996 Joint Frequency Distributions at 11-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.78	A	0.12	0.26	0.5	0.84	0.74	0.54	0.45	0.32	0.18	0.11	0.08	0.05	0.06	0.06	0.07	0.07
	B	0.03	0.05	0.12	0.19	0.16	0.09	0.08	0.07	0.04	0.01	0.02	0.01	0.02	0.02	0.01	0.02
	C	0.05	0.09	0.14	0.2	0.16	0.09	0.09	0.09	0.07	0.04	0.03	0.03	0.02	0.03	0.02	0.03
	D	0.86	0.69	0.57	0.45	0.47	0.34	0.33	0.33	0.38	0.35	0.33	0.31	0.35	0.4	0.57	0.72
	E	0.59	0.45	0.33	0.23	0.22	0.15	0.13	0.13	0.17	0.24	0.32	0.28	0.29	0.4	0.51	0.62
	F	0.26	0.28	0.27	0.19	0.18	0.17	0.2	0.25	0.3	0.32	0.22	0.17	0.15	0.2	0.24	0.25
2.5	A	0.03	0.07	0.17	0.45	0.56	0.43	0.33	0.22	0.18	0.08	0.06	0.05	0.04	0.03	0.03	0.03
	B	0.02	0.05	0.2	0.39	0.42	0.31	0.27	0.22	0.16	0.1	0.06	0.05	0.05	0.04	0.03	0.02
	C	0.05	0.15	0.46	0.68	0.65	0.45	0.46	0.59	0.59	0.26	0.16	0.12	0.16	0.12	0.07	0.05
	D	0.95	1.09	0.94	0.72	0.56	0.34	0.47	1.3	2.12	1.89	1.93	0.95	1.08	0.81	0.56	0.63
	E	0.87	0.59	0.34	0.19	0.11	0.1	0.13	0.24	0.67	1.82	2.41	1.72	1.84	1.41	0.8	0.8
	F	0.09	0.07	0.05	0.03	0.01	0.01	0.05	0.1	0.25	0.33	0.11	0.36	0.39	0.39	0.12	0.07
4.5	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0.02	0.01	0
	C	0.02	0.04	0.07	0.04	0.02	0.01	0.01	0.03	0.15	0.09	0.11	0.19	0.31	0.19	0.09	0.02
	D	0.81	0.8	0.42	0.16	0.07	0.04	0.11	0.99	3.24	3.52	2.59	1.61	1.86	1.05	0.54	0.44
	E	0.21	0.2	0.08	0.01	0	0	0.01	0.07	0.32	1.74	1.08	1.32	1.31	0.32	0.23	0.22
	F	0	0.01	0	0	0	0	0	0	0.02	0.04	0	0.05	0.05	0.01	0.01	0
6.9	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0	0
	D	0.19	0.2	0.05	0	0	0	0.01	0.31	0.96	1.42	0.87	0.93	0.62	0.48	0.31	0.15
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.6	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0.01	0.01	0	0	0	0	0	0.05	0.03	0.08	0.09	0.19	0.08	0.05	0.04	0.02
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0.01	0	0	0.01	0.01	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Key: LANL, Los Alamos National Laboratory.
Source: LANL 1997.

Table J–62. Projected LANL Population Surrounding TA–55 for Year 2005

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	25	26	44	221	701	1,606	1,125	2,962	**6,710**
SSW	0	0	26	20	56	21	1,373	4,464	4,949	43,596	**54,505**
SW	0	0	26	22	80	29	155	1,767	817	30,893	**33,789**
WSW	0	0	26	21	56	302	159	1,187	2,500	61	**4,312**
W	0	0	27	20	26	457	190	1,084	135	350	**2,289**
WNW	0	12	39	135	90	532	73	138	1,755	1,306	**4,080**
NW	0	152	1,287	2,379	1,500	720	102	195	248	274	**6,857**
NNW	0	427	844	224	126	421	169	211	174	220	**2,816**
N	500	585	264	107	137	560	609	688	659	289	**4,398**
NNE	0	480	61	57	56	463	958	919	658	143	**3,795**
NE	0	101	12	17	22	378	12,856	2,950	1,954	3,236	**21,526**
ENE	0	10	12	17	22	618	13,270	3,439	2,869	1,938	**22,195**
E	0	10	12	17	22	684	3,598	590	719	1,161	**6,813**
ESE	0	10	12	17	33	220	1,602	3,608	316	834	**6,652**
SE	0	0	0	0	4,488	952	6,143	76,455	4,503	742	**93,283**
SSE	0	0	0	117	85	224	5,021	10,633	2,091	483	**18,654**
Total	**500**	**1,787**	**2,673**	**3,196**	**6,843**	**6,802**	**46,979**	**109,934**	**25,472**	**88,488**	**292,674**

Key: LANL, Los Alamos National Laboratory; TA–55, Technical Area 55.
Source: DOC 1992.

J.5.4.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the lead assembly facility at LANL, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).
- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).
- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.
- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

- Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative, because use of the actual stack height negates plume rise.
- The calculated doses are 50-year committed doses from 1 year of intake.

J.5.4.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.4.4.

J.5.5 SRS

J.5.5.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at SRS. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.5.1.1 Meteorological Data

The meteorological data used for the SRS dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location (H-Area) and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operation. Table J–63 presents the JFD used in the dose assessments for SRS.

J.5.5.1.2 Population Data

The SRS population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered within H-Area, the location from which radionuclides are assumed to be released during incident-free operations. Table J–64 presents the population data used for the lead assembly dose assessments at SRS.

J.5.5.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. SRS food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition of Final PEIS* (HNUS 1996).

Table J–63. SRS 1987–1991 Joint Frequency Distributions at 61-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
2.0	A	0.37	0.41	0.37	0.42	0.4	0.37	0.4	0.36	0.36	0.35	0.45	0.39	0.45	0.43	0.37	0.41
	B	0.08	0.08	0.09	0.1	0.05	0.06	0.06	0.05	0.08	0.07	0.05	0.05	0.05	0.08	0.05	0.07
	C	0.03	0.06	0.09	0.07	0.06	0.05	0.06	0.05	0.07	0.05	0.06	0.05	0.08	0.05	0.05	0.05
	D	0.02	0.05	0.06	0.04	0.06	0.03	0.06	0.07	0.06	0.03	0.07	0.05	0.04	0.03	0.05	0.04
	E	0.01	0.02	0.04	0.01	0.01	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.02
	F	0	0.01	0.01	0.01	0.01	0.01	0	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
4.0	A	0.87	0.74	0.88	1	0.94	0.94	0.65	0.62	0.74	0.72	1	1.28	1.29	0.94	0.53	0.6
	B	0.27	0.41	0.58	0.62	0.43	0.34	0.24	0.22	0.32	0.33	0.48	0.67	0.56	0.37	0.25	0.21
	C	0.17	0.57	1.13	1.03	0.6	0.41	0.41	0.37	0.48	0.52	0.59	0.79	0.53	0.45	0.3	0.24
	D	0.1	0.44	1.07	0.89	0.55	0.5	0.71	0.69	0.92	0.91	0.8	0.81	0.72	0.57	0.43	0.27
	E	0.06	0.27	0.69	0.48	0.3	0.33	0.46	0.7	0.67	0.57	0.54	0.47	0.43	0.43	0.33	0.3
	F	0.02	0.05	0.09	0.04	0.02	0.08	0.09	0.09	0.11	0.08	0.12	0.09	0.03	0.05	0.05	0.07
6.0	A	0.57	0.26	0.16	0.19	0.15	0.07	0.07	0.09	0.14	0.14	0.21	0.24	0.27	0.24	0.14	0.24
	B	0.14	0.39	0.38	0.31	0.16	0.11	0.07	0.08	0.19	0.21	0.32	0.51	0.51	0.36	0.13	0.09
	C	0.12	0.54	1.3	0.74	0.35	0.19	0.22	0.25	0.47	0.46	0.56	0.69	0.64	0.56	0.21	0.12
	D	0.12	0.43	0.85	0.58	0.4	0.44	0.65	1.16	1.45	0.78	0.9	0.77	0.78	0.65	0.32	0.09
	E	0.07	0.53	0.69	0.71	0.6	0.45	0.65	1.01	1.18	0.94	0.91	0.89	0.48	0.4	0.19	0.14
	F	0.01	0.26	0.21	0.14	0.14	0.19	0.13	0.16	0.22	0.21	0.24	0.23	0.07	0.04	0.02	0.04
8.0	A	0.09	0.05	0.01	0.01	0.01	0	0.01	0.01	0.02	0.02	0.02	0.04	0.03	0.02	0.01	0.06
	B	0.01	0.08	0.03	0.01	0.01	0.01	0	0.01	0.05	0.04	0.05	0.1	0.17	0.21	0.06	0.01
	C	0.01	0.1	0.2	0.08	0.02	0.03	0.03	0.06	0.16	0.16	0.21	0.26	0.45	0.43	0.1	0.02
	D	0.01	0.05	0.1	0.02	0.01	0.01	0.05	0.18	0.22	0.15	0.1	0.09	0.03	0.05	0.03	0
	E	0	0.05	0.03	0.04	0.01	0.01	0	0.03	0.04	0.02	0.04	0.01	0.01	0	0	0
	F	0	0.03	0.02	0.02	0	0.01	0	0.01	0.02	0.01	0.02	0.01	0	0	0	0
12.0	A	0.01	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0	0.01	0	0.01
	B	0	0.01	0	0	0	0	0	0	0	0	0.01	0.01	0.06	0.06	0.01	0
	C	0	0.01	0	0	0	0.01	0	0.03	0.04	0.04	0.05	0.06	0.16	0.17	0.02	0.01
	D	0	0.02	0.02	0	0	0	0	0.01	0.02	0.04	0	0	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.1	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Simpkins 1997.

Table J–64. Projected SRS Population Surrounding H-Area for Year 2005

Direction	Distance (miles)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	0	485	1,807	5,207	3,545	**11,044**
SSW	0	0	0	0	0	0	629	1,906	5,070	2,361	**9,966**
SW	0	0	0	0	0	25	895	7,586	1,939	2,953	**13,398**
WSW	0	0	0	0	0	71	2,428	4,529	3,330	8,327	**18,685**
W	0	0	0	0	0	683	4,586	54,394	22,338	13,086	**95,087**
WNW	0	0	0	0	0	1,384	7,849	172,996	76,767	6,917	**265,913**
NW	0	0	0	0	0	1,026	14,508	34,759	4,044	3,629	**57,966**
NNW	0	0	0	0	0	2,691	30,598	23,544	8,243	6,184	**71,260**
N	0	0	0	0	0	363	4,049	3,790	4,887	20,832	**33,921**
NNE	0	0	0	0	0	89	1,790	3,016	6,535	21,457	**32,887**
NE	0	0	0	0	0	15	3,754	3,684	6,147	9,896	**23,496**
ENE	0	0	0	0	0	9	3,723	6,246	6,956	43,139	**60,073**
E	0	0	0	0	0	113	7,647	3,844	6,830	4,084	**22,518**
ESE	0	0	0	0	0	3	1,329	2,551	3,551	5,933	**13,367**
SE	0	0	0	0	0	0	552	4,950	4,962	8,342	**18,806**
SSE	0	0	0	0	0	0	374	597	1,940	2,703	**5,614**
Total	**0**	**0**	**0**	**0**	**0**	**6,472**	**85,196**	**330,199**	**168,746**	**163,388**	**754,001**

Source: DOC 1992.

J.5.5.1.4 Source Term Data

Incident-free radiological releases, stack heights, and release locations are provided in the ORNL *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998e).

J.5.5.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operations of the facilities at SRS, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

- Ground surfaces were assumed to have no previous deposition of radionuclides.
- The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).
- The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).
- The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

- Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative because use of the actual stack height negates plume rise.

- The calculated doses are 50-year committed doses from 1 year of intake.

J.5.5.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.5.4.

J.6 REFERENCES

Antonio, E., 1998, Battelle Pacific Northwest National Laboratory, Richland, WA, personal communication (facsimile) to R. Schlegel, Science Applications International Corporation, Germantown, MD, *Doses at 400 Area*, March 23.

DOC (U.S. Department of Commerce), 1992, *Census of Population and Housing, 1990: Summary Tape File 3 on CD-ROM*, Bureau of the Census, May.

DOE (U.S. Department of Energy), 1993, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, Office of Environment, Safety and Health, January 7.

DOE (U.S. Department of Energy), 1995, *Occupational Radiation Protection*, 10 CFR 835, Washington, DC, January 1.

DOE (U.S. Department of Energy), 1997a, *1996 Environmental Report for Pantex Plant*, DOE/AL/65030-9704, Albuquerque Operations Office, Amarillo Area Office, Amarillo, TX, May.

DOE (U.S. Department of Energy), 1997b, *Draft Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site*, DOE/EIS-0277D, Office of Environmental Management, Washington, DC, November.

Gouveia, F., 1997, Los Alamos National Laboratory, Los Alamos, NM, personal communication to R. Schlegel, Science Applications International Corporation, Germantown, MD, *1993 LLNL Star Data*, February.

HNUS (Halliburton NUS Corporation), 1996, *Health Risk Data for Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, Gaithersburg, MD, February.

ICRP (International Commission on Radiological Protection), 1991, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Elmsford, NY.

LANL (Los Alamos National Laboratory), 1997, *LANL Joint Frequency Distribution Data*, from Internet Homepage, www.lanl.gov/public/welcome.html, February.

Mitchell, R.G., D. Peterson, D. Roush, R.W. Brooks, L.R. Paulus, and D.B. Martin, 1997, *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1996*, DOE/ID-12082(96), U.S. Department of Energy, Idaho Operations Office, Idaho Falls, ID, August.

NAS (National Academy of Sciences and National Research Council), 1990, Committee on the Biological Effects of Ionizing Radiations, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V*, Board of Radiation Effects Research, Commission on Life Sciences, National Academy Press, Washington, DC.

Neitzel, D.A., ed., 1996, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, rev. 8, PNL-6415, Battelle, Pacific Northwest National Laboratory, Richland, WA, August.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR 50, Appendix I*, Regulatory Guide 1.109, Office of Standards Development, Washington, DC, October.

NWS (National Weather Service), 1997, *Meteorological Data for Pantex Site*, Texas Natural Resources Conservation Commission, Amarillo, TX.

O'Connor, D.G., et al., 1998a, *ANL-W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13478, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998b, *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13481, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998c, *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13480, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998d, *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13482, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998e, *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13483, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

Sagendorf, J., 1992, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Washington, DC, personal communications to S. Maheras, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID, *Meteorological Joint Frequency Data Sets for INEEL*, January.

Simpkins, A.A., 1997, Westinghouse Savannah River Company, Aiken, SC, personal communication to J.R. Sessions, Westinghouse Savannah River Company, Aiken, SC, *Meteorological and Worker Dose Data for Plutonium Residues EIS*, May.

TNRCC (Texas Natural Resource Conservation Commission), 1997, *TNRCC Rules*, 101, "General Rules (Air Quality)"; 112, "Control of Air Pollution from Sulfur Compounds (Reg. II)"; 113, "Control of Air Pollution from Toxic Materials (Reg. III)," Austin, TX.

UC (Regents of the University of California), 1998a, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Hanford Site*, LA-UR-97-2907, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998b, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford*, CURL-ID-128275, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998c, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Hanford*, CURL-ID-128276, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998d, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Hanford Site*, LA-UR-97-2064, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998e, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Idaho National Engineering and Environmental Laborator*, LA-UR-97-2908, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998f, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Idaho National Engineering and Environmental Laboratory*, LA-UR-97-2065, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998g, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Pantex Plant*, LA-UR-97-2909, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998h, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Pantex Plant*, LA-UR-97-2067, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998i, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Savannah River Site*, LA-UR-97-2910, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998j, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Savannah River Site*, CURL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998k, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Savannah River Site*, CURL-ID-128272, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998l, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in New Facilities at Savannah River Site*, CURL-ID-128273, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998m, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site*, CURL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998n, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Savannah River Site*, LA-UR-97-2066, Los Alamos National Laboratory, Los Alamos, NM.

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Appendix K
Facility Accidents

K.1 IMPACT ASSESSMENT METHODS FOR FACILITY ACCIDENTS

K.1.1 Introduction

The potential for facility accidents and the magnitude of their consequences are important factors for making reasonable choices among the various surplus plutonium disposition alternatives analyzed in the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS). Guidance on implementation of 40 CFR 1502.22, as amended (EPA 1992), requires the evaluation of impacts that have a low frequency of occurrence but high consequences. Further, public comments received during the scoping process have clearly indicated the public's concern with facility safety and health risks and the need to address these concerns in the decisionmaking process.

For the No Action Alternative, potential accidents are defined in existing facility documentation, such as Safety Analysis Reports (SARs), hazards assessment documents, National Environmental Policy Act (NEPA) documents, and probabilistic risk assessments (PRAs). The accidents include radiological and chemical accidents that have a low frequency of occurrence but high consequences, and a spectrum of other accidents that have a higher frequency of occurrence and lesser consequences. The data in these documents include accident scenarios, materials at risk, source terms (quantities of hazardous materials released to the environment), and consequences.

For each facility, a hazards analysis document identifying and estimating the effects of all major hazards that could affect the environment, workers, and the public would be issued in conjunction with the conceptual design package. Additional accident analyses for identified major hazards would be provided in a preliminary SAR issued during the period of definitive design (Title II) review. A final SAR would be prepared during the construction period and issued before testing began as final documented evidence that the new facility could be operated in a manner that did not pose any undue risk to the health and safety of workers and the public.

In determining the potential for facility accidents and the magnitude of their consequences, the SPD EIS considers two important concepts in the presentation of results: (1) risk and (2) uncertainties and conservatism.

K.1.1.1 Risk

One type of metric that can be obtained from the accident analysis results presented in the SPD EIS is accident risk. Risk is usually defined as the product of the consequences and estimated frequency of a given accident. Accident consequences may be presented in terms of dose (e.g., person-rem) or health effects (e.g., latent cancer fatalities [LCFs]). The accident frequency is the number of times the accident is expected to occur over a given period of time (e.g., per year). In general, the frequency of design basis and beyond-design-basis accidents is much lower than 1 per year, and therefore is approximately equal to the probability of the accident during 1 year. If an accident is expected to occur once every 1,000 years (i.e., a frequency of 1.0×10^{-3} per year) and the consequences of the accident are five LCFs, then the risk is $1.0\times10^{-3}\times5 = 5.0\times10^{-3}$ LCF per year.

A number of specific types of risk can be directly calculated from the MACCS2 results reported in the SPD EIS. One type of risk, average individual risk, is the product of the total consequences experienced by the population and the accident frequency, divided by the population. For example, if an accident has a frequency of 1.0×10^{-3} per year, the consequence thereof is 5 LCFs, and the population in which the fatalities are experienced is 100,000, then the average individual risk is $1.0\times10^{-3} \times 5/100{,}000 = 5.0\times10^{-8}$ LCF per year.

It is important to note that this metric is meaningful only when the mean value for consequence is used, because risk itself is not a random parameter, even though it involves underlying randomness. It is also noteworthy that the value of the average individual risk depends on the size of the area for which the population is defined. In general, the larger the area considered, the smaller the average individual risk for a given accident. The choice of an 80-km (50-mi) radius is common practice.

The average individual risk is a measure of the risk that an average individual (in this case within 80 km [50 mi] of the accident) experiences from specified accidents at the facility. This risk can be compared with other average individual risks, such as the risk of dying from a motor vehicle accident (about 1 in 80), the risk of death from fires (about 1 in 500), or the risk of accidental poisoning (about 1 in 1,000). These comparisons are not meant to imply that risks of an LCF caused by U.S. Department of Energy (DOE) operations are trivial, but only to show how they compare with other, more common risks. Radiological risks to the general public from DOE operations are considered to be involuntary risks as opposed to voluntary risks, such as operating a motor vehicle.

It is also possible to calculate population risk, which is the product of the total consequences experienced by the population and accident frequency. For example, if an accident has a frequency of 1.0×10^{-3} per year and the consequences of the accident is 5 LCFs, then the population risk is $1.0\times10^{-3}\times5 = 5.0\times10^{-3}$ LCF per year. Population risk is a measure of the expected number of consequences experienced by the population as a whole over the course of a year. Like average individual risk, population risk is sensitive to the size of the area for which the population is defined.

It would be inappropriate, however, to simply take the LCFs given the dose at 1,000 m (3,281 ft) or the LCFs given the dose at the site boundary and multiply them by the corresponding accident frequencies in an attempt to obtain the maximum individual risk to the noninvolved worker or the maximally exposed individual (MEI) member of the public. The reasons for this are discussed in the following paragraphs.

The distribution of centerline consequences from which the reported doses are obtained is constructed by modeling the accidental release many times using different weather conditions (i.e., windspeed, wind direction, stability class, and rainfall) each time. For each weather condition, the centerline consequences at 1,000 m (3,281 ft) and at the site boundary are calculated, and those values contribute to their respective distributions. Thus, given the accidental release, there is a 95 percent chance that the centerline consequences at 1,000 m (3,281 ft) and at the site boundary will fall below the reported 95th percentile consequences, and the expected consequences would be equal to the reported mean consequences. It is noteworthy, however, that the actual locations of the centerline consequences vary with wind direction, so the reported consequences are not associated with a specific point at 1,000 m (3,281 ft) or the site boundary. It is known only that the centerline consequences, wherever they might be, are characterized by the reported values.

A problem arises if the above consequences are used to characterize individual risk. Although there is always some location that is exposed to the centerline consequences, no location is associated with the risk obtained by multiplying the centerline consequences by the accident frequency, because the direction of the plume centerline changes for each set of weather conditions. As a result, the risk to an individual at the location of maximum risk is likely to be much lower than the risk calculated by multiplying the centerline consequences by the accident frequency. In fact, because there are 16 sectors, and because doses decrease with lateral movement away from the centerline even within a sector, risk values generated in this way would tend to overstate the risk by a factor of as much as 100, and possibly more. The values are bounding, but have a potentially misleading degree of conservatism. Ultimately, the Melcor Accident Consequence Code System (MACCS2) is capable of calculating individual consequences at the point of maximum consequences (as reported in the SPD EIS), but it is not configured to calculate individual risk at the point of maximum risk.

K.1.1.2 Uncertainties and Conservatism

The analyses of accidents are based on calculations relevant to hypothetical sequences of events and models of their effects. The models provide estimates of the frequencies, source terms, pathways for dispersion, exposures, and the effects on human health and the environment that are as realistic as possible within the scope of the analysis. In many cases, a paucity of experience with the accidents postulated leads to uncertainty in the calculation of their consequences and frequencies. This fact has prompted the use of models or input values that yield conservative estimates of consequence and frequency. All alternatives have been evaluated using uniform methods and data, allowing for a fair comparison of all alternatives.

Although average individual and population risks can be calculated from the information in the SPD EIS, the equations for such calculations involve accident frequency, a parameter whose calculation is subject to considerable uncertainty. The uncertainty in estimates of the frequency of highly unlikely events can be several orders of magnitude. This is the reason accident frequencies are reported in the SPD EIS qualitatively, in terms of broad frequency bins, as opposed to numerically. Similarly, any metric that includes frequency as a factor will have at least as much, and generally more, uncertainty associated with it. Therefore, the consequence metrics have been preserved as the primary accident analysis results, and accident frequencies identified qualitatively, to provide a perspective on risk that does not imply an unjustified level of precision.

K.1.2 Safety Design Process

Surplus plutonium disposition facilities would be designed to comply with current Federal, State, and local laws, DOE orders, and industrial codes and standards. This would result in a plant that is highly resistant to the effects of natural phenomena, including earthquake, flood, tornado, and high wind, as well as credible events as appropriate to the site, such as fire, explosions, and man-made threats.

The design process for the surplus plutonium disposition facilities would comply with the requirements for safety analysis and evaluation in DOE Orders 430.1 and 5480.23. These orders require that the safety assessment be an integral part of the design process to ensure compliance with all DOE construction and operation safety criteria by the time the facilities are constructed and in operation.

The safety analysis process begins early in conceptual design with the identification of hazards that could produce unintended adverse safety consequences to workers or the public. As the design develops, failure modes and effects analyses (FMEAs) are performed to identify events capable of releasing hazardous material. The kinds of events considered include equipment failure, spills, human error, fire, explosions, criticality, earthquake, electrical storms, tornado, flood, and aircraft crash. These postulated events become focal points for design changes or improvements to prevent unacceptable accidents. The analyses continue as the design progresses, the object being to assess the need for safety equipment and the performance of such equipment. Eventually, the safety analyses are formally documented in a SAR and, if appropriate, a PRA. The PRA documents the estimated frequency and consequences of a complete spectrum of accidents and helps to identify where design improvements could make meaningful safety improvements.

The first SAR, completed at the conclusion of conceptual design, includes identification of hazards and some limited assessment of a few enveloping design basis accidents. It includes deterministic safety analysis and FMEA of major systems. A comprehensive preliminary SAR, completed by the end of the preliminary design, provides a broad assessment of the range of design basis accident scenarios and the performance of equipment provided in the facility specifically for accident consequence mitigation. A limited PRA may be included in that analysis.

The SAR continues to be developed during detailed design. The safety review of the report and any supporting PRA are completed and safety issues resolved before the initiation of facility construction. Also, a final SAR is produced that includes documentation of safety-related design changes made during construction and the impact of those changes on the safety assessment. It also includes the results of any safety-related research and development that was performed to support the safety assessment of the facility. Approval of the final SAR is required before the facility is allowed to commence operation.

K.1.3 Facility Accident Identification and Quantification

K.1.3.1 Background

Identification of accident scenarios for the surplus plutonium disposition facilities is fairly straightforward. The proposed facilities are simple, and their processes have been used in other facilities for other purposes. From an accident identification and quantification perspective, therefore, these processes are well known and understood. Very few of the proposed activities would differ from activities at other facilities.

New facilities would likely be designed, constructed, and operated to provide an even lower accident risk than other facilities that have used these types of processes. The new facilities would benefit from lessons learned in the operation of similar processes. They would be designed to surpass existing plutonium facilities in the ability to reduce the frequency of accidents and to mitigate the consequences thereof.

A large experience base exists for the design of the proposed surplus plutonium disposition facilities and processes. Because the principal hazard to workers and the public from plutonium is the inhalation of very small particles, the safety management approach that has evolved is centered on control of those particles. The control approach is to perform all operations that could release airborne plutonium particles in a glovebox. The glovebox protects workers from inhalation of the particles and provides a convenient means for the collection of any particle that becomes airborne on filters. Air from the gloveboxes, operating areas, and buildings is exhausted through multiple stages of high efficiency particulate air (HEPA) filters and monitored for radioactivity prior to release from the building. These exhaust systems are designed for effective performance even under the severe conditions of design basis accidents, such as major fires involving an entire process line.

While the new processes and facilities would be designed to reduce the risks of a wide range of possible accidents to a level deemed acceptable, some such risks would remain. As with all engineered structures—e.g., houses, bridges, dams—there is some level of earthquake or high wind the structure could not survive. While new plutonium facilities must be designed to very high standards—for instance, they must survive, with little plutonium release, a 1-in-10,000-year earthquake—an accident more severe than the design basis can always be postulated. Current DOE standards require that new facilities be designed to prevent to the extent possible, and then withstand, control, and mitigate, all credible process-related accidents. For safety analysis purposes, credible accidents are generally defined as accidents with frequencies greater than 1 in 1 million per year, including such natural phenomena–induced accidents as earthquakes, high winds, and flooding. The accidents considered in the design, construction, and operation of these facilities are generally called design basis accidents.

In addition to the accident risks from the design basis accidents, the new facilities would face risks from beyond-design-basis accidents. For most plutonium facilities, the design basis includes all types of process-related accidents that have occurred in past operations: major spills, leaks, transfer errors, process-related fires, explosions, and nuclear criticalities. Certain natural phenomena–initiated accidents also meet the DOE design basis criteria. While extremely unlikely, all new plutonium facilities, as essentially all manmade structures, could collapse under the influence of an earthquake. For most new plutonium facilities, the worst possible accident is a beyond-design-basis earthquake that results in partial or total collapse of the structure, spills, possibly fires, and loss of confinement of the plutonium powder. Also conceivable are such external events as the crash of a large aircraft onto the structure with an ensuing fuel-fed fire. At most locations away from major airports, however, the likelihood is less than 1 in 10 million per year. For some locations, such as Pantex, the frequency is higher, so aircraft crash–initiated accidents are a basic consideration.

The accident analysis reported in the SPD EIS is less detailed than a formal PRA or facility safety analysis because it addresses bounding accidents (accidents with low frequency of occurrence and high consequence) and a representative spectrum of possible operational accidents (accidents with high frequency of occurrence and low consequence). The technical approach for the selection of accidents is consistent with the DOE Office of NEPA Oversight's *Recommendation for the Preparation of Environmental Assessments and Environmental Impact Statements* (DOE 1993), which recommends consideration of two major categories of accidents: design basis accidents and beyond-design-basis accidents.[1]

K.1.3.2 Identification of Accident Scenarios and Frequencies

A range of design basis and beyond-design-basis accident scenarios have been identified for each of the surplus plutonium disposition technologies (UC 1998a, 1998b, 1998c, 1998d, 1998e, 1998f, 1998g, 1998h, 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). For each technology, the wide range of process-related accidents possible during construction and operation of the facility have been evaluated to ensure that their consequences are low or the frequency of occurrence, extremely low.

All of the analyzed accidents would involve a release of small, respirable plutonium particles or direct gamma and neutron radiation, and to a lesser extent, fission products from a nuclear criticality. Analyses of each proposed operation for accidents involving hazardous chemicals are reflected in the data reports supporting the SPD EIS. However, as the quantities of hazardous chemicals to be handled are small relative to those of many industrial facilities, no major chemical accidents were identified. The general categories of process-related accidents considered include:

- Drops or spills of materials within and outside the gloveboxes
- Fires involving process equipment or materials, and room or building fires
- Explosions initiated by the process equipment or materials or by conditions or events external to the process
- Nuclear criticalities

For each of these accident categories, a conservative preliminary assessment of consequence was made, and where consequences were significant, one or more bounding accident scenarios were postulated. The building confinement and fire suppression systems would be adequate to reduce the risks of most spills and minor fires. The systems would be designed to prevent, to the extent practicable, larger fires and explosions. Great efforts have always been made to prevent nuclear criticalities, which have the potential to kill workers in their immediate vicinity. In all cases, standard practice is expected to keep the frequency of accidental nuclear criticalities as low as possible.

Because the DOE design criteria require that new plutonium processing buildings be of very robust, reinforced-concrete construction, very few events outside the building would have sufficient energy to threaten the building confinement. The principal concern would be the crash of a large commercial or military aircraft

[1] Some of the data reports supporting the SPD EIS use the terms "evaluation basis" and "beyond-evaluation-basis" to denote the two major categories of accidents. For clarity, the SPD EIS uses the terms "design basis" and "beyond-design-basis" throughout.

into the facility. Such an event, however, is highly unlikely. Only those crashes with a frequency greater than 10^{-7} per year are addressed in the SPD EIS.

Design basis and beyond-design-basis natural phenomena–initiated accidents are also considered. Because of the robust nature of construction of new plutonium facilities, the only design-basis natural phenomena-initiated accidents with the potential to impact the facility interior are seismic events. Similarly, seismic events also bound the consequences and risks posed by beyond-design-basis natural phenomena.

Accident frequencies are generally grouped into the bins of "anticipated," "unlikely," and "extremely unlikely," with estimated frequencies of greater than 10^{-2}, 10^{-2} to 10^{-4}, and 10^{-4} to 10^{-6} per year, respectively. The accidents evaluated represent a spectrum of accident frequencies and consequences ranging from low-frequency/high-consequence to high-frequency/low-consequence events. However, given the preliminary nature of the designs under consideration, it was not possible to assess quantitatively the frequency of occurrence of all the events addressed. The evaluation does not indicate the total risk of operating the facility, but does provide information on high-risk events that could be used to develop an accident risk ranking of the various alternatives.

K.1.3.3 Identification of Material at Risk

For each accident scenario, the material at risk—generally plutonium—was identified. Plutonium to be disposed of has a wide range of chemical and isotopic forms. The sources of plutonium vary among the various candidate facilities, and for specific facilities among various alternatives. Table K–1 presents the isotopic breakdowns that were used in the development of accident consequences in the SPD EIS. The vulnerability of material generally depends on the form of that material, the degree and robustness of containment, and the energetics of the potential accident scenario. For example, plutonium stored in strong, tight storage containers is not generally vulnerable to simple drops or spills, but may be vulnerable in a total collapse earthquake scenario.

Table K–1. Isotopic Breakdown of Plutonium Used in Accident Analysis

Isotope	Pit Disassembly, MOX, and Lead Assembly	Immobilization: Plutonium Conversion	Immobilization: First Stage, Hybrid Case	Immobilization: First Stage, 50-t Case
Plutonium 238	3.00×10^{-2}	0.0	0.0	1.98×10^{-2}
Plutonium 239	92.2	86.0	86.0	90.1
Plutonium 240	6.46	11.0	11.0	8.12
Plutonium 241	5.00×10^{-2}	1.49	1.49	5.74×10^{-1}
Plutonium 242	1.00×10^{-1}	4.95×10^{-1}	4.95×10^{-1}	2.48×10^{-1}
Americium 241	9.00×10^{-1}	9.90×10^{-1}	9.90×10^{-1}	9.31×10^{-1}

On an industrial scale, the quantities of hazardous chemicals are generally small. The occupational risks are generally limited to material handling and are managed under the required industrial hygiene program. No substantial hazardous chemical releases are expected.

K.1.3.4 Identification of Material Potentially Released to the Environment

The amount and particle size distribution of material aerosolized in an accident generally depends on the form of that material, the degree and robustness of containment, and the energetics of the potential accident scenario. Once the material is aerosolized, it must still travel through building confinement and filtration systems or bypass the systems before being released to the environment.

A standard DOE formula was used to estimate the source term for each accident at each of the proposed surplus plutonium facilities:

$$\text{Source Term} = \text{MAR} \times \text{DR} \times \text{ARF} \times \text{RF} \times \text{LPF}$$

where:

MAR = material at risk (curies or grams)
DR = damage ratio
ARF = airborne release fraction
RF = respirable fraction[2]
LPF = leak path factor

The value of each of these factors depends on the details of the specific accident scenario postulated. ARF and RF were estimated according to reference material in *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities* (DOE-HDBK-3010-94) (DOE 1994a). Conservative HEPA filter efficiencies of 0.999 and 0.99 were assumed, based on two stages of filtration, for a total LPF of 1.0×10^{-5}; however, actual efficiencies would likely be 0.999 and 0.998 or better. For the Building 221–F ventilation system at the Savannah River Site (SRS), a total LPF of 4.9×10^{-3} was used to account for the F-Area sand filters.

No accident scenarios were identified that would result in a substantial release of plutonium or other radionuclides via liquid pathways.

K.1.4 Evaluation of Consequences of Accidents

K.1.4.1 Potential Receptors

For each potential accident, information is provided on accident consequences and frequencies to three types of receptors: (1) a noninvolved worker, (2) the maximally exposed member of the public, and (3) the offsite population. The first receptor, a noninvolved worker, is a hypothetical individual working on the site but not involved in the proposed activity. The worker is assumed to be downwind at a point 1,000 m (3,281 ft) from the accident. Although other distances closer to the accident could have been assumed, the calculations break down at distances of about 200 m (656 ft) or less due to limitations in modeling the effects of building wake and local terrain on dispersion of the released radioactive substances. A worker closer than 1,000 m (3,281 ft) to the accident would generally receive a higher dose; a worker farther away, a lower dose. At some sites where the distance from the accident to the nearest site boundary is less than 1,000 m (3,281 ft), the worker is assumed to be at the site boundary. The second receptor, a maximally exposed member of the public, is a hypothetical individual assumed to be downwind at the site boundary. Exposures received by this individual are intended to represent the highest doses to a member of the public. The third receptor, the offsite population, is all members of the public within 80 km (50 mi) of the accident location.

Consequences to workers directly involved in the processes under consideration are addressed generically, without attempt at an scenario-specific quantification of consequences. This approach to in-facility consequences was selected for two reasons. First, the uncertainties involved in quantifying accident consequences become overwhelming for most radiological accidents due to the high sensitivity of dose values to assumptions about the details of the release and the location and behavior of the impacted worker. Also, the dominant accident risks to the worker of facility operations are from standard industrial accidents, as opposed to bounding radiological accidents. The accident fatality risk for DOE has been reported as

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[2] Respirable fractions are not applied in the assessment of doses based on noninhalation pathways, such as criticality.

2.3×10^{-5} per person per year. According to historical data on standard industrial accidents, the national average fatality risk from manufacturing operations is 3.5×10^{-5} per person per year.

K.1.4.2 Modeling of Dispersion of Releases to the Environment

The MACCS2 computer code (version 1.12) was used to estimate the consequences of accidents for the proposed surplus plutonium disposition facilities. A detailed description of the MACCS2 model is available in NUREG/CR-4691 (NRC 1990). Originally developed to model the radiological consequences of nuclear reactor accidents, this code has been used for the analysis of accidents for many EISs and other safety documentation, and is considered applicable to the analysis of accidents associated with the disposition of plutonium.

MACCS2 models the offsite consequences of an accident that releases a plume of radioactive materials into the atmosphere, specifically, the degree of dispersion versus distance as a function of historical wind direction, speed, and atmospheric conditions. Were such an accidental release to occur, the radioactive gases and aerosols in the plume would be transported by the prevailing wind and dispersed in the atmosphere, and the population would be exposed to radiation. MACCS2 generates the distribution of downwind doses at specified distances, as well as the distribution of population doses out to 80 km (50 mi).

As implemented, the MACCS2 model evaluates doses due to inhalation of aerosols, such as respirable plutonium, as well as exposure to the passing plume. This represents the major portion of the dose that a noninvolved worker or member of the public would receive as a result of a plutonium disposition facility accident. The longer-term effects of plutonium deposited on the ground and surface waters after the accident, including the resuspension and inhalation of plutonium and the ingestion of contaminated crops, were not modeled for the SPD EIS. These pathways have been studied and been found not to contribute as significantly to dosage as inhalation, and they are controllable through interdiction. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances (as much as two orders of magnitude at the 80 km [50 mi] limit). Thus, the method used in the SPD EIS is conservative compared with dose results that would be obtained if deposition and resuspension were taken into account.

Longer-term effects of fission products released in a nuclear criticality accident have been extensively studied. The principal concern is ingestion of iodine 131 via milk that becomes contaminated due to the ingestion of contaminated grains by milk cows. This pathway can be controlled if necessary. In terms of the effects of an accidental criticality, doses from this pathway are small.

The region around the facility is divided by a polar-coordinate grid centered on the facility itself. The user specifies the number of radial divisions and their endpoint distances. The angular divisions used to define the spatial grid correspond to the 16 directions of the compass.

MACCS2 was applied in a probabilistic manner using a weather bin–sampling technique. Centerline doses, as a function of distance, were calculated for each of 1,460 meteorological sequence samples, resulting in a distribution of doses reflecting variations in weather conditions at the time of the postulated accidental release. The code outputs the conditional probability of exceeding a dose as a function of distance. The mean and 95th percentile consequences are reported in the SPD EIS. Doses higher than the 95th percentile values would be expected only 5 percent of the time.

MACCS2 cannot be used to calculate directly the distribution of maximum doses (resulting from meteorological variations) around irregular contours, such as a site boundary. As a result, analyses that use

MACCS2 to calculate site boundary doses usually default to calculating doses at the distance corresponding to the shortest distance to the site boundary. In effect, the site boundary is treated as if it were circular, with a radius equal to the shortest distance from the facility to the actual site boundary. While this approximation is conservative with respect to dose (with the possible exception of doses from elevated plumes), it eliminates the use of some site-specific information, namely the site boundary location (other than the nearest point), wind direction, and any correlation between wind direction and other meteorological parameters. Because the primary purpose of the SPD EIS is to aid in decisions about facility locations, and because differences in dose values among the various options are largely a function of site-specific variations, a different approach was taken to more accurately characterize the potential for maximum doses at the site boundary.

For the SPD EIS, MACCS2 was used to generate intermediate results that could be further processed to obtain the distribution of doses around the site boundary, accounting for variations in site boundary distance as a function of direction. The specific instrument was the Type B result option of MACCS2, which renders the distribution of doses at a specified radial distance within a specified compass sector, given a release. Type B results were requested for the site boundary distance for each of the 16 compass sectors over which the meteorological data is defined. This resulted in 16 separate dose distributions; one for each specific location around the site boundary. The distribution of maximum doses around the site boundary was constructed by first summing the values of the Type B distributions for each dose value. The resulting distribution was then truncated for low dose values to the point where the remainder of the distribution was normalized. This produced the distribution of maximum doses around the site boundary, which is the distribution from which the mean and 95th percentile doses are reported.

Radiological consequences may vary somewhat as a result of variations in the duration of release. For longer releases, there is a greater chance of plume meander (i.e., variations in wind direction over the duration of release). MACCS2 models plume meander by increasing the lateral dispersion coefficient of the plume for longer release durations, thus lowering the dose. For perspective, doses from an homogenous, 1-hr release would be 30 percent lower than those of a 10-minute release as a result of plume meander; doses from a 2-hr release, 46 percent lower. The other effect of longer release durations is involvement of a greater variety of meteorological conditions in a given release, which reduces the variance of the resulting dose distributions. This would tend to lower high-percentile doses, raise low-percentile doses, and have no effect on the mean dose.

For the SPD EIS accident analysis, a duration of 10 minutes was assumed for all releases. This is consistent with the accident phenomenology expected for all scenarios, with the possible exception of fire. Depending on the circumstances, the time between fire ignition and extinction may be considerably longer, particularly for the larger, beyond-design-basis fires. However, even in a fire of long duration, it is possible to release substantial fractions of the total radiological source term in fairly short periods, as the fire consumes areas of high MAR concentrations. The assumption of a 10-minute release duration for fire is intended to generically account for this circumstance.

K.1.4.3 Modeling of Consequences of Releases to the Environment

The mean and 95th percentile consequences of accidental radiological releases, given variations in meteorological conditions at the time of the accident, are calculated as radiological doses in terms of rem. The mean consequences, or the expected consequences of the accident, are an appropriate statistic for use in risk estimates. The 95th percentile consequences represent bounding consequences of the accident; that is, if the accident were to occur and release the stated source term, there would be a 95 percent probability of lower than the stated consequences. This statistic is thus useful for characterizing the bounding consequence potential of the proposed activity under the stated accident condition. The consequences are also expressed as the additional potential or likelihood of death from cancer for the noninvolved worker and the maximally exposed member of the public, and the expected number of incremental LCFs among the exposed population.

The probability coefficients for determining the likelihood of fatal cancer, given a dose, are taken from the *1990 Recommendations of the International Commission on Radiation Protection* (ICRP 1991). For low doses or low dose rates, respective probability coefficients of 4.0×10^{-4} and 1.0×10^{-3} fatal cancers per rem are applied for workers and the general public.[3] For high doses received at a high rate, respective probability coefficients of 8.0×10^{-4} and 1.0×10^{-3} fatal cancers per rem are applied for noninvolved workers and the public. These higher probability coefficients apply where doses are above 20 rem and dose rates above 10 rem per hour.

K.1.5 Accident Scenarios for Surplus Plutonium Disposition Facilities

Bounding design basis and beyond-design-basis accident scenarios have been developed from accident scenarios presented in each of the surplus plutonium disposition data reports (UC 1998a, 1998b, 1998c, 1998d, 1998e, 1998f, 1998g, 1998h, 1998i, 1998j, 1998k, 1998l, 1998m, 1998n). These scenarios are discussed in detail, along with specific assumptions for each facility and site, in these documents.

K.1.5.1 Accident Scenario Consistency

In preparing the accident analysis for the SPD EIS, the primary objective was to ensure consistency between the data reports so that results of the analyses for the proposed surplus plutonium disposition alternatives could be compared on as equal a footing as possible. In spite of efforts by all parties, some inconsistencies exist between the data reports. This does not imply technical inaccuracy in any analysis; it merely reflects the uncertainties and reliance on convention that are inherent in accident analyses in general. In order to provide a consistent analytical basis, information in the data reports has been modified or augmented as described below.

Aircraft Crash. It was decided early in the process of developing accident scenarios that aircraft crash scenarios would not be provided in the data reports, but would be developed, as appropriate, directly for the SPD EIS.

Frequencies of an aircraft crash into each facility for each alternative were developed in accordance with DOE-STD-3014 (DOE 1996a). The frequency of crashes involving aircraft capable of penetrating the subject facility (assumed to be all aircraft except those in general aviation) would be below 1.0×10^{-7} per year for all facilities except those at Pantex and the combination of Building 221–F and the Defense Waste Processing Facility (DWPF) at SRS. For facilities at Pantex, the frequency of impact would be 1.4×10^{-6} per year; for the combination of Building 221–F and DWPF, 1.1×10^{-7} per year.

Of the variety of impact conditions accounted for in the above frequency values (e.g., impact angle, direction, lateral distance from building center, speed) only a fraction would have the potential to produce consequences comparable to those reported in the SPD EIS, while other impacts (grazing impacts, impacts into office areas, etc.) would not result in significant radiological impacts. Therefore, it was qualitatively determined that the overall scenario frequency of aircraft crash into Building 221–F and DWPF at SRS, leading to radiological consequences, was below 1.0×10^{-7} per year, so that additional examination was unnecessary. Aircraft crashes at Pantex with the potential for significant consequences could occur more frequently than 1.0×10^{-7} per year, so these scenarios were analyzed further.

[3] Probability coefficients for the likelihood of nonfatal cancer are 8.0×10^{-5} for adult workers and 1.0×10^{-4} for the public. The probability coefficients for severe hereditary effects are 8.0×10^{-5} for adult workers and 1.3×10^{-4} for the public.

For the facilities at Pantex, the potential for an aircraft crash into vaults containing large quantities of plutonium powder was examined in relation to the potential for a crash into the facility as a whole. For the pit conversion and mixed oxide (MOX) facilities, the footprint of the vault would be considerably less than one-tenth that of the facility as a whole, indicating that vault impact frequencies would be on the order of, and perhaps less than, one-tenth the facility impact frequencies. Moreover, fewer types of aircraft would have the potential to penetrate the vault due to the robustness of the reinforced-concrete vault structures and their location in the basements of the facilities. Inside the vault, the storage containers would provide additional protection against the release of material. The protection provided by the vault structure and the storage containers can be regarded as conducive to a further reduction in the frequency of aircraft crashes into vault areas.

In response to public concern over the risk of an aircraft crash at Pantex, and consistent with a Memorandum of Understanding between the DOE Amarillo Area Office and the Federal Aviation Administration (FAA), an Overflight Working Group was established. This working group provided a number of recommendations for reducing the risk of an aircraft crash into any facility at Pantex. DOE supplemented the Memorandum of Understanding with an Interagency Agreement with the FAA. These actions resulted in the following recommendations:

- Modifying the vectoring of approaching aircraft to preclude extended flying over plant boundaries and reducing the number of aircraft turning on final approach over the plant
- Modifying holding patterns so that they are away from the plant
- Developing a new global positioning satellite (GPS), nonprecision approach to runway 22
- Replacing the backcourse localizer approach to runway 22 with an offset localizer approach
- Upgrading the lighting system for the approach to runway 4
- Establishing a hotline between the FAA and DOE
- Establishing new very high frequency omnidirection radio tactical (VORTAC) air navigation device locations
- Installing a GPS ground differential station, and commissioning a new GPS precision approach to runway 22

As of this date, all the recommendations except the last two have been implemented. The recommendation to install a precision approach is on hold until the FAA develops the standards for the augmentation system. While these changes cannot be quantitatively reflected in the frequency of aircraft crash as calculated by DOE-STD-3014, the improvements have been acknowledged as representing a reduction in the exposure of Pantex to aircraft, which translates to a reduction in the aircraft crash frequency at that site.

As a result of the above considerations, it was determined that the overall scenario frequency of an aircraft crash into a plutonium powder vault associated with either the pit conversion or MOX facility was below the threshold frequency of 1.0×10^{-7} per year. Additionally, it was qualitatively determined that in light of the above considerations, the overall frequency of aircraft impact into the pit or MOX facilities at Pantex was below 1×10^{-6} per year, or "beyond extremely unlikely." The development of consequences of an aircraft crash was therefore refocused on the MAR that could be in process areas at the time of the crash. To develop representative consequences, it was assumed that the aircraft impact would involve the process area containing the largest amount of material in the most dispersable form. For the MOX facility, the impact was assumed to involve the unloading vessel and hopper storage, powder blending process, and MOX powder storage areas. These processes would contain the bulk of process plutonium in powder form. The total quantity of plutonium in powder form would be 1.8×10^5 g (6.3×10^3 oz), assuming that one-third of the plutonium in MOX powder storage was in powder form, one-third in green pellet form, and one third in the form of sintered pellets. However, given the potentially high energy densities associated with an aircraft crash, it was assumed that the green pellets would be equally vulnerable to release as powder, for a total effective powder quantity of 3.5×10^5 g (1.2×10^4 oz). For the pit conversion facility, the impact was assumed to involve the bisector, blending, canning, nondestructive analysis, and temporary storage areas, for a total of 6.0×10^4g (2.1×10^3 oz) of plutonium in powder form.

The initial effect of the impact would be to disperse the material in a manner consistent with DOE-HDBK-3010-94 values for debris impact in powder. For this phenomenon, DOE-HDBK-3010-94 recommends bounding ARF and RF values of 1×10^{-2} and 0.2. However, according to *Particle Size of PuO_2 Generated by HYDOX-Ga Removal Process and Impact on Useability of DOE-HDBK-3010-94 ARF and RF Values* (Mishima 1997),[4] the range of powder fractions with an aerodynamic equivalent diameter (AED) of less than 10 microns (i.e., respirable) varies from 4.0×10^{-5} to 3.0×10^{-1}, with only 1 of the 10 analyzed samples exceeding 2.0×10^{-3}. Given that the debris impact could not subdivide the particles, an RF value of 3×10^{-2} was chosen. This choice was based on the assumption that 10 percent of the powder present at the time of impact would have a below-10-micron-AED fraction of 0.3, and the remainder, a below-10-micron-AED fraction of 2×10^{-3} or less. Combining this RF with the ARF of 1.0×10^{-2} results in a combined ARF and RF value of 3×10^{-4}, corresponding to a source term of 104 g (3.7 oz) for the MOX facility and 18 g (0.63 oz) for the pit conversion facility.

An aircraft crash could also induce a fire capable of entraining additional material in a lofted plume. The ARF and RF values for thermal stress are 6×10^{-3} and 1×10^{-2} respectively, which would result in a 20 percent increase in the source term. This additional source term should not contribute significantly to the noninvolved worker dose or the MEI dose, given the trajectory of the plume. However, it would contribute to the population dose. For simplicity, the source term was included in the ground-level release, for a total plutonium release of 22 g (0.78 oz) for the pit conversion facility and 125 g (4.4 oz) for the MOX facility.

Criticality. All of the data reports provide technically defensible information on criticality, but the analytical assumptions vary among the reports. To assess the significance of the variations, MACCS2 runs were performed for each criticality source term. The resulting doses varied by a factor of about 15 for all criticalities except the natural phenomena hazard (NPH) vault criticality in the immobilization data report. Doses from this criticality were roughly 100 times larger than any other doses and were dominated by aerosolized plutonium from the vault.

For the SPD EIS, it was decided to discard the NPH vault criticality on the grounds that it is, at most, an improbable event that is conditional on the occurrence of a beyond-design-basis earthquake and does not represent the potential consequences of an isolated criticality. Beyond-design-basis earthquakes have been addressed via a total collapse scenario in all data reports, and the additional assumption of a criticality occurring in addition to the total collapse does not significantly increase doses beyond those resulting from the collapse itself.

[4] The analyses documented therein encompass the HYDOX, gallium removal, milling, and MOX fuel fabrication processes, and are therefore relevant to all plutonium powder forms in the pit conversion and MOX facilities.

Of the remaining criticalities, the criticality in the rotary splitter tumbler in the glass immobilization data report produced the highest doses, dominated by fission products as opposed to plutonium. The source term for this criticality is based on a fission yield from 1.0×10^{19} fissions in an oxide powder.

For the SPD EIS, it was decided to use this source term for criticality for all facilities, because all facilities would handle oxide powder in quantities sufficient for criticality. The estimated frequency of extremely unlikely (i.e., 10^{-6} to 10^{-4} per year) reported in the immobilization data report was also used because it is the bounding estimate. (An extremely unlikely powder criticality was also cited in the MOX data report; in the pit conversion data report, likelihood was assessed in terms of undue criticality risk, of which three of the four identified criticalities had none.)

The criticality source term provided in the immobilization data report neglects some very short lived isotopes that would be expected in a criticality, namely bromine 85, iodine 136, krypton 89 and 90, and xenon 137. Since the half-lives of these isotopes are all less than 4 minutes, they do not have a significant direct impact on radiological consequences. However, the daughters of some of the isotopes are themselves radioactive; in particular, krypton 89 decays to rubidium 89, which has a half-life of 15 minutes. The significance of the daughters for overall consequences has been assessed for Pantex , which is considered bounding, since Pantex has the highest windspeeds and tends to carry the daughters the farthest for a given level of decay. As expected, the increase in dose is greatest for the noninvolved worker; approximately 25 percent higher for both the mean and 95th percentile. The dose increase decreases to 3 and 13 percent, respectively, for the mean and 95th percentile doses to the population within 80 km (50 mi). Dose increases at other sites are expected to be lower than corresponding increases at Pantex. Because these increases are small considering the great uncertainty inherent in the estimate of the total number of fissions, the source term in the immobilization data report remains a conservative estimate of the potential release from a criticality accident, and no modification of the source term has been made.

Design Basis Earthquake. Each data report presents an analysis of the design basis earthquake. The immobilization and MOX data reports provide source terms for that earthquake, while the pit conversion data reports indicate no release as a result of a design basis earthquake because the facility would be designed to withstand the event.

For the SPD EIS, a nonzero source term for pit conversion was generated by applying a building ventilation LPF of 1.0×10^{-5}, accounting for a HEPA filtered release, to the beyond-design-basis earthquake source term. It is recognized that this is a conservative procedure, in that the beyond-design-basis earthquake would release more material into the air within the building than a design basis earthquake. The combined ARF×RF for powder under beyond-design-basis earthquake conditions has been assessed as three times that for design basis earthquake conditions, and the total amount of vulnerable material may be somewhat greater. (For perspective, it resulted in a ratio of design basis earthquake to beyond-design-basis earthquake source term values that is somewhat higher than the corresponding ratio for MOX fuel fabrication, but lower than for plutonium conversion and immobilization.)

Beyond-Design-Basis Earthquake. All of the proposed operations would be in either existing or new facilities that would be expected to meet or exceed the requirements of DOE O 420.1 (DOE 1995) and DOE-STD-1020-94 (DOE 1994b) for reducing the risks associated with natural phenomena hazards. The proposed surplus plutonium disposition would be characterized as Performance Category 3 facilities. Such facilities would have to be designed or evaluated for a design basis earthquake with a mean annual exceedance probability of 5×10^{-4}, corresponding to a return period of 2,000 years. For sites such as Lawrence Livermore National Laboratory (LLNL), which are near tectonic plate boundaries, the requirements would include a mean annual seismic hazard exceedance probability of 1.0×10^{-3}, or a return period of 1,000 years.

The numerical seismic design requirements detailed in DOE-STD-1020-94 are structured such that there is assurance that specific performance goals are met. For plutonium facilities (Performance Category 3), the performance goal is that occupant safety, continued operation, and hazard confinement would be assured for earthquakes with an annual probability exceeding approximately 1×10^{-4}. There is sufficient conservatism in the design of buildings and the structures, systems, and components important to safety that these goals should be met given that they are designed against earthquakes with an estimated mean annual probability of 5×10^{-4}.

While the DOE order and standard require site-specific seismic evaluations, results of 1980s seismic studies were reported for all DOE sites to illustrate the variability among them. Estimated maximum horizontal ground surface accelerations for the design basis earthquake are 0.20g for Hanford, 0.17g for the Idaho National Engineering and Environmental Laboratory (INEEL), 0.57g for LLNL, 0.21g for the Los Alamos National Laboratory (LANL), 0.13g for Pantex, and 0.18g for SRS (DOE 1994c). In all cases, there is great uncertainty as to the annual probability of exceeding a specific ground acceleration for a site, as well as the maximum ground acceleration corresponding to a specific annual probability or return period. Estimated ground accelerations for earthquakes with a mean annual probability of 1×10^{-4} (corresponding to return periods of 10,000 years) are 0.39g for Hanford, 0.24g for INEEL, 0.82g for LLNL, 0.37g for LANL, 0.21g for Pantex, and 0.32g for SRS (DOE 1994c). In general, estimated ground accelerations for return periods exceeding 10,000 years have not been estimated for these DOE sites.

By contrast, nonnuclear structures at these sites and the surrounding community would be constructed to the standards of the Uniform Building Code for that region. These peak acceleration values are 50 to 82 percent of the peak acceleration design requirements for plutonium facilities in the same area and correspond approximately to DOE Performance Category 1 facilities with 500-year return intervals. During major earthquakes, structures built to these Uniform Building Code requirements would be expected to suffer significantly more damage than reinforced-concrete structures designed for plutonium operations.

At sites far from tectonic plate boundaries, deterministic techniques such as those used by the U.S. Nuclear Regulatory Commission (NRC) in evaluating safe-shutdown earthquakes for the siting of nuclear reactors have also been used to determine the maximum seismic ground motion requirements for facility designs. These techniques involve estimating the ground acceleration at the proposed plant either by assuming the largest historical earthquake within the tectonic province or by assessing the maximum earthquake potential of the appropriate tectonic structure or capable fault closest to the plant. For NRC-licensed reactors, this technique resulted in safe-shutdown earthquakes with estimated return periods in the 1,000- to 100,000-year range (DOE 1994c:C-17).

All the existing facilities under consideration in the SPD EIS have had seismic evaluations demonstrating that they meet the seismic evaluation requirements for the design basis earthquake. Some facilities, such as Building 332 at LLNL under consideration for preparation of the lead test assemblies, have had extensive evaluations of the ability of the structures, systems, and components important to safety to survive a range of seismic loadings. Evaluations reported in the *LLNL Site-Wide EIS* (DOE 1992) indicate that Building 332 would survive a postulated 0.8g earthquake and retain those features essential for the safe containment of radioactive materials. The estimated return interval for this level of ground accelerations is about 10,000 years. The facility was also examined for damage due to a 0.9g earthquake and found to be survivable (DOE 1992:app. D.5.2.1), albeit with some potential for loss of confinement due to equipment damage in safety systems (DOE 1992:table I-14).

The magnitude of potential earthquakes with return periods greater than 10,000 years is highly uncertain. For purposes of the SPD EIS, it was assumed that at all the candidate sites, earthquakes with return periods in the 100,000- to 10-million-year range might result in sufficient ground motion to cause major damage to even a modern, well-engineered and well-constructed plutonium facility. Therefore, in the absence of convincing evidence otherwise, a total collapse of the plutonium facilities was assumed to be scientifically credible and within the rule of reason for return intervals in this range.

Each data report presents an analysis of total collapse. The immobilization and MOX data reports are fairly consistent in their use of damage estimates and release fractions. They assume that material in storage containers in vault storage would be adequately protected from the scenario energetics, for a damage ratio of zero in the vault. They also assume powder ARF and RF values of 1.0×10^{-3} and 0.3, respectively. The pit conversion data reports assume a damage ratio of 50 percent for material held in storage containers, applies cumulative ARF and RF values of 2.7×10^{-3} to powder subject to seismic vibration, free-fall spill, and turbulent air currents; and also presents a resuspension source term.

For the SPD EIS, the pit conversion source term was modified by adjusting the damage ratio in the vault from 0.5 to 0 based on the corresponding analyses in the immobilization and MOX data reports, and adjusting the ARF and RF values for powder to 1.0×10^{-3} and 0.3, respectively. It is recognized that these adjustments are in the nonconservative direction, but either set of assumptions is considered technically sound and defensible. The value of 2.7×10^{-3}, used in the pit conversion data report, is based on seismic-induced collapse of large structures into loose bulk powder; this assumption is considered unnecessarily conservative given the expectation of containered storage for the majority of the powder inventory at any given time. The resuspension source term was kept (and was not applied to either immobilization or MOX). Although worth noting, this difference between the data reports is not considered particularly significant, for the resuspension source term constitutes only 30 percent of the total.

The frequency for all beyond-design-basis earthquakes for all facilities is reported in the SPD EIS as extremely unlikely to beyond extremely unlikely (the pit conversion facility data report estimated a frequency of less than 1×10^{-6} per year.) They are reported as such because the uncertainties inherent in associating damage levels with earthquake frequencies become overwhelming below frequencies of about 1.0×10^{-5} per year.

Filtration Efficiency. The immobilization and MOX data reports use a building filtration efficiency of 1.0×10^{-5} for particulate releases (except for Building 221–F, which is filtered through the F-Area sand filter). The pit conversion data report uses a building filtration efficiency of 2.0×10^{-6}. For consistency, the pit conversion source terms have been adjusted to reflect an LPF of 1.0×10^{-5}. This is reasonable because it is expected that the ventilation efficiencies of all HEPA-filtered buildings would be essentially the same.

Beyond-Design-Basis Fire. The MOX data report presents an analysis of a beyond-design-basis fire whose basis in terms of scenario definition was from the *Data Report for Plutonium Conversion Facility*, (Smith, Wilkey, and Siebe 1996), which was produced for the *Storage and Disposition Final PEIS* (DOE 1996b). Neither the pit conversion nor the immobilization data reports contain analyses of a beyond-design-basis fire.

For the SPD EIS, beyond-design-basis fires were developed for pit conversion and immobilization by replacing the building filtration LPF with an LPF of 1.4 percent, in accordance with the beyond-design-basis scenario definition presented in the *Data Report for Plutonium Conversion Facility* and adapted for the MOX fuel fabrication analysis. (For perspective, it resulted in a ratio of design basis fire to beyond-design-basis fire source term values that are within a factor of 2 of the corresponding ratio for MOX fuel fabrication.)

It is understood that the LPF of 1.4 percent is based on a facility-specific analysis of the Plutonium Finishing Building (PF–4) in Technical Area 55 at LANL, and that an analysis of other facilities using the same phenomenological assumptions might yield somewhat different results. However, for the purpose of this analysis, and considering the degree of similarity expected between facilities as a result of required plutonium-handling practices, this value was used generically in the assessment of beyond-design-basis fire.

K.1.5.2 Facility Accident Scenarios

K.1.5.2.1 Pit Conversion Facility

A wide range of potential accident scenarios were considered for the pit conversion facility. These scenarios are considered in detail in the pit conversion facility data reports (UC 1998a, 1998e, 1998k, 1998l). The analysis assumes that the pit conversion facility is located in a new or upgraded existing building designed to withstand design basis natural phenomena hazards such as earthquakes, winds, tornadoes, and floods such that no unfiltered releases would be expected. Also, no site-specific accidents conducive to releases are identified. Therefore, the potential accident scenarios apply to all four candidate sites.

Analysis of the proposed process operations for the pit conversion facility identified the following broad categories of accidents: aircraft crash, criticality, design basis earthquake, beyond-design-basis earthquake, explosion, fire, leaks or spills, and tritium release. Basic characteristics of each of these postulated accidents are described below. Additional discussion of scenario development based on consistency concerns can be found in Section K.1.5.1.

Aircraft Crash. A crash of a large, heavy commercial or military aircraft directly into a reinforced-concrete facility could damage the structure sufficient to breach confinement and disperse material into the environment. A subsequent fuel-fed fire could provide energy to further damage structures and equipment, aerosolize material, and drive materials into the environment. Source terms are highly speculative but would be expected to exceed those from the beyond-design-basis earthquake. At all sites except Pantex, the frequency of such a crash is below 10^{-7} per year.

Criticality. Engineered and administrative controls should be available to ensure that the double-contingency principles are in place for all portions of the process. It is assumed that human error results in multiple failures leading to an inadvertent nuclear criticality. The estimated frequency of this accident is in the range of 10^{-4} to 10^{-6} per year. A bounding source term resulting from 10^{19} fissions is assumed.

Design Basis Earthquake. The principal design basis natural phenomena event that could release material to the environment is the design basis earthquake. While the major safety systems, including building confinement and the building HEPA filtration system should continue to function, the vibratory motion would be expected to resuspend loose plutonium powder within gloveboxes and cause some minor spills. These would be picked up by the ventilation system and filtered by the HEPA filters before release from the building. Although highly uncertain, the source term should be much lower than that postulated for the beyond-design-basis earthquake. Based on an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 3.9×10^{-4} g (1.4×10^{-5} oz) is postulated. The estimated frequency of this accident is in the range of 10^{-4} to 10^{-2} per year.

Beyond-Design-Basis Earthquake. The postulated beyond-design-basis earthquake is assumed to be of sufficient magnitude to cause total collapse of the process equipment, building walls, roof, and floors, and loss of the containment function of the building. The material in the building is assumed to be driven airborne by the seismic vibrations, free-fall during the collapse, and impact. Molten metal in furnaces is also assumed to burn in the aftermath of the collapse. An instantaneous plus-resuspension ground-level release of 39 g (1.4 oz) of respirable plutonium is estimated for the process area. While the release of an additional 2,529 g (89 oz) from the vault would be possible, it would be unlikely given the expected packaging of materials in the vault. The estimated frequency of this accident is in the range of 10^{-5} to 10^{-7} per year.

Explosion. The bounding explosion is a deflagration of a hydrogen gas mixture inside the hydride oxidation (HYDOX) furnace. The deflagration is assumed to result from multiple equipment failures and operator errors that lead to a buildup of hydrogen and a flow of oxygen into the inert-atmosphere glovebox used in the HYDOX process. Also assumed is an MAR of 4.5 kg (9.9 lb) of plutonium powder, and given the venting of pressurized gas through the powder, bounding ARF and RF of 0.1 and 0.7, respectively. The explosive energy would be sufficient to damage glovebox windows but insufficient to threaten the building HEPA filter system. Based on an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 3.2×10^{-3} g (1.1×10^{-4} oz) is postulated. The estimated frequency of this accident is in the range of 10^{-2} to 10^{-4} per year.

Fire. According to the several safety analyses of the plutonium facility at LANL, the bounding fire within the pit conversion facility is a fire involving all of the gloves in a glovebox used for blending plutonium powder. A flammable cleaning liquid is assumed to be brought into the glovebox, in violation of procedure, then to spill and ignite. The gloves are assumed to be stowed outside the glovebox but to be ignited by the fire and completely consumed. An MAR of 2 g (0.07 oz) of plutonium dust is assumed for each of 12 gloves, with all of the 24 g (0.85 oz) assumed to be aerosolized. The sprinkler system is assumed to function and protect the room and remainder of the building. Also assumed are an ARF of 0.05 and an RF of 1.0, resulting in a 1.2-g (0.04-oz) release to the building ventilation system. Based on an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 1.2×10^{-5} g (4.2×10^{-7} oz) is postulated. The estimated frequency of this accident is in the range of 10^{-2} to 10^{-4} per year.

Leaks or Spills of Nuclear Material. The most catastrophic leak or spill postulated would result from a forklift or other large vehicle running over a package of nuclear material and breaching the storage container. If a 4-kg (8.8-lb) package of plutonium oxide were breached, a total airborne release of 0.44 g (0.016 oz) to the room would occur, and after HEPA filtration of the facility exhaust, a total release of 4.4×10^{-6}. This accident has an estimated frequency in the range of 10^{-4} to 10^{-6} per year.

Tritium Release. A major glovebox fire is assumed to heat multiple parts contaminated with up to 20 g (0.71 oz) of tritium and convert all of it into tritiated water vapor. Very conservatively, the ARF, RF, and LPF are all assumed to be 1.0, resulting in a release of 20 g (0.71 oz) (1.9×10^{-5} Ci) through the stack to the atmosphere. The estimated frequency of this accident is in the range of 10^{-4} to 10^{-6} per year.

K.1.5.2.2 Immobilization Facility

A wide range of potential accident scenarios are reflected in the immobilization facility data reports (UC 1998b, 1998c, 1998f, 1998g, 1998i, 1998j). The analysis assumes that the immobilization facility is located in a new or upgraded existing building designed to withstand design basis natural phenomena hazards such as earthquakes, winds, tornadoes, and floods such that no unfiltered releases would be expected. Also, no site-specific accidents conducive to releases are identified. Therefore, the potential accident scenarios apply to all four candidate sites. Additional discussion of scenario development based on consistency concerns can be found in Section K.1.5.1.

Analysis of the proposed process operations identified specific scenarios for the conversion process, each of the immobilization options (ceramic and glass), and the canister-handling portion of the process. Design basis and beyond-design-basis earthquakes were identified for the overall facility. Identified as accidents specific to the plutonium conversion processes were a criticality, an explosion in HYDOX furnace, a calcining furnace–glovebox fire, and a hydrogen explosion in the plutonium conversion room. For the ceramic immobilization option, moreover, a sintering furnace–glovebox fire was identified; for the glass immobilization option, a melter eruption and a melter spill. All of the scenarios identified with the canister handling phase were negligible compared with the conversion and immobilization scenarios.

Plutonium Conversion Operations

Criticality. Review of the possibility of accidents attributable to plutonium conversion operations indicated that the principal processes of concern include the halide wash operations, the HYDOX furnace, and the sorting/unpacking glovebox. Engineered and administrative controls should be available to ensure that the double-contingency principles are in place for all portions of the process. It is assumed that human error could result in multiple failures leading to an inadvertent nuclear criticality. The estimated frequency of this accident is in the range of 10^{-4} to 10^{-6} per year. A bounding source term resulting from 10^{19} fissions is assumed.

Explosion in HYDOX Furnace. The bounding explosion is a deflagration of a hydrogen gas mixture inside the HYDOX furnace. The deflagration is assumed to result from multiple equipment failures and operator errors that lead to a buildup of hydrogen and a flow of oxygen into the inert-atmosphere glovebox used in the HYDOX process. Also assumed is an MAR of 4.8 kg (11 lb) of plutonium powder, and given the venting pressurized gas through the powder, bounding ARF and RF of 0.1 and 0.7, respectively. The explosive energy would be sufficient to damage glovebox windows but insufficient to threaten the building HEPA filter system. Based on an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 3.4×10^{-3} g (1.2×10^{-4} oz) is postulated. The estimated frequency of this accident is approximately 10^{-3} per year or in the unlikely range.

Hydrogen Explosion in Plutonium Conversion Room. A supply pipe leak in the plutonium conversion room could result in a hydrogen explosion. Conversion of plutonium metal is accomplished using the HYDOX process, which entails the introduction of hydrogen gas. Were the hydrogen supply piping to leak into the operating/maintenance room, the gas could be ignited by an electrical short or operating mechanical equipment, causing an explosion. Depending on the volume of the leak, the structural integrity of the glovebox glove ports could fail and disperse the plutonium oxide. It is assumed that the building ventilation does not fail, and that the two HEPA filters provide filtration prior to discharge of the powder to the stack. An entire day's inventory of 25 kg (55 lb) of plutonium oxide powder is assumed present in the plutonium conversion gloveboxes. Based on an ARF of 5×10^{-3}, an RF of 0.3, and an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 3.8×10^{-4} g (1.3×10^{-5} oz) of plutonium is postulated. The estimated frequency of this accident is approximately 10^{-3} per year or in the unlikely range.

Furnace-Initiated Glovebox Fire (Calcining Furnace). It is assumed that a fault in the calcining furnace results in the ignition of any combustibles (e.g., bags) left inside the glovebox. The fire would be self-limiting, but would cause suspension of the radioactive material. It is also assumed that the glovebox (including the window) maintains its structural integrity, but that the internal glovebox HEPA filter fails. All of the loose surface contamination within the glovebox, assumed to be 10 percent of the daily inventory (4.5 kg [9.9 lb] of plutonium) of the calcining furnace, is assumed to be involved. Based on an ARF of 6×10^{-3}, an RF of 0.01, and an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 2.7×10^{-7} g (9.5×10^{-9} oz) of plutonium is postulated. The estimated frequency of this accident is in the range of 10^{-4} to 10^{-6} per year.

Ceramic Immobilization Option

Criticality. Review of the possibility of accidents attributable to the ceramic immobilization operations indicated that the principal operation of concern is the rotary splitter tumbler. Engineered and administrative controls should be available to ensure that the double-contingency principles are in place for all portions of the process. It is assumed that human error results in multiple failures leading to an inadvertent nuclear criticality. The estimated frequency of this accident is in the range of 10^{-4} to 10^{-6} per year. A bounding source term resulting from 10^{19} fissions is assumed.

Design Basis Earthquake. The principal design basis natural phenomena event that could release material to the environment is the design basis earthquake. While the major safety systems, including building confinement and the building HEPA filtration system should continue to function, the vibratory motion would be expected to suspend loose plutonium powder within gloveboxes and cause some minor spills. These would be picked up by the ventilation system and filtered by the HEPA filters before release from the building. Most material storage containers are assumed to be engineered to withstand design basis earthquakes without failing. For plutonium conversion, it is assumed that at the time of the event the entire day's inventory (25 kg [55 lb] of plutonium) is present in the form of oxide powder. For the ceramic immobilization portion, this includes the oxide inventories from the rotary splitter, oxide grinding, blend and granulate feed storage, drying and storage, pressing, inspection, and load trays and weigh areas. Although the source term is highly uncertain, an assessment of the MAR, ARF, and RF for each of the process areas indicated a potential for the release of 38 g (1.3 oz) of plutonium to the still-functioning building ventilation system and 3.8×10^{-4} g (1.3×10^{-5} oz) from the stack. The nominal frequency estimate for a design basis earthquake affecting new DOE plutonium facilities is 5×10^{-4} per year, or in the unlikely range.

Beyond-Design-Basis Earthquake. The postulated beyond-design-basis earthquake is assumed to be of sufficient magnitude to cause total collapse of the process equipment, building walls, roof, and floors, and loss of the containment function of the building. The material in the building is assumed to be driven airborne by the seismic vibrations, free-fall during the collapse, and impact. Material in storage containers in vaults would be adequately protected from the scenario energetics. Although the source term is highly uncertain, an assessment of the MAR, ARF, and RF for each of the process areas indicated a potential for the release of 19 g (0.67 oz) of plutonium at ground level. The estimated frequency of this accident is in the range of 10^{-5} to 10^{-7} per year.

Furnace-Initiated Glovebox Fire (Sintering Furnace). It is assumed that the sintering gas supplied to the furnace gloveboxes is a safe gas mixture—hydrogen and argon. Human errors are at issue—either a vendor/supplier that causes a supply of air or noninerting gas to be supplied to the furnace glovebox, or a piping error at the facility itself, in which oxygen is inadvertently substituted for the inert gas. Any combustibles (e.g., bags) left inside the glovebox could ignite, causing a glovebox fire. It is assumed that the fire is self-limiting, but causes suspension of the radioactive material. It is also assumed that the glovebox (including the window) maintains its structural integrity, but that the internal glovebox HEPA filter fails. All of the loose surface contamination within the glovebox, assumed to be 10 percent of the daily inventory (25 kg [55 lb] of plutonium) of the calcining furnace, is assumed to be involved. Based on an ARF of 6×10^{-3}, an RF of 0.01, and an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 1.5×10^{-6} g (5.3×10^{-8} oz) of plutonium is postulated. The estimated frequency of this accident is in the range of 10^{-4} to 10^{-6} per year.

GLASS IMMOBILIZATION OPTION

Design Basis Earthquake. The principal design basis natural phenomena event that could release material to the environment is the design basis earthquake. While the major safety systems, including building confinement and the building HEPA filtration system should continue to function, the vibratory motion would be expected to suspend loose plutonium powder within gloveboxes and cause some minor spills. These would be picked up by the ventilation system and filtered by the HEPA filters before release from the building. Most material storage containers are assumed to be engineered to withstand design basis earthquakes without failing. For plutonium conversion, it is assumed that at the time of the event the entire day's inventory (25 kg [55 lb] of plutonium) is present in the form of oxide powder. For the glass immobilization portion, this includes oxide inventories from the rotary splitter, oxide grinding, blend melter, and feed storage. Although the source term is highly uncertain, an assessment of the MAR, ARF, and RF for each of the process areas indicated a potential for the release of 33 g (1.2 oz) of plutonium to the still-functioning building ventilation system and 3.3×10^{-4} g (1.2×10^{-5} oz) from the stack. The nominal frequency estimate for a design basis earthquake affecting new DOE plutonium facilities is 5×10^{-4} per year, or in the unlikely range.

Beyond-Design-Basis Earthquake. The postulated beyond-design-basis earthquake is assumed to be of sufficient magnitude to cause total collapse of the process equipment, building walls, roof, and floors, and loss of the containment function of the building. The material in the building is assumed to be driven airborne by the seismic vibrations, free-fall during the collapse, and impact. Material in storage containers in vaults storage would be adequately protected from the scenario energetics. Although the source term is highly uncertain, an assessment of the MAR, ARF, and RF for each of the process areas indicated a potential for the release of 17 g (0.60 oz) of plutonium released at ground level. The estimated frequency of this accident is in the range of 10^{-5} to 10^{-7} per year.

Melter Eruption. A melter eruption could result from the buildup of impurities in, or addition of impurities to, the glass frit or melt. Impurities range from water, which could cause a steam eruption, to chemical contaminants, which could react at elevated temperatures and produce a highly exothermic reaction (eruption or deflagration). The resulting sudden pressure increase could eject the fissile material bearing melt liquid into the processing glovebox structure. However the energy release would likely be insufficient to challenge the glovebox structure. It is assumed that the entire contents of the melter, about 1.4 kg (3.1 lb) of plutonium, are ejected into the glovebox. Based on an ARF of 4×10^{-4}, an RF of 1, and an LPF of 1.0×10^{-5} for two HEPAs, a stack release of 1.4×10^{-6} g (4.9×10^{-8} oz) of plutonium is postulated. The estimated frequency of this accident is approximately 2.5×10^{-3} per year, or in the unlikely range.

Melter Spill. A melter spill into the glovebox could occur due to improper alignment of the product glass cans during pouring operations. The melter glovebox enclosure and the off-gas exhaust ventilation system would confine radioactive material released in the spill. The glovebox structure and its associated filtered exhaust ventilation system would not be impacted by this event. It is assumed that the entire contents of the melter, about 1.4 kg (3.1 lb) of plutonium, are spilled into the glovebox. On the basis of an ARF of 2.4×10^{-5}, a RF of 1, and an LPF of 1.0×10^{-5} for two HEPAs, a stack release of 3.3×10^{-7} g (1.2×10^{-8} oz) of plutonium is postulated. The estimated frequency of this accident is approximately 3×10^{-4} per year, or in the unlikely range.

CAN-IN-CANISTER OPERATIONS

Can-Handling Accident (Before Shipment to Vitrification Facility). A can-handling accident would involve a can containing either ceramic pellets or a vitrified glass log of plutonium material. Studies supporting the DWPF SAR (DOE 1994c) indicate that the source term resulting from dropping or tipping a log of vitrified waste, even without credit for the steel canister, would be negligible. Both surplus plutonium immobilization technologies (ceramic and glass) result in a form with a durability that is comparable to that of the DWPF vitrified waste form. Consequently, no postulated can-handling event would result in a radioactive release to the environment.

Melter Spill (Melt Pour at Vitrification Facility). Analysis of a spill of melt material was included in studies performed in support of the DWPF SAR. According to that analysis, the source term resulting from the dropping or tipping a log of vitrified waste, even without credit for the steel canister, would be negligible. Both surplus plutonium immobilization technologies (ceramic and glass) result in a form with a durability that is comparable to the DWPF vitrified waste form. Consequently, it is postulated that no melter spill event results in a radioactive release to the environment.

Canister Handling Accident (After Melt Pour at DWPF). Analysis of events involving the handling and storage of vitrified waste canisters was included in studies performed in support of the DWPF SAR. Results of that analysis indicate that the source term resulting from the dropping or tipping of a log of vitrified waste, even without credit for the steel canister, would be negligible. Both surplus plutonium immobilization technologies (ceramic and glass) result in a form with a durability that is comparable to the DWPF vitrified waste form. Consequently, it is postulated that no canister-handling event results in a radioactive release to the environment.

K.1.5.2.3 MOX Facility Accident Scenarios

A wide range of potential accident scenarios were considered in the analysis reflected in the MOX facility SPD EIS data reports, (UC 1998d, 1998h, 1998m, 1998n). The analysis assumes that the MOX facility is located in a new or upgraded existing building designed to withstand design basis natural phenomena hazards such as earthquakes, winds, tornadoes, and floods such that no unfiltered releases would be expected.

Analysis of the proposed process operations for the MOX facility identified the following broad categories of accidents: aircraft crash (Pantex only), criticality, design basis earthquake, beyond-design-basis earthquake, explosion in sintering furnace, fire, and beyond-design-basis fire. Basic characteristics of each of these postulated accidents are described below. Additional discussion of scenario development based on consistency concerns can be found in Section K.1.5.1.

Aircraft Crash. A crash of a large, heavy commercial or military aircraft directly into a reinforced-concrete facility could damage the structure sufficiently to breach confinement and disperse material into the environment. A subsequent fuel-fed fire could provide energy to further damage structures and equipment, aerosolize material, and drive materials into the environment. Source terms are highly speculative but would be expected to exceed those from the beyond-design-basis earthquake. At all sites except Pantex, the frequency of such a crash is below 10^{-7} per year.

Criticality. Review of the possibility of accidents for the MOX facility indicated no undue criticality risk associated with the proposed operations. Engineered and administrative controls should be available to ensure that the double-contingency principles are in place for all portions of the process. It is assumed that human error could result in multiple failures leading to an inadvertent nuclear criticality. The estimated frequency of this accident is in the range of 10^{-4} to 10^{-6} per year. A bounding source term resulting from 10^{19} fissions is assumed.

Design Basis Earthquake. The principal design basis natural phenomena event that could release material to the environment is the design basis earthquake. While the major safety systems, including building confinement and the building HEPA filtration system should continue to function, the vibratory motion would be expected to resuspend loose plutonium powder within gloveboxes and cause some minor spills. These would be picked up by the ventilation system and filtered by the HEPA filters before to release from the building. Material storage containers including cans, hoppers, and bulk storage vessels are assumed to be engineered to withstand design basis earthquakes without failing. Although the source term is highly uncertain, an assessment of the MAR, ARF, and RF for each of the process areas indicated a potential for the release of 4 g (0.14 oz) of plutonium (in the form of MOX powder) to the still-functioning building ventilation system and 4.0×10^{-5} g (3.5×10^{-7} oz) from the stack. The nominal frequency estimate for a design basis earthquake for new DOE plutonium facilities is 5×10^{-4} per year, or in the unlikely range.

Beyond-Design-Basis Earthquake. The postulated beyond-design-basis earthquake is assumed to be of sufficient magnitude to cause total collapse of the process equipment, building walls, roof, and floors, and loss of the containment function of the building. The material in the building is assumed to be driven airborne by the seismic vibrations, free-fall during the collapse, and impact. Although the source term is highly uncertain, an assessment of the MAR, ARF, and RF for each of the process areas indicated a potential for the release of 124 g (4.4 oz) of plutonium (in the form of MOX powder) at ground level. The estimated frequency of this accident is in the range of 10^{-5} to 10^{-7} per year.

Explosion in Sintering Furnace. The several furnaces proposed for the MOX fuel fabrication process all use nonexplosive mixtures of 6 percent hydrogen and 94 percent argon. Given the physical controls on the piping for nonexplosive and explosive gas mixtures, operating procedures, and other engineered safety controls, accidental use of an explosive gas is extremely unlikely, though not impossible. A bounding explosion or deflagration is postulated to occur in one of the three sintering furnaces in the MOX facility building. Multiple equipment failures and operator errors would be required to lead to a buildup of hydrogen and an inflow of oxygen into the inert furnace atmosphere. As much as 5.6 kg (12.3 lb) of plutonium in the form of MOX powder would be at risk, and a bounding ARF of 0.01 and RF of 1.0 is assumed. Based on an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 5.6×10^{-4} g (2.0×10^{-5} oz) of plutonium (in the form of MOX powder) is postulated. It is estimated that the frequency of this accident is in the range of 10^{-4} to 10^{-6} per year.

Fire. The design basis fire is postulated to occur in the pellet-processing area. The fire is assumed to involve all of the hydraulic fluid, lubricants, and other combustibles within that area. All of the MOX powder (5.6 kg [12.3 lb] of plutonium) in the pelleting press and feed hopper is assumed to be involved. Based on an ARF of 6×10^{-3}, an RF of 0.01, and an LPF of 1.0×10^{-5} for two HEPA filters, a stack release of 3.4×10^{-6} g (1.2×10^{-7} oz) of plutonium (in the form of MOX powder) is postulated. It is estimated that the frequency of this accident is in the range of 10^{-4} to 10^{-6} per year.

Beyond-Design-Basis Fire. The MOX facility would be built and operated such that there would be insufficient combustible materials to support a large fire. To bound the possible consequences of a major fire, a large quantity of combustible materials are assumed to be introduced into the process area near the blending area, which contains a fairly large amount of plutonium. A major fire is assumed to occur that causes the building ventilation and filtration systems to fail, possibly due to clogged HEPA filters. A total of 11 kg (24 lb) of plutonium in the form of MOX powder is assumed at risk. Based on an ARF of 6×10^{-3}, a RF of 0.01, and an LPF of 1.4×10^{-2} for two damaged, clogged HEPA filters, a stack release of 9.4×10^{-3} g (3.3×10^{-4} oz) of plutonium (in the form of MOX powder) is postulated. It is estimated that the frequency of this accident is less than 10^{-6} per year.

K.1.5.2.4 Lead Assembly Accident Scenarios

Design basis and beyond-design-basis accident scenarios have been developed for the fabrication of MOX fuel lead assemblies. These scenarios are discussed in detail, with specific assumptions for each facility and site, in the site data reports (O'Connor 1998a, 1998b, 1998c, 1998d, 1998e). In spite of efforts by all parties, however, some inconsistencies exist between the data reports. This does not imply technical inaccuracy in any analysis; it merely reflects the uncertainties and reliance on convention inherent in accident analyses in general. In preparing the accident analysis for the SPD EIS, therefore, information in the data reports was modified or augmented to ensure the consistency, as appropriate, that is necessary for a reliable comparison of lead assembly fabrication accidents and the other accidents analyzed herein. Modifications were made to ensure that to the extent practical, differences in analytical results were based on actual differences in facility conditions, as opposed to arbitrary differences in analytical methods or assumptions. One change, reflected in Table K–2, involved the assumption for all accidents of an isotopic composition of plutonium identical to that assumed in the analyses of pit disassembly and conversion and MOX fuel fabrication.

Criticality. Criticalities could be postulated in several areas (e.g., powder storage, the gloveboxes involved in mixing, the furnace, the fuel rod storage area). The estimated frequencies associated with these events would vary depending on the controls in place, the number of operator movements, and the amount of fissile material present. A generic approach was taken with respect to the selection of the specifics of this event, rather than selection of a criticality scenario associated with a specific operation in the lead assembly fabrication.

Table K–2. Isotopic Composition of Plutonium Used in Lead Assembly Accident Analysis

Isotope	Weight Percent
Plutonium 238	3.0×10^{-2}
Plutonium 239	92.2
Plutonium 240	6.46
Plutonium 241	5.0×10^{-2}
Plutonium 242	1.0×10^{-1}
Americium 241	9.0×10^{-1}

The criticality source term stipulated in the data reports was modified to make it identical to the corresponding source term used in the assessment of criticality in the pit conversion, immobilization, and MOX facilities. That source term is based on a fission yield from 1.0×10^{19} fissions in an oxide powder. The discussion provided in Section K.1.5 on criticality is also applicable here.

Design Basis Earthquake. An earthquake appropriate with the facility's design basis was selected. For this event, major portions of the process line gloveboxes are assumed to be breached, making the contents available for release. The storage vault and receiving area are assumed to have suitable storage containers for plutonium oxide that would survive the earthquake (storage containers with double containment). In-process material in gloveboxes is, however, more vulnerable, as are powder storage areas that may exist. Of particular concerns are the dispersable powders at the powder-blending stations. Finished pellets and fuel rods are thought to be generally nondispersable, even though they could escape the gloveboxes. In this earthquake, some non-seismically qualified process equipment could fail, and some process material spill. It is also conservatively assumed that glovebox filtration would fail.

The lead assembly data reports use ARF and RF values of 1.0×10^{-2} and 0.2, respectively, for plutonium oxide in cans involved in a design basis earthquake. These values are based on DOE-HDBK-3010-94 recommendations for the suspension of bulk powder by debris impact and air turbulence from falling objects. For consistency with the design basis accident analyses for the other facilities, these values were changed to 1.0×10^{-3} and 0.1, values based on DOE-HDBK-3010-94 recommendations for the suspension of bulk powder due to vibration of substrate from shock-impact to powder confinement (e.g., gloveboxes, cans) due to external energy (e.g., seismic vibrations). Such values are appropriate for earthquakes in which structural integrity is largely maintained and there is not a significant amount of debris or falling objects.

Beyond-Design-Basis Earthquake. For this analysis an event much more severe in consequences than would be expected from the design basis earthquake was examined. For some existing DOE facilities, the estimated seismic frequencies of beyond-design-basis events can be greater than 1.0×10^{-6} per year. The design basis for every building in the complex varies considerably depending on site specifics, including the type of construction used in the building. A damage assessment of the facility is further complicated by the fact that seismic considerations could also be incorporated in the glovebox design of the facility. In reality, such a catastrophic event may or may not demolish the building and the gloveboxes. However, for the purposes of illustrating a high-consequence accident, total demolition of the building is assumed. In this event, no credit is taken for the building, filters, or gloveboxes.

In the data report, an estimated frequency of 1.0×10^{-6} per year is cited as appropriate. To acknowledge the high degree of uncertainty in assessing a frequency of this scenario, a range of extremely unlikely to beyond extremely unlikely has been assigned to this event.

The source term for the beyond-design-basis earthquake includes a contribution from the plutonium storage vault, the assumed DR being 5 percent. The values used for the ARF, RF and vault DR—1.0×10^{-3}, 0.3, and

0, respectively—derive from adjustments consistent with the analysis of the corresponding scenario in the MOX facility data report. This results in a reduction of the source term for this accident by a factor of 2, to 11 g (0.39 oz) plutonium.

Extensive analyses have been performed on the seismic hazard at LLNL and the response of the plutonium facility, Building 332, to that hazard. According to the geology and seismology studies characterizing the nature and magnitude of the seismic threat, there is no physiographic basis for postulating earthquake magnitudes and ground accelerations higher than Richter magnitude 6.9 and 1.1g, respectively. Building 332, Increment III, has been evaluated for resistance to earthquakes and ground accelerations of these magnitudes and found to be adequate. Events of significantly higher magnitude and ground acceleration would be required to collapse Increment III. The frequency of these larger events would most likely be extremely low (1.0×10^{-6} per year or less), as the physiography of the dominant fault systems is such that they are thought incapable of producing the required magnitudes of ground accelerations (Coats 1998). Results of a number of reviews of Increment III indicate that the actual ground motion needed to cause collapse of the structure is above 1.5g. Based on the current LLNL hazard curve and various estimates of the fragility curves for collapse of Increment III, the frequency of collapse is estimated at 1.0×10^{-7} per year or less (Murray 1998). The frequency of a total collapse of Building 332 at LLNL is thus considered sufficiently low that additional examination is deemed unnecessary.

Explosion. An explosion event was postulated in the sintering furnace in the lead assembly fabrication facility. A nonexplosive mixture of 6 percent hydrogen and 94 percent argon is used in the furnace. Multiple equipment and operator errors would have to occur to enable the buildup of an explosive mixture of hydrogen and air in the box. It is assumed that green pellets are subjected to the direct force of the shock waves resulting from such an explosion. It is further assumed that the gloveboxes involved in powder blending are damaged indirectly by the explosion. It is not expected that the shock wave impacting this area would be severe enough to significantly damage all of the storage inventory because interim storage containers would provide some mitigation.

Fire. A moderate-size room fire is assumed. Combustible material such as hydraulic fluid, alcohol, or contaminated combustibles is assumed to be present in the room. Adjoining facilities such as offices conceivably add to the risk of fires in the building. The gloveboxes are assumed to fail in the fire. The MOX powder in interim storage is assumed to be at risk and subjected to the thermal stress of the fire, given failure of the gloveboxes. Because of the limited combustible material and mitigation features such as fire protection systems and a firefighting unit, the event is assumed to be terminated. This fire is not severe enough to jeopardize the overall confinement characteristics of the building.

The source term for the design basis fire analyzed in the lead assembly data reports is dominated by the explosive release of high pressure from two plutonium oxide cans as they are heated to the point of failure. The ARF and RF values for this phenomenon are 0.1 and 0.7, respectively, and reflect burst pressures on the order of 25 to 500 psig. The potential for this kind of release is highly uncertain, and a valid design basis fire may be defined without including it, as is the case with the data reports for the other facilities. Therefore, for greater consistency between the design basis fire for the lead assembly and those for the other facilities, it is assumed that the two plutonium oxide cans are already open and vulnerable to the same phenomena as the rest of the analyzed powder. This results in a reduction of the data report source term by a factor of 38.

It is noteworthy that the lead assembly data report assumes a room fire, and the other data reports, a process fire. This is not considered inconsistent: the lead assembly processes are expected to be closer to one another other than the MOX processes, so the potential for propagation of fire may be somewhat greater.

Beyond-Design-Basis Fire. Fuel-manufacturing operations do not involve the use of significant amounts of combustible material. For the purpose of analysis, the lead assembly data reports define a beyond-design-basis fire that results in building collapse, the breach of material in the plutonium storage vault, and a lofted plume. These assumptions, however, are inconsistent with the beyond-design-basis fires analyzed for the other facilities. The beyond-design-basis fire has therefore been modified to reflect a room fire or building fire that clogs the building HEPA filters, resulting in a ground-level, unfiltered release. The assumed LPF is 1.4×10^{-2} (Smith, Wilkey, and Siebe 1996), consistent with the other analyses. Additionally, it is assumed that the fire does not involve the vault or that the storage canisters in the vault provide adequate protection for the duration of the fire.

Next Section

K.2 FACILITY ACCIDENT IMPACTS AT HANFORD

The potential source terms and consequences of postulated bounding facility accidents for each facility option at Hanford are presented in Tables K–3 through K–9. Accident scenarios and source terms were developed from data reports prepared for each technology. Consequences were estimated using the MACCS2 computer code and local population and meteorology data. The consequences are presented for mean and 95th percentile meteorological conditions.

Meteorological data are based on 10-m (33-ft) weather readings at Hanford for the 1996 calendar year.[5] In accordance with the MACCS2 format requirements, the data set consists of 8,760 consecutive hourly readings of windspeed, wind direction, Pasquill-Gifford stability class, and accumulated rainfall.

Population estimates for Hanford are for the year 2010, are based on the *Census of Population and Housing, 1990* (DOC 1992), and are identical to the estimates used for the analysis of normal operations in this SPD EIS. Population values are formatted into 16 sectors centered around the 16 standard compass directions, which are further subdivided into 10 radial distance intervals out to 80 km (50 mi).

[5] The choice of calendar year was based primarily on data quality. For some combinations of site and calendar year, the data set contains significant gaps, making that data undesirable for use in dispersion modeling. As a result, not all sites were analyzed using meteorological data for the same calendar year.

Table K–3. Accident Impacts of Pit Conversion Facility in FMEF at Hanford

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Fire	1.2×10^{-5}	Unlikely	Mean	2.8×10^{-6}	1.1×10^{-9}	5.2×10^{-7}	2.6×10^{-10}	8.7×10^{-4}	4.3×10^{-7}
			95th percentile	1.1×10^{-5}	4.3×10^{-9}	1.6×10^{-6}	8.1×10^{-10}	5.3×10^{-3}	2.6×10^{-6}
Explosion	3.2×10^{-3}	Unlikely	Mean	7.3×10^{-4}	2.9×10^{-7}	1.4×10^{-4}	6.8×10^{-8}	2.3×10^{-1}	1.1×10^{-4}
			95th percentile	2.8×10^{-3}	1.1×10^{-6}	4.2×10^{-4}	2.1×10^{-7}	1.4	6.8×10^{-4}
Leaks/spills of nuclear material	4.4×10^{-6}	Extremely unlikely	Mean	1.0×10^{-6}	4.1×10^{-10}	1.9×10^{-7}	9.6×10^{-11}	3.2×10^{-4}	1.6×10^{-7}
			95th percentile	3.9×10^{-6}	1.6×10^{-9}	5.9×10^{-7}	3.0×10^{-10}	1.9×10^{-3}	9.5×10^{-7}
Tritium release	2.0×10^{1}	Extremely unlikely	Mean	7.8×10^{-2}	3.1×10^{-5}	1.5×10^{-2}	7.3×10^{-6}	2.4×10^{1}	1.2×10^{-2}
			95th percentile	3.0×10^{-1}	1.2×10^{-4}	4.5×10^{-2}	2.3×10^{-5}	1.5×10^{2}	7.3×10^{-2}
Criticality	1.0×10^{19} Fissions	Extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	1.2×10^{-3}	6.0×10^{-7}	8.5×10^{-1}	4.3×10^{-4}
			95th percentile	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Design basis earthquake	3.9×10^{-4}	Unlikely	Mean	9.0×10^{-5}	3.6×10^{-8}	1.7×10^{-5}	8.4×10^{-9}	2.8×10^{-2}	1.4×10^{-5}
			95th percentile	3.5×10^{-4}	1.4×10^{-7}	5.2×10^{-5}	2.6×10^{-8}	1.7×10^{-1}	8.4×10^{-5}
Beyond-design-basis fire	1.7×10^{-2}	Beyond extremely unlikely	Mean	2.9×10^{-2}	1.1×10^{-5}	1.1×10^{-3}	5.6×10^{-7}	1.5	7.7×10^{-4}
			95th percentile	1.1×10^{-1}	4.3×10^{-5}	4.1×10^{-3}	2.0×10^{-6}	9.9	4.3×10^{-3}
Beyond-design-basis earthquake	3.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	6.6×10^{1}	2.6×10^{-2}	2.6	1.3×10^{-3}	3.6×10^{3}	1.8
			95th percentile	2.5×10^{2}	9.9×10^{-2}	9.4	4.7×10^{-3}	2.3×10^{4}	9.8

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: FMEF, Fuels and Materials Examination Facility.

Note: Calculated using the source terms in the pit conversion data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998a.

Table K–4. Accident Impacts of Ceramic Immobilization Facility in FMEF and HLWVF at Hanford (Hybrid Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	1.2×10^{-3}	6.0×10^{-7}	8.5×10^{-1}	4.3×10^{-4}
			95th percentile	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	3.4×10^{-3}	Unlikely	Mean	1.0×10^{-3}	4.0×10^{-7}	1.9×10^{-4}	9.4×10^{-8}	3.1×10^{-1}	1.6×10^{-4}
			95th percentile	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	2.7×10^{-7}	Extremely unlikely	Mean	8.0×10^{-8}	3.2×10^{-11}	1.5×10^{-8}	7.4×10^{-12}	2.5×10^{-5}	1.2×10^{-8}
			95th percentile	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	3.8×10^{-4}	Unlikely	Mean	1.1×10^{-4}	4.4×10^{-8}	2.1×10^{-5}	1.0×10^{-8}	3.4×10^{-2}	1.7×10^{-5}
			95th percentile	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Glovebox fire (sintering furnace)	1.5×10^{-6}	Extremely unlikely	Mean	4.4×10^{-7}	1.8×10^{-10}	8.3×10^{-8}	4.1×10^{-11}	1.4×10^{-4}	6.9×10^{-8}
			95th percentile	1.7×10^{-6}	6.8×10^{-10}	2.6×10^{-7}	1.3×10^{-10}	8.3×10^{-4}	4.1×10^{-7}
Design basis earthquake	3.8×10^{-4}	Unlikely	Mean	1.1×10^{-4}	4.5×10^{-8}	2.1×10^{-5}	1.0×10^{-8}	3.5×10^{-2}	1.7×10^{-5}
			95th percentile	4.3×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Beyond-design-basis fire	2.1×10^{-3}	Beyond extremely unlikely	Mean	4.5×10^{-3}	1.8×10^{-6}	1.8×10^{-4}	8.9×10^{-8}	2.4×10^{-1}	1.2×10^{-4}
			95th percentile	1.7×10^{-2}	6.8×10^{-6}	6.5×10^{-4}	3.2×10^{-7}	1.6	6.8×10^{-4}
Beyond-design-basis earthquake	1.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	4.1×10^{1}	1.6×10^{-2}	1.6	8.1×10^{-4}	2.2×10^{3}	1.1
			95th percentile	1.5×10^{2}	1.6×10^{-2}	5.8	2.9×10^{-3}	1.4×10^{4}	6.1

a Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

b Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility, HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998c.

Table K–5. Accident Impacts of Glass Immobilization Facility in FMEF and HLWVF at Hanford (Hybrid Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	1.2×10^{-3}	6.0×10^{-7}	8.5×10^{-1}	4.3×10^{-4}
			95th percentile	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	3.4×10^{-3}	Unlikely	Mean	1.0×10^{-3}	4.0×10^{-7}	1.9×10^{-4}	9.4×10^{-8}	3.1×10^{-1}	1.6×10^{-4}
			95th percentile	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	2.7×10^{-7}	Extremely unlikely	Mean	8.0×10^{-8}	3.2×10^{-11}	1.5×10^{-8}	7.4×10^{-12}	2.5×10^{-5}	1.2×10^{-8}
			95th percentile	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	3.8×10^{-4}	Unlikely	Mean	1.1×10^{-4}	4.4×10^{-8}	2.1×10^{-5}	1.0×10^{-8}	3.4×10^{-2}	1.7×10^{-5}
			95th percentile	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Melter eruption	1.4×10^{-6}	Unlikely	Mean	4.1×10^{-7}	1.6×10^{-10}	7.6×10^{-8}	3.8×10^{-11}	1.3×10^{-4}	6.4×10^{-8}
			95th percentile	1.6×10^{-6}	6.3×10^{-10}	2.4×10^{-7}	1.2×10^{-10}	7.7×10^{-4}	3.8×10^{-7}
Melter spill	3.3×10^{-7}	Unlikely	Mean	9.6×10^{-8}	3.9×10^{-11}	1.8×10^{-8}	9.0×10^{-12}	3.0×10^{-5}	1.5×10^{-8}
			95th percentile	3.7×10^{-7}	1.5×10^{-10}	5.6×10^{-8}	2.8×10^{-11}	1.8×10^{-4}	9.0×10^{-8}
Design basis earthquake	3.3×10^{-4}	Unlikely	Mean	9.7×10^{-5}	3.9×10^{-8}	1.8×10^{-5}	9.1×10^{-9}	3.0×10^{-2}	1.5×10^{-5}
			95th percentile	3.7×10^{-4}	1.5×10^{-7}	5.6×10^{-5}	2.8×10^{-8}	1.8×10^{-1}	9.1×10^{-5}
Beyond-design-basis fire	3.8×10^{-4}	Beyond extremely unlikely	Mean	8.1×10^{-4}	3.3×10^{-7}	3.2×10^{-5}	1.6×10^{-8}	4.4×10^{-2}	2.2×10^{-5}
			95th percentile	3.1×10^{-3}	1.2×10^{-6}	1.2×10^{-4}	5.8×10^{-8}	2.8×10^{-1}	1.2×10^{-4}
Beyond-design-basis earthquake	1.7×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	3.6×10^{1}	1.4×10^{-2}	1.4	7.1×10^{-4}	1.9×10^{3}	9.7×10^{-1}
			95th percentile	1.4×10^{2}	5.4×10^{-2}	5.1	2.6×10^{-3}	1.2×10^{4}	5.4

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998b.

Table K–6. Accident Impacts of Ceramic Immobilization Facility in FMEF and HLWVF at Hanford (50-t Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	1.2×10^{-3}	6.0×10^{-7}	8.5×10^{-1}	4.3×10^{-4}
			95th percentile	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	3.4×10^{-3}	Unlikely	Mean	1.0×10^{-3}	4.0×10^{-7}	1.9×10^{-4}	9.4×10^{-8}	3.1×10^{-1}	1.6×10^{-4}
			95th percentile	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	2.7×10^{-7}	Extremely unlikely	Mean	8.0×10^{-8}	3.2×10^{-11}	1.5×10^{-8}	7.4×10^{-12}	2.5×10^{-5}	1.2×10^{-8}
			95th percentile	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	3.8×10^{-4}	Unlikely	Mean	1.1×10^{-4}	4.4×10^{-8}	2.1×10^{-5}	1.0×10^{-8}	3.4×10^{-2}	1.7×10^{-5}
			95th percentile	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Glovebox fire (sintering furnace)	1.5×10^{-6}	Extremely unlikely	Mean	4.4×10^{-7}	1.8×10^{-10}	8.3×10^{-8}	4.1×10^{-11}	1.4×10^{-4}	6.9×10^{-8}
			95th percentile	1.7×10^{-6}	6.8×10^{-10}	2.6×10^{-7}	1.3×10^{-10}	8.3×10^{-4}	4.1×10^{-7}
Design basis earthquake	3.8×10^{-4}	Unlikely	Mean	1.0×10^{-4}	4.1×10^{-8}	1.9×10^{-5}	9.6×10^{-9}	3.2×10^{-2}	1.6×10^{-5}
			95th percentile	3.9×10^{-4}	1.6×10^{-7}	5.9×10^{-5}	3.0×10^{-8}	1.9×10^{-1}	9.6×10^{-5}
Beyond-design-basis fire	2.1×10^{-3}	Beyond extremely unlikely	Mean	4.5×10^{-3}	1.8×10^{-6}	1.8×10^{-4}	8.9×10^{-8}	2.4×10^{-1}	1.2×10^{-4}
			95th percentile	1.7×10^{-2}	6.8×10^{-6}	6.5×10^{-4}	3.2×10^{-7}	1.6	6.8×10^{-4}
Beyond-design-basis earthquake	1.9×10^{1}	Unlikely to beyond extremely unlikely	Mean	3.8×10^{1}	1.5×10^{-2}	1.5	7.4×10^{-4}	2.0×10^{3}	1.0
			95th percentile	1.4×10^{2}	5.7×10^{-2}	5.4	2.7×10^{-3}	1.3×10^{4}	5.6

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility, HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998c.

Table K–7. Accident Impacts of Glass Immobilization Facility in FMEF and HLWVF at Hanford (50-t Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	1.2×10^{-3}	6.0×10^{-7}	8.5×10^{-1}	4.3×10^{-4}
			95th percentile	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	3.4×10^{-3}	Unlikely	Mean	1.0×10^{-3}	4.0×10^{-7}	1.9×10^{-4}	9.4×10^{-8}	3.1×10^{-1}	1.6×10^{-4}
			95th percentile	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	2.7×10^{-7}	Extremely unlikely	Mean	8.0×10^{-8}	3.2×10^{-11}	1.5×10^{-8}	7.4×10^{-12}	2.5×10^{-5}	1.2×10^{-8}
			95th percentile	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	3.8×10^{-4}	Unlikely	Mean	1.1×10^{-4}	4.4×10^{-8}	2.1×10^{-5}	1.0×10^{-8}	3.4×10^{-2}	1.7×10^{-5}
			95th percentile	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Melter eruption	1.4×10^{-6}	Unlikely	Mean	4.1×10^{-7}	1.6×10^{-10}	7.6×10^{-8}	3.8×10^{-11}	1.3×10^{-4}	6.4×10^{-8}
			95th percentile	1.6×10^{-6}	6.3×10^{-10}	2.4×10^{-7}	1.2×10^{-10}	7.7×10^{-4}	3.8×10^{-7}
Melter spill	3.3×10^{-7}	Unlikely	Mean	9.6×10^{-8}	3.9×10^{-11}	1.8×10^{-8}	9.0×10^{-12}	3.0×10^{-5}	1.5×10^{-8}
			95th percentile	3.7×10^{-7}	1.5×10^{-10}	5.6×10^{-8}	2.8×10^{-11}	1.8×10^{-4}	9.0×10^{-8}
Design basis earthquake	3.3×10^{-4}	Unlikely	Mean	9.0×10^{-5}	3.6×10^{-8}	1.7×10^{-5}	8.4×10^{-9}	2.8×10^{-2}	1.4×10^{-5}
			95th percentile	3.5×10^{-4}	1.4×10^{-7}	5.2×10^{-5}	2.6×10^{-8}	1.7×10^{-1}	8.4×10^{-5}
Beyond-design-basis fire	3.8×10^{-4}	Beyond extremely unlikely	Mean	8.1×10^{-4}	3.3×10^{-7}	3.2×10^{-5}	1.6×10^{-8}	4.4×10^{-2}	2.2×10^{-5}
			95th percentile	3.1×10^{-3}	1.2×10^{-6}	1.2×10^{-4}	5.8×10^{-8}	2.8×10^{-1}	1.2×10^{-4}
Beyond-design-basis earthquake	1.7×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	3.3×10^{1}	1.3×10^{-2}	1.3	6.6×10^{-4}	1.8×10^{3}	9.0×10^{-1}
			95th percentile	1.3×10^{2}	5.0×10^{-2}	4.8	2.4×10^{-3}	1.2×10^{4}	5.0

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998b.

Table K–8. Accident Impacts of MOX Facility in FMEF at Hanford

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	1.2×10^{-3}	6.0×10^{-7}	8.5×10^{-1}	4.3×10^{-4}
			95th percentile	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in sintering furnace	5.5×10^{-4}	Extremely unlikely	Mean	1.3×10^{-4}	5.1×10^{-8}	2.4×10^{-5}	1.2×10^{-8}	4.0×10^{-2}	2.0×10^{-5}
			95th percentile	4.9×10^{-4}	2.0×10^{-7}	7.4×10^{-5}	3.7×10^{-8}	2.4×10^{-1}	1.2×10^{-4}
Fire	3.4×10^{-6}	Extremely unlikely	Mean	7.8×10^{-7}	3.1×10^{-10}	1.5×10^{-7}	7.3×10^{-11}	2.4×10^{-4}	1.2×10^{-7}
			95th percentile	3.0×10^{-6}	1.2×10^{-9}	4.5×10^{-7}	2.3×10^{-10}	1.5×10^{-3}	7.3×10^{-7}
Design basis earthquake	7.9×10^{-5}	Unlikely	Mean	1.8×10^{-5}	7.3×10^{-9}	3.4×10^{-6}	1.7×10^{-9}	5.7×10^{-3}	2.8×10^{-6}
			95th percentile	7.0×10^{-5}	2.8×10^{-8}	1.1×10^{-5}	5.3×10^{-9}	3.4×10^{-2}	1.7×10^{-5}
Beyond-design-basis fire	9.5×10^{-3}	Beyond extremely unlikely	Mean	1.6×10^{-2}	6.4×10^{-6}	6.3×10^{-4}	3.2×10^{-7}	8.7×10^{-1}	4.3×10^{-4}
			95th percentile	6.1×10^{-2}	2.4×10^{-5}	2.3×10^{-3}	1.1×10^{-6}	5.6	2.4×10^{-3}
Beyond-design-basis earthquake	8.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.5×10^{2}	6.1×10^{-2}	6.0	3.0×10^{-3}	8.2×10^{3}	4.1
			95th percentile	5.7×10^{2}	2.3×10^{-1}	2.2×10^{1}	1.1×10^{-2}	5.3×10^{4}	2.3×10^{1}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: FMEF, Fuels and Materials Examination Facility.

Note: Calculated using the source terms in the MOX data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998d.

Table K–9. Accident Impacts of New MOX Facility at Hanford

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely Unlikely	Mean	2.9×10^{-2}	1.1×10^{-5}	1.8×10^{-3}	8.8×10^{-7}	1.2	5.8×10^{-4}
			95th percentile	9.1×10^{-2}	3.6×10^{-5}	5.7×10^{-3}	2.8×10^{-6}	7.6	3.7×10^{-3}
Explosion in sintering furnace	5.5×10^{-4}	Extremely Unlikely	Mean	8.0×10^{-4}	3.2×10^{-7}	3.5×10^{-5}	1.8×10^{-8}	5.0×10^{-2}	2.5×10^{-5}
			95th percentile	2.9×10^{-3}	1.2×10^{-6}	1.1×10^{-4}	5.7×10^{-8}	3.2×10^{-1}	1.4×10^{-4}
Fire	3.4×10^{-6}	Extremely Unlikely	Mean	4.9×10^{-6}	2.0×10^{-9}	2.2×10^{-7}	1.1×10^{-10}	3.1×10^{-4}	1.5×10^{-7}
			95th percentile	1.8×10^{-5}	7.1×10^{-9}	7.0×10^{-7}	3.5×10^{-10}	2.0×10^{-3}	8.6×10^{-7}
Design basis earthquake	7.9×10^{-5}	Unlikely	Mean	1.1×10^{-4}	4.6×10^{-8}	5.0×10^{-6}	2.5×10^{-9}	7.1×10^{-3}	3.6×10^{-6}
			95th percentile	4.1×10^{-4}	1.7×10^{-7}	1.6×10^{-5}	8.2×10^{-9}	4.6×10^{-2}	2.0×10^{-5}
Beyond-design-basis fire	9.5×10^{-3}	Beyond extremely unlikely	Mean	1.6×10^{-2}	6.4×10^{-6}	6.3×10^{-4}	3.2×10^{-7}	8.7×10^{-1}	4.3×10^{-4}
			95th percentile	6.1×10^{-2}	2.4×10^{-5}	2.3×10^{-3}	1.1×10^{-6}	5.6	2.4×10^{-3}
Beyond-design-basis earthquake	8.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.5×10^{2}	6.1×10^{-2}	6.0	3.0×10^{-3}	8.2×10^{3}	4.1
			95th percentile	5.7×10^{2}	2.3×10^{-1}	2.2×10^{1}	1.1×10^{-2}	5.3×10^{4}	2.3×10^{1}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Note: Calculated using the source terms in the MOX data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998d.

K.3 FACILITY ACCIDENT IMPACTS AT INEEL

The potential source terms and consequences of postulated bounding facility accidents for each facility option for INEEL are presented in Tables K–10 and K–11. Accident scenarios and source terms were developed from data reports prepared for each technology. Consequences were estimated using the MACCS2 computer code and local population and meteorology data. The consequences are presented for mean and 95th percentile meteorological conditions.

Meteorological data are based on 10-m (33-ft) weather readings at INEEL for the 1993 calendar year.[6] In accordance with MACCS2 format requirements, the data set consists of 8,760 consecutive hourly readings of windspeed, wind direction, Pasquill-Gifford stability class, and accumulated rainfall.

Population estimates for INEEL are for the year 2010, are based on the *Census of Population and Housing, 1990* (DOC 1992), and are identical to the estimates used for the analysis of normal operations in this SPD EIS. Population values are formatted into 16 sectors centered around the 16 standard compass directions, which are further subdivided into 10 radial distance intervals out to 80 km (50 mi).

[6] The choice of calendar year was based primarily on data quality. For some combinations of site and calendar year, the data set contains significant gaps, making that data undesirable for use in dispersion modeling. As a result, not all sites were analyzed using meteorological data for the same calendar year.

Table K–10. Accident Impacts of Pit Conversion Facility in FPF at INEEL

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Fire	1.2×10^{-5}	Unlikely	Mean	2.5×10^{-6}	1.0×10^{-9}	3.0×10^{-7}	1.5×10^{-10}	5.6×10^{-5}	2.8×10^{-8}
			95th percentile	6.4×10^{-6}	2.5×10^{-9}	1.1×10^{-6}	5.3×10^{-10}	2.1×10^{-4}	1.0×10^{-7}
Explosion	3.2×10^{-3}	Unlikely	Mean	6.5×10^{-4}	2.6×10^{-7}	7.8×10^{-5}	3.9×10^{-8}	1.5×10^{-2}	7.4×10^{-6}
			95th percentile	1.7×10^{-3}	6.7×10^{-7}	2.8×10^{-4}	1.4×10^{-7}	5.5×10^{-2}	2.7×10^{-5}
Leaks/spills of nuclear material	4.4×10^{-6}	Extremely unlikely	Mean	9.1×10^{-7}	3.6×10^{-10}	1.1×10^{-7}	5.4×10^{-11}	2.1×10^{-5}	1.0×10^{-8}
			95th percentile	2.3×10^{-6}	9.3×10^{-10}	3.9×10^{-7}	1.9×10^{-10}	7.7×10^{-5}	3.8×10^{-8}
Tritium release	2.0×10^{1}	Extremely unlikely	Mean	7.0×10^{-2}	2.8×10^{-5}	8.3×10^{-3}	4.1×10^{-6}	1.6	7.9×10^{-4}
			95th percentile	1.8×10^{-1}	7.1×10^{-5}	3.0×10^{-2}	1.5×10^{-5}	5.9	2.9×10^{-3}
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	4.8×10^{-4}	2.4×10^{-7}	2.2×10^{-2}	1.1×10^{-5}
			95th percentile	3.3×10^{-2}	1.3×10^{-5}	1.6×10^{-3}	7.9×10^{-7}	8.5×10^{-2}	4.2×10^{-5}
Design basis earthquake	3.9×10^{-4}	Unlikely	Mean	8.0×10^{-5}	3.2×10^{-8}	9.5×10^{-6}	4.8×10^{-9}	1.8×10^{-3}	9.1×10^{-7}
			95th percentile	2.1×10^{-4}	8.2×10^{-8}	3.4×10^{-5}	1.7×10^{-8}	6.8×10^{-3}	3.4×10^{-6}
Beyond-design-basis fire	1.7×10^{-2}	Beyond extremely unlikely	Mean	3.0×10^{-2}	1.2×10^{-5}	8.1×10^{-4}	4.1×10^{-7}	9.6×10^{-2}	4.8×10^{-5}
			95th percentile	1.1×10^{-1}	4.5×10^{-5}	2.9×10^{-3}	1.5×10^{-6}	3.6×10^{-1}	1.8×10^{-4}
Beyond-design-basis earthquake	$3..9\times10^{1}$	Extremely unlikely to beyond extremely unlikely	Mean	7.0×10^{1}	2.8×10^{-2}	1.9	9.3×10^{-4}	2.2×10^{2}	1.1×10^{-1}
			95th percentile	2.6×10^{2}	1.0×10^{-1}	6.7	3.3×10^{-3}	8.4×10^{2}	4.2×10^{-1}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 mi] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: FPF, Fuel Processing Facility.

Note: Calculated using the source terms in the pit conversion data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998l.

Table K–11. Accident Impacts of MOX Facility in New Construction at INEEL

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	2.9×10^{-2}	1.2×10^{-5}	7.0×10^{-4}	3.5×10^{-7}	2.7×10^{-2}	1.4×10^{-5}
			95th percentile	1.2×10^{-1}	4.6×10^{-5}	2.4×10^{-3}	1.2×10^{-6}	1.1×10^{-1}	5.4×10^{-5}
Explosion in sintering furnace	5.5×10^{-4}	Extremely unlikely	Mean	8.3×10^{-4}	3.3×10^{-7}	2.2×10^{-5}	1.1×10^{-8}	3.1×10^{-3}	1.6×10^{-6}
			95th percentile	3.6×10^{-3}	1.4×10^{-6}	8.5×10^{-5}	4.2×10^{-8}	1.2×10^{-2}	5.9×10^{-6}
Fire	3.4×10^{-6}	Extremely unlikely	Mean	5.1×10^{-6}	2.0×10^{-9}	1.3×10^{-7}	6.7×10^{-11}	1.9×10^{-5}	9.5×10^{-9}
			95th percentile	2.2×10^{-5}	8.8×10^{-9}	5.2×10^{-7}	2.6×10^{-10}	7.2×10^{-5}	3.6×10^{-8}
Design basis earthquake	7.9×10^{-5}	Unlikely	Mean	1.2×10^{-4}	4.7×10^{-8}	3.1×10^{-6}	1.6×10^{-9}	4.4×10^{-4}	2.2×10^{-7}
			95th percentile	5.1×10^{-4}	2.1×10^{-7}	1.2×10^{-5}	6.0×10^{-9}	1.7×10^{-3}	8.3×10^{-7}
Beyond-design-basis fire	9.5×10^{-3}	Beyond extremely unlikely	Mean	1.7×10^{-2}	6.8×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	5.4×10^{-2}	2.7×10^{-5}
			95th percentile	6.4×10^{-2}	2.6×10^{-5}	1.6×10^{-3}	8.2×10^{-7}	2.1×10^{-1}	1.0×10^{-4}
Beyond-design-basis earthquake	8.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.6×10^{2}	6.4×10^{-2}	4.3	2.2×10^{-3}	5.1×10^{2}	2.5×10^{-1}
			95th percentile	6.0×10^{2}	2.4×10^{-1}	1.5×10^{1}	7.7×10^{-3}	1.9×10^{3}	9.7×10^{-1}
			95th percentile						

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Note: Calculated using the source terms in the MOX data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998m.

K.4 FACILITY ACCIDENT IMPACTS AT PANTEX

The potential source terms and consequences of postulated bounding facility accidents for each facility option for Pantex are presented in Tables K–12 and K–13. Accident scenarios and source terms were developed from data reports prepared for each technology. Consequences were estimated using the MACCS2 computer code and local population and meteorology data. The consequences are presented for mean and 95th percentile meteorological conditions.

Meteorological data are based on 10-m (33-ft) weather readings from the Pantex Tower for the 1996 calendar year.[7] In accordance with MACCS2 format requirements, the data set consists of 8,760 consecutive hourly readings of windspeed, wind direction, Pasquill-Gifford stability class, and accumulated rainfall.

Population estimates for Pantex are for the year 2010, are based on the *Census of Population and Housing, 1990* (DOC 1992), and are identical to the estimates used for the analysis of normal operations in this SPD EIS. Population values are formatted into 16 sectors centered around the 16 standard compass directions, which are further subdivided into 10 radial distance intervals out to 80 km (50 mi).

[7] The choice of calendar year was based primarily on data quality. For some combinations of site and calendar year, the data set contains significant gaps, making that data undesirable for use in dispersion modeling. As a result, not all sites were analyzed using meteorological data for the same calendar year.

Table K–12. Accident Impacts of New Pit Conversion Facility at Pantex

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Fire	1.2×10^{-5}	Unlikely	Mean	2.3×10^{-6}	9.1×10^{-10}	7.6×10^{-7}	3.8×10^{-10}	1.8×10^{-4}	9.1×10^{-8}
			95th percentile	5.2×10^{-6}	2.1×10^{-9}	2.1×10^{-6}	1.0×10^{-9}	8.6×10^{-4}	4.3×10^{-7}
Explosion	3.2×10^{-3}	Unlikely	Mean	6.0×10^{-4}	2.4×10^{-7}	2.0×10^{-4}	9.9×10^{-8}	4.8×10^{-2}	2.4×10^{-5}
			95th percentile	1.4×10^{-3}	5.4×10^{-7}	5.4×10^{-4}	2.7×10^{-7}	2.2×10^{-1}	1.1×10^{-4}
Leaks/spills of nuclear material	4.4×10^{-6}	Extremely unlikely	Mean	8.4×10^{-7}	3.3×10^{-10}	2.8×10^{-7}	1.4×10^{-10}	6.7×10^{-5}	3.3×10^{-8}
			95th percentile	1.9×10^{-6}	7.6×10^{-10}	7.6×10^{-7}	3.8×10^{-10}	3.1×10^{-4}	1.6×10^{-7}
Tritium release	2.0×10^{1}	Extremely unlikely	Mean	6.4×10^{-2}	2.6×10^{-5}	2.1×10^{-2}	1.1×10^{-5}	5.1	2.5×10^{-3}
			95th percentile	1.4×10^{-1}	5.8×10^{-5}	5.8×10^{-2}	2.9×10^{-5}	2.4×10^{1}	1.2×10^{-2}
Criticality	1.0×10^{19} Fissions	Extremely unlikely	Mean	6.1×10^{-3}	2.5×10^{-6}	2.7×10^{-3}	1.3×10^{-6}	2.7×10^{-1}	1.4×10^{-4}
			95th percentile	1.5×10^{-2}	6.0×10^{-6}	6.0×10^{-3}	3.0×10^{-6}	1.6	8.5×10^{-4}
Design basis earthquake	3.9×10^{-4}	Unlikely	Mean	7.4×10^{-5}	2.9×10^{-8}	2.4×10^{-5}	1.2×10^{-8}	5.9×10^{-3}	2.9×10^{-6}
			95th percentile	1.7×10^{-4}	6.7×10^{-8}	6.7×10^{-5}	3.3×10^{-8}	2.8×10^{-2}	1.4×10^{-5}
Beyond-design-basis fire	1.7×10^{-2}	Beyond extremely unlikely	Mean	9.6×10^{-3}	3.8×10^{-6}	1.5×10^{-3}	7.5×10^{-7}	2.8×10^{-1}	1.4×10^{-4}
			95th percentile	2.8×10^{-2}	1.1×10^{-5}	4.4×10^{-3}	2.2×10^{-6}	1.3	6.3×10^{-4}
Beyond-design-basis earthquake	3.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	2.2×10^{1}	8.8×10^{-3}	3.5	1.7×10^{-3}	6.4×10^{2}	3.2×10^{-1}
			95th percentile	6.4×10^{1}	2.6×10^{-2}	1.0×10^{1}	5.1×10^{-3}	3.0×10^{3}	1.5
Aircraft crash	2.2×10^{1}	Beyond extremely unlikely	Mean	1.3×10^{1}	5.0×10^{-3}	2.0	9.8×10^{-4}	3.7×10^{2}	1.8×10^{-1}
			95th percentile	3.6×10^{1}	1.5×10^{-2}	5.7	2.9×10^{-3}	1.7×10^{3}	8.3×10^{-1}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,028 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Note: Calculated using the source terms in the pit conversion data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998k.

Table K–13. Accident Impacts of New MOX Facility at Pantex

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	1.3×10^{-2}	5.2×10^{-6}	3.8×10^{-3}	1.9×10^{-6}	3.0×10^{-1}	1.5×10^{-4}
			95th percentile	3.9×10^{-2}	1.5×10^{-5}	9.3×10^{-3}	4.6×10^{-6}	1.8	9.2×10^{-4}
Explosion in sintering furnace	5.5×10^{-4}	Extremely unlikely	Mean	2.9×10^{-4}	1.1×10^{-7}	4.8×10^{-5}	2.4×10^{-8}	9.1×10^{-3}	4.6×10^{-6}
			95th percentile	8.9×10^{-4}	3.6×10^{-7}	1.3×10^{-4}	6.7×10^{-8}	4.2×10^{-2}	2.1×10^{-5}
Fire	3.4×10^{-6}	Extremely unlikely	Mean	1.7×10^{-6}	7.0×10^{-10}	2.9×10^{-7}	1.5×10^{-10}	5.6×10^{-5}	2.8×10^{-8}
			95th percentile	5.4×10^{-6}	2.2×10^{-9}	8.1×10^{-7}	4.1×10^{-10}	2.6×10^{-4}	1.3×10^{-7}
Design basis earthquake	7.9×10^{-5}	Unlikely	Mean	4.1×10^{-5}	1.6×10^{-8}	6.8×10^{-6}	3.4×10^{-9}	1.3×10^{-3}	6.5×10^{-7}
			95th percentile	1.3×10^{-4}	5.1×10^{-8}	1.9×10^{-5}	9.4×10^{-9}	5.9×10^{-3}	3.0×10^{-6}
Beyond-design-basis fire	9.5×10^{-3}	Beyond extremely unlikely	Mean	5.4×10^{-3}	2.2×10^{-6}	8.4×10^{-4}	4.2×10^{-7}	1.6×10^{-1}	7.9×10^{-5}
			95th percentile	1.6×10^{-2}	6.2×10^{-6}	2.5×10^{-3}	1.2×10^{-6}	7.2×10^{-1}	3.6×10^{-4}
Beyond-design-basis earthquake	8.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	5.1×10^{1}	2.0×10^{-2}	8.0	4.0×10^{-3}	1.5×10^{3}	7.4×10^{-1}
			95th percentile	1.5×10^{2}	5.9×10^{-2}	2.3×10^{1}	1.2×10^{-2}	6.8×10^{3}	3.4e+00
Aircraft crash	1.3×10^{2}	Beyond extremely unlikely	Mean	7.1×10^{1}	2.8×10^{-2}	1.1×10^{1}	5.6×10^{-3}	2.1×10^{3}	1.0
			95th percentile	2.1×10^{2}	8.2×10^{-2}	3.3×10^{1}	1.6×10^{-2}	9.5×10^{3}	4.7

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Note: Calculated using the source terms in the MOX data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998n.

K.5 FACILITY ACCIDENT IMPACTS AT SRS

The potential source terms and consequences of postulated bounding facility accidents for each facility option for SRS are presented in Tables K–14 through K–23. Accident scenarios and source terms were developed from data reports prepared for each technology. Consequences were estimated using the MACCS2 computer code and local population and meteorology data. The consequences are presented for both mean and 95th percentile meteorological conditions.

Meteorological data are based on 10-m (33-ft) weather readings at SRS, are identical to the data used in *F-Canyon Plutonium Solutions Environmental Impact Statement*, (DOE 1994d), and included in Sample Problem D of the MACCS2 Users Guide. In accordance with MACCS2 format requirements, the data set consists of 8,760 consecutive hourly readings of windspeed, wind direction, Pasquill-Gifford stability class, and accumulated rainfall.

Population estimates for SRS are for the year 2010, are based on the *Census of Population and Housing, 1990* (DOC 1992), and are identical to the estimates used for the analysis of normal operations in the SPD EIS. Population values are formatted into 16 sectors centered around the 16 standard compass directions, which are further subdivided into 10 radial distance intervals out to 80 km (50 mi).

Table K–14. Accident Impacts of New Pit Conversion Facility at SRS

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Fire	1.2×10^{-5}	Unlikely	Mean	2.6×10^{-6}	1.1×10^{-9}	2.1×10^{-7}	1.0×10^{-10}	5.4×10^{-4}	2.7×10^{-7}
			95th percentile	6.2×10^{-6}	2.5×10^{-9}	6.7×10^{-7}	3.3×10^{-10}	2.4×10^{-3}	1.2×10^{-6}
Explosion	3.2×10^{-3}	Unlikely	Mean	6.9×10^{-4}	2.8×10^{-7}	5.4×10^{-5}	2.7×10^{-8}	1.4×10^{-1}	7.0×10^{-5}
			95th percentile	1.6×10^{-3}	6.5×10^{-7}	1.8×10^{-4}	8.8×10^{-8}	6.2×10^{-1}	3.1×10^{-4}
Leaks/spills of nuclear material	4.4×10^{-6}	Extremely unlikely	Mean	9.6×10^{-7}	3.9×10^{-10}	7.5×10^{-8}	3.8×10^{-11}	2.0×10^{-4}	9.8×10^{-8}
			95th percentile	2.3×10^{-6}	9.1×10^{-10}	2.5×10^{-7}	1.2×10^{-10}	8.7×10^{-4}	4.3×10^{-7}
Tritium release	2.0×10^{1}	Extremely unlikely	Mean	7.4×10^{-2}	2.9×10^{-5}	5.8×10^{-3}	2.9×10^{-6}	1.5×10^{1}	7.5×10^{-3}
			95th percentile	1.7×10^{-1}	7.0×10^{-5}	1.9×10^{-2}	9.4×10^{-6}	6.7×10^{1}	3.3×10^{-2}
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	7.9×10^{-3}	3.2×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	4.2×10^{-1}	2.1×10^{-4}
			95th percentile	1.7×10^{-2}	6.7×10^{-6}	1.8×10^{-3}	9.2×10^{-7}	1.8	9.0×10^{-4}
Design basis earthquake	3.9×10^{-4}	Unlikely	Mean	8.5×10^{-5}	3.4×10^{-8}	6.6×10^{-6}	3.3×10^{-9}	1.7×10^{-2}	8.6×10^{-6}
			95th percentile	2.0×10^{-4}	8.0×10^{-8}	2.2×10^{-5}	1.1×10^{-8}	7.7×10^{-2}	3.8×10^{-5}
Beyond-design-basis fire	1.7×10^{-2}	Beyond extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	4.8×10^{-4}	2.4×10^{-7}	8.8×10^{-1}	4.4×10^{-4}
			95th percentile	4.0×10^{-2}	1.6×10^{-5}	1.6×10^{-3}	7.8×10^{-7}	3.7	1.9×10^{-3}
Beyond-design-basis earthquake	3.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	2.5×10^{1}	1.0×10^{-2}	1.1	5.5×10^{-4}	2.0×10^{3}	1.0
			95th percnetile	9.1×10^{1}	3.7×10^{-2}	3.6	1.8×10^{-3}	8.5×10^{3}	4.3

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] (or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Note: Calculated using the source terms in the pit conversion data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998e.

Table K–15. Accident Impacts of Ceramic Immobilization Facility in Building 221–F and DWPF at SRS (Hybrid Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	5.3×10^{-3}	2.1×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	3.5×10^{-1}	1.8×10^{-4}
			95th percentile	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	1.7	Unlikely	Mean	1.9×10^{-1}	7.7×10^{-5}	2.6×10^{-2}	1.3×10^{-5}	7.6×10^{1}	3.8×10^{-2}
			95th percentile	4.2×10^{-1}	1.7×10^{-4}	8.0×10^{-2}	4.0×10^{-5}	3.4×10^{2}	1.7×10^{-1}
Glovebox fire (calcining furnace)	1.3×10^{-4}	Extremely unlikely	Mean	1.5×10^{-5}	6.1×10^{-9}	2.1×10^{-6}	1.0×10^{-9}	6.0×10^{-3}	3.0×10^{-6}
			95th percentile	3.3×10^{-5}	1.3×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	2.7×10^{-2}	1.3×10^{-5}
Hydrogen explosion	1.8×10^{-1}	Unlikely	Mean	2.1×10^{-2}	8.5×10^{-6}	2.9×10^{-3}	1.4×10^{-6}	8.4	4.2×10^{-3}
			95th percentile	4.7×10^{-2}	1.9×10^{-5}	8.8×10^{-3}	4.4×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Glovebox fire (sintering furnace)	7.4×10^{-4}	Extremely unlikely	Mean	8.5×10^{-5}	3.4×10^{-8}	1.2×10^{-5}	5.8×10^{-9}	3.4×10^{-2}	1.7×10^{-5}
			95th percentile	1.9×10^{-4}	7.4×10^{-8}	3.5×10^{-5}	1.8×10^{-8}	1.5×10^{-1}	7.5×10^{-5}
Design basis earthquake	3.8	Unlikely	Mean	3.1	1.2×10^{-3}	1.4×10^{-1}	6.8×10^{-5}	2.5×10^{2}	1.3×10^{-1}
			95th percentile	1.1×10^{1}	4.6×10^{-3}	4.4×10^{-1}	2.2×10^{-4}	1.0×10^{3}	5.3×10^{-1}
Beyond-design-basis fire	2.1×10^{-3}	Beyond extremely unlikely	Mean	1.7×10^{-3}	6.9×10^{-7}	7.6×10^{-5}	3.8×10^{-8}	1.4×10^{-1}	7.0×10^{-5}
			95th percentile	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	1.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.6×10^{1}	6.3×10^{-3}	6.8×10^{-1}	3.4×10^{-4}	1.3×10^{3}	6.3×10^{-1}
			95th percentile	5.7×10^{1}	2.3×10^{-2}	2.2	1.1×10^{-3}	5.3×10^{3}	2.7

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998i.

Table K–16. Accident Impacts of Glass Immobilization Facility in Building 221–F and DWPF at SRS (Hybrid Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	5.3×10^{-3}	2.1×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	3.5×10^{-1}	1.8×10^{-4}
			95th percentile	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	1.7	Unlikely	Mean	1.9×10^{-1}	7.7×10^{-5}	2.6×10^{-2}	1.3×10^{-5}	7.6×10^{1}	3.8×10^{-2}
			95th percentile	4.2×10^{-1}	1.7×10^{-4}	8.0×10^{-2}	4.0×10^{-5}	3.4×10^{2}	1.7×10^{-1}
Glovebox fire (calcining furnace)	1.3×10^{-4}	Extremely unlikely	Mean	1.5×10^{-5}	6.1×10^{-9}	2.1×10^{-6}	1.0×10^{-9}	6.0×10^{-3}	3.0×10^{-6}
			95th percentile	3.3×10^{-5}	1.3×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	2.7×10^{-2}	1.3×10^{-5}
Hydrogen explosion	1.8×10^{-1}	Unlikely	Mean	2.1×10^{-2}	8.5×10^{-6}	2.9×10^{-3}	1.4×10^{-6}	8.4	4.2×10^{-3}
			95th percentile	4.7×10^{-2}	1.9×10^{-5}	8.8×10^{-3}	4.4×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Melter eruption	6.8×10^{-4}	Unlikely	Mean	7.9×10^{-5}	3.2×10^{-8}	1.1×10^{-5}	5.4×10^{-9}	3.1×10^{-2}	1.6×10^{-5}
			95th percentile	1.7×10^{-4}	6.9×10^{-8}	3.3×10^{-5}	1.6×10^{-8}	1.4×10^{-1}	6.9×10^{-5}
Melter spill	1.6×10^{-4}	Unlikely	Mean	1.9×10^{-5}	7.4×10^{-9}	2.5×10^{-6}	1.3×10^{-9}	7.3×10^{-3}	3.7×10^{-6}
			95th percentile	4.0×10^{-5}	1.6×10^{-8}	7.7×10^{-6}	3.8×10^{-9}	3.3×10^{-2}	1.6×10^{-5}
Design basis earthquake	3.3	Unlikely	Mean	2.7	1.1×10^{-3}	1.2×10^{-1}	5.9×10^{-5}	2.2×10^{2}	1.1×10^{-1}
			95th percentile	1.0×10^{1}	4.0×10^{-3}	3.9×10^{-1}	1.9×10^{-4}	9.2×10^{2}	4.6×10^{-1}
Beyond-design-basis fire	3.8×10^{-4}	Beyond extremely unlikely	Mean	3.1×10^{-4}	1.2×10^{-7}	1.4×10^{-5}	6.8×10^{-9}	2.5×10^{-2}	1.3×10^{-5}
			95th percentile	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	1.7×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.4×10^{1}	5.5×10^{-3}	6.0×10^{-1}	3.0×10^{-4}	1.1×10^{3}	5.5×10^{-1}
			95th percentile	5.0×10^{1}	2.0×10^{-2}	2.0	9.8×10^{-4}	4.6×10^{3}	2.3
			95th percentile						

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998j.

Table K–17. Accident Impacts of Ceramic Immobilization in Building 221-F and DWPF at SRS (50-t Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	5.3×10^{-3}	2.1×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	3.5×10^{-1}	1.8×10^{-4}
			95th percentile	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	1.7	Unlikely	Mean	1.9×10^{-1}	7.7×10^{-5}	2.6×10^{-2}	1.3×10^{-5}	7.6×10^{1}	3.8×10^{-2}
			95th percentile	4.2×10^{-1}	1.7×10^{-4}	8.0×10^{-2}	4.0×10^{-5}	3.4×10^{2}	1.7×10^{-1}
Glovebox fire (calcining furnace)	1.3×10^{-4}	Extremely unlikely	Mean	1.5×10^{-5}	6.1×10^{-9}	2.1×10^{-6}	1.0×10^{-9}	6.0×10^{-3}	3.0×10^{-6}
			95th percentile	3.3×10^{-5}	1.3×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	2.7×10^{-2}	1.3×10^{-5}
Hydrogen explosion	1.8×10^{-1}	Unlikely	Mean	2.1×10^{-2}	8.5×10^{-6}	2.9×10^{-3}	1.4×10^{-6}	8.4	4.2×10^{-3}
			95th percentile	4.7×10^{-2}	1.9×10^{-5}	8.8×10^{-3}	4.4×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Glovebox fire (sintering furnace)	7.4×10^{-4}	Extremely unlikely	Mean	8.5×10^{-5}	3.4×10^{-8}	1.2×10^{-5}	5.8×10^{-9}	3.4×10^{-2}	1.7×10^{-5}
			95th percentile	1.9×10^{-4}	7.4×10^{-8}	3.5×10^{-5}	1.8×10^{-8}	1.5×10^{-1}	7.5×10^{-5}
Design basis earthquake	3.8	Unlikely	Mean	2.9	1.1×10^{-3}	1.3×10^{-1}	6.3×10^{-5}	2.3×10^{2}	1.2×10^{-1}
			95th percentile	1.1×10^{1}	4.2×10^{-3}	4.1×10^{-1}	2.0×10^{-4}	9.6×10^{2}	4.9×10^{-1}
Beyond-design-basis fire	2.1×10^{-3}	Beyond extremely unlikely	Mean	1.7×10^{-3}	6.9×10^{-7}	7.6×10^{-5}	3.8×10^{-8}	1.4×10^{-1}	7.0×10^{-5}
			95th percentile	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	1.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.4×10^{1}	5.7×10^{-3}	6.3×10^{-1}	3.1×10^{-4}	1.2×10^{3}	5.8×10^{-1}
			95th percentile	5.3×10^{1}	2.1×10^{-2}	2.1	1.0×10^{-3}	4.8×10^{3}	2.5

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998i.

Table K–18. Accident Impacts of Glass Immobilization in Building 221-F and DWPF at SRS (50-t Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	5.3×10^{-3}	2.1×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	3.5×10^{-1}	1.8×10^{-4}
			95th percentile	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	1.7	Unlikely	Mean	1.9×10^{-1}	7.7×10^{-5}	2.6×10^{-2}	1.3×10^{-5}	7.6×10^{1}	3.8×10^{-2}
			95th percentile	4.2×10^{-1}	1.7×10^{-4}	8.0×10^{-2}	4.0×10^{-5}	3.4×10^{2}	1.7×10^{-1}
Glovebox fire (calcining furnace)	1.3×10^{-4}	Extremely unlikely	Mean	1.5×10^{-5}	6.1×10^{-9}	2.1×10^{-6}	1.0×10^{-9}	6.0×10^{-3}	3.0×10^{-6}
			95th percentile	3.3×10^{-5}	1.3×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	2.7×10^{-2}	1.3×10^{-5}
Hydrogen explosion	1.8×10^{-1}	Unlikely	Mean	2.1×10^{-2}	8.5×10^{-6}	2.9×10^{-3}	1.4×10^{-6}	8.4	4.2×10^{-3}
			95th percentile	4.7×10^{-2}	1.9×10^{-5}	8.8×10^{-3}	4.4×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Melter eruption	6.8×10^{-4}	Unlikely	Mean	7.9×10^{-5}	3.2×10^{-8}	1.1×10^{-5}	5.4×10^{-9}	3.1×10^{-2}	1.6×10^{-5}
			95th percentile	1.7×10^{-4}	6.9×10^{-8}	3.3×10^{-5}	1.6×10^{-8}	1.4×10^{-1}	6.9×10^{-5}
Melter spill	1.6×10^{-4}	Unlikely	Mean	1.9×10^{-5}	7.4×10^{-9}	2.5×10^{-6}	1.3×10^{-9}	7.3×10^{-3}	3.7×10^{-6}
			95th percentile	4.0×10^{-5}	1.6×10^{-8}	7.7×10^{-6}	3.8×10^{-9}	3.3×10^{-2}	1.6×10^{-5}
Design basis earthquake	3.3	Unlikely	Mean	2.5	1.0×10^{-3}	1.1×10^{-1}	5.5×10^{-5}	2.0×10^{2}	1.0×10^{-1}
			95th percentile	9.2	3.7×10^{-3}	3.6×10^{-1}	1.8×10^{-4}	8.5×10^{2}	4.3×10^{-1}
Beyond-design-basis fire	3.8×10^{-4}	Beyond extremely unlikely	Mean	3.1×10^{-4}	1.2×10^{-7}	1.4×10^{-5}	6.8×10^{-9}	2.5×10^{-2}	1.3×10^{-5}
			95th percentile	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	1.7×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.3×10^{1}	5.1×10^{-3}	5.6×10^{-1}	2.8×10^{-4}	1.0×10^{3}	5.1×10^{-1}
			95th percentile	4.7×10^{1}	1.9×10^{-2}	1.8	9.1×10^{-4}	4.3×10^{3}	2.2

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998j.

Table K–19. Accident Impacts of Ceramic Immobilization Facility in New Construction and DWPF at SRS (Hybrid Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely Unlikely	Mean	5.3×10^{-3}	2.1×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	3.5×10^{-1}	1.8×10^{-4}
			95th percentile	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	3.4×10^{-3}	Unlikely	Mean	3.9×10^{-4}	1.6×10^{-7}	5.3×10^{-5}	2.7×10^{-8}	1.6×10^{-1}	7.8×10^{-5}
			95th percentile	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	2.7×10^{-7}	Extremely Unlikely	Mean	3.1×10^{-8}	1.2×10^{-11}	4.2×10^{-9}	2.1×10^{-12}	1.2×10^{-5}	6.2×10^{-9}
			95th percentile	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	3.8×10^{-4}	Unlikely	Mean	4.3×10^{-5}	1.7×10^{-8}	5.9×10^{-6}	2.9×10^{-9}	1.7×10^{-2}	8.6×10^{-6}
			95th percentile	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Glovebox fire (sintering furnace)	1.5×10^{-6}	Extremely Unlikely	Mean	1.7×10^{-7}	6.9×10^{-11}	2.4×10^{-8}	1.2×10^{-11}	6.9×10^{-5}	3.4×10^{-8}
			95th percentile	3.8×10^{-7}	1.5×10^{-10}	7.2×10^{-8}	3.6×10^{-11}	3.1×10^{-4}	1.5×10^{-7}
Design basis earthquake	3.8×10^{-4}	Unlikely	Mean	4.4×10^{-5}	1.7×10^{-8}	5.9×10^{-6}	3.0×10^{-9}	1.7×10^{-2}	8.7×10^{-6}
			95th percentile	9.6×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.1×10^{-9}	7.9×10^{-2}	3.9×10^{-5}
Beyond-design-basis fire	2.1×10^{-3}	Beyond extremely unlikely	Mean	1.7×10^{-3}	6.9×10^{-7}	7.6×10^{-5}	3.8×10^{-8}	1.4×10^{-1}	7.0×10^{-5}
			95th percentile	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	1.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.6×10^{1}	6.3×10^{-3}	6.8×10^{-1}	3.4×10^{-4}	1.3×10^{3}	6.3×10^{-1}
			95th percentile	$5.7 \times 10_{1}$	2.3×10^{-2}	2.2	1.1×10^{-3}	5.3×10^{3}	2.7

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998g.

Table K–20. Accident Impacts of Glass Immobilization Facility in New Construction and DWPF at SRS (Hybrid Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	5.3×10^{-3}	2.1×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	3.5×10^{-1}	1.8×10^{-4}
			95th percentile	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	3.4×10^{-3}	Unlikely	Mean	3.9×10^{-4}	1.6×10^{-7}	5.3×10^{-5}	2.7×10^{-8}	1.6×10^{-1}	7.8×10^{-5}
			95th percentile	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	2.7×10^{-7}	Extremely unlikely	Mean	3.1×10^{-8}	1.2×10^{-11}	4.2×10^{-9}	2.1×10^{-12}	1.2×10^{-5}	6.2×10^{-9}
			95th percentile	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	3.8×10^{-4}	Unlikely	Mean	4.3×10^{-5}	1.7×10^{-8}	5.9×10^{-6}	2.9×10^{-9}	1.7×10^{-2}	8.6×10^{-6}
			95th percentile	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Melter eruption	1.4×10^{-6}	Unlikely	Mean	1.6×10^{-7}	6.4×10^{-11}	2.2×10^{-8}	1.1×10^{-11}	6.4×10^{-5}	3.2×10^{-8}
			95th percentile	3.5×10^{-7}	1.4×10^{-10}	6.7×10^{-8}	3.3×10^{-11}	2.9×10^{-4}	1.4×10^{-7}
Melter spill	3.3×10^{-7}	Unlikely	Mean	3.8×10^{-8}	1.5×10^{-11}	5.1×10^{-9}	2.6×10^{-12}	1.5×10^{-5}	7.5×10^{-9}
			95th percentile	8.3×10^{-8}	3.3×10^{-11}	1.6×10^{-8}	7.8×10^{-12}	6.8×10^{-5}	3.3×10^{-8}
Design basis earthquake	3.3×10^{-4}	Unlikely	Mean	3.8×10^{-5}	1.5×10^{-8}	5.2×10^{-6}	2.6×10^{-9}	1.5×10^{-2}	7.6×10^{-6}
			95th percentile	8.3×10^{-5}	3.3×10^{-8}	1.6×10^{-5}	7.9×10^{-9}	6.9×10^{-2}	3.4×10^{-5}
Beyond-design-basis fire	3.8×10^{-4}	Beyond extremely unlikely	Mean	3.1×10^{-4}	1.2×10^{-7}	1.4×10^{-5}	6.8×10^{-9}	2.5×10^{-2}	1.3×10^{-5}
			95th percentile	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	1.7×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.4×10^{1}	5.5×10^{-3}	6.0×10^{-1}	3.0×10^{-4}	1.1×10^{3}	5.5×10^{-1}
			95th percentile	5.0×10^{1}	2.0×10^{-2}	2.0	9.8×10^{-4}	4.6×10^{3}	2.3

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998f.

Table K–21. Accident Impacts of Ceramic Immobilization Facility in New Construction and DWPF at SRS (50-t Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	5.3×10^{-3}	2.1×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	3.5×10^{-1}	1.8×10^{-4}
			95th percentile	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	3.4×10^{-3}	Unlikely	Mean	3.9×10^{-4}	1.6×10^{-7}	5.3×10^{-5}	2.7×10^{-8}	1.6×10^{-1}	7.8×10^{-5}
			95th percentile	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	2.7×10^{-7}	Extremely unlikely	Mean	3.1×10^{-8}	1.2×10^{-11}	4.2×10^{-9}	2.1×10^{-12}	1.2×10^{-5}	6.2×10^{-9}
			95th percentile	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	3.8×10^{-4}	Unlikely	Mean	4.3×10^{-5}	1.7×10^{-8}	5.9×10^{-6}	2.9×10^{-9}	1.7×10^{-2}	8.6×10^{-6}
			95th percentile	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Glovebox fire (sintering furnace)	1.5×10^{-6}	Extremely unlikely	Mean	1.7×10^{-7}	6.9×10^{-11}	2.4×10^{-8}	1.2×10^{-11}	6.9×10^{-5}	3.4×10^{-8}
			95th percentile	3.8×10^{-7}	1.5×10^{-10}	7.2×10^{-8}	3.6×10^{-11}	3.1×10^{-4}	1.5×10^{-7}
Design basis earthquake	3.8×10^{-4}	Unlikely	Mean	4.0×10^{-5}	1.6×10^{-8}	5.5×10^{-6}	2.7×10^{-9}	1.6×10^{-2}	8.0×10^{-6}
			95th percentile	8.8×10^{-5}	3.5×10^{-8}	1.7×10^{-5}	8.3×10^{-9}	7.2×10^{-2}	3.6×10^{-5}
Beyond-design-basis fire	2.1×10^{-3}	Beyond extremely unlikely	Mean	1.7×10^{-3}	6.9×10^{-7}	7.6×10^{-5}	3.8×10^{-8}	1.4×10^{-1}	7.0×10^{-5}
			95th percentile	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	1.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.4×10^{1}	5.7×10^{-3}	6.3×10^{-1}	3.1×10^{-4}	1.2×10^{3}	5.8×10^{1}
			95th percentile	5.3×10^{1}	2.1×10^{-2}	2.1	1.0×10^{-3}	4.8×10^{3}	2.5

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998g.

Table K–22. Accident Impacts of Glass Immobilization Facility in New Construction and DWPF at SRS (50-t Case)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	5.3×10^{-3}	2.1×10^{-6}	4.6×10^{-4}	2.3×10^{-7}	3.5×10^{-1}	1.8×10^{-4}
			95th percentile	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	3.4×10^{-3}	Unlikely	Mean	3.9×10^{-4}	1.6×10^{-7}	5.3×10^{-5}	2.7×10^{-8}	1.6×10^{-1}	7.8×10^{-5}
			95th percentile	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	2.7×10^{-7}	Extremely unlikely	Mean	3.1×10^{-8}	1.2×10^{-11}	4.2×10^{-9}	2.1×10^{-12}	1.2×10^{-5}	6.2×10^{-9}
			95th percentile	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	3.8×10^{-4}	Unlikely	Mean	4.3×10^{-5}	1.7×10^{-8}	5.9×10^{-6}	2.9×10^{-9}	1.7×10^{-2}	8.6×10^{-6}
			95th percentile	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Melter eruption	1.4×10^{-6}	Unlikely	Mean	1.6×10^{-7}	6.4×10^{-11}	2.2×10^{-8}	1.1×10^{-11}	6.4×10^{-5}	3.2×10^{-8}
			95th percentile	3.5×10^{-7}	1.4×10^{-10}	6.7×10^{-8}	3.3×10^{-11}	2.9×10^{-4}	1.4×10^{-7}
Melter spill	3.3×10^{-7}	Unlikely	Mean	3.8×10^{-8}	1.5×10^{-11}	5.1×10^{-9}	2.6×10^{-12}	1.5×10^{-5}	7.5×10^{-9}
			95th percentile	8.3×10^{-8}	3.3×10^{-11}	1.6×10^{-8}	7.8×10^{-12}	6.8×10^{-5}	3.3×10^{-8}
Design basis earthquake	3.3×10^{-4}	Unlikely	Mean	3.5×10^{-5}	1.4×10^{-8}	4.8×10^{-6}	2.4×10^{-9}	1.4×10^{-2}	7.0×10^{-6}
			95th percentile	7.7×10^{-5}	3.1×10^{-8}	1.5×10^{-5}	7.3×10^{-9}	6.4×10^{-2}	3.1×10^{-5}
Beyond-design-basis fire	3.8×10^{-4}	Beyond extremely unlikely	Mean	3.1×10^{-4}	1.2×10^{-7}	1.4×10^{-5}	6.8×10^{-9}	2.5×10^{-2}	1.3×10^{-5}
			95th percentile	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	1.7×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.3×10^{1}	5.1×10^{-3}	5.6×10^{-1}	2.8×10^{-4}	1.0×10^{3}	5.1×10^{-1}
			95th percentile	4.7×10^{1}	1.9×10^{-2}	1.8	9.1×10^{-4}	4.3×10^{3}	2.2

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: DWPF, Defense Waste Processing Facility; HYDOX, hydride oxidation.

Note: Calculated using the source terms in the immobilization data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998f.

Table K–23. Accident Impacts of New MOX Facility at SRS

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely Unlikely	Mean	1.6×10^{-2}	6.2×10^{-6}	7.5×10^{-4}	3.8×10^{-7}	4.9×10^{-1}	2.5×10^{-4}
			95th percentile	4.7×10^{-2}	1.9×10^{-5}	2.6×10^{-3}	1.3×10^{-6}	2.2	1.1×10^{-3}
Explosion in sintering furnace	5.5×10^{-4}	Extremely Unlikely	Mean	3.3×10^{-4}	1.3×10^{-7}	1.2×10^{-5}	6.2×10^{-9}	2.9×10^{-2}	1.4×10^{-5}
			95th percentile	1.2×10^{-3}	4.7×10^{-7}	4.9×10^{-5}	2.4×10^{-8}	1.2×10^{-1}	6.1×10^{-5}
Fire	3.4×10^{-6}	Extremely Unlikely	Mean	2.0×10^{-6}	8.0×10^{-10}	7.5×10^{-8}	3.8×10^{-11}	1.8×10^{-4}	8.8×10^{-8}
			95th percentile	7.1×10^{-6}	2.9×10^{-9}	3.0×10^{-7}	1.5×10^{-10}	7.4×10^{-4}	3.7×10^{-7}
Design basis earthquake	7.9×10^{-5}	Unlikely	Mean	4.6×10^{-5}	1.9×10^{-8}	1.7×10^{-6}	8.7×10^{-10}	4.1×10^{-3}	2.0×10^{-6}
			95th percentile	1.7×10^{-4}	6.6×10^{-8}	6.9×10^{-6}	3.5×10^{-9}	1.7×10^{-2}	8.7×10^{-6}
Beyond-design-basis fire	9.5×10^{-3}	Beyond extremely unlikely	Mean	6.1×10^{-3}	2.5×10^{-6}	2.7×10^{-4}	1.3×10^{-7}	5.0×10^{-1}	2.5×10^{-4}
			95th percentile	2.3×10^{-2}	9.0×10^{-6}	8.8×10^{-4}	4.4×10^{-7}	2.1	1.0×10^{-3}
Beyond-design-basis earthquake	8.9×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	5.8×10^{1}	2.3×10^{-2}	2.5	1.3×10^{-3}	4.7×10^{3}	2.3
			95th percentile	2.1×10^{2}	8.5×10^{-2}	8.3	4.1×10^{-3}	2.0×10^{4}	9.9

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Note: Calculated using the source terms in the MOX data report, as modified in Section K.1.5.1, site meteorology, projected regional population, and the MACCS2 computer code.

Source: UC 1998h.

K.6 LEAD ASSEMBLY ACCIDENT IMPACTS

Tables K–24 through K–29 present the source terms and accident impacts of fabrication of lead assemblies for the candidate process locations.

Table K–24. Accident Impacts of Lead Assembly Fabrication at ANL–W

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely Unlikely	Mean	2.5×10^{-2}	9.9×10^{-6}	1.3×10^{-3}	6.4×10^{-7}	6.8×10^{-2}	3.4×10^{-5}
			95th percentile	7.7×10^{-2}	3.1×10^{-5}	4.9×10^{-3}	2.5×10^{-6}	3.4×10^{-1}	1.6×10^{-4}
Design basis earthquake	3.9×10^{-5}	Unlikely	Mean	5.0×10^{-5}	2.0×10^{-8}	2.0×10^{-6}	1.0×10^{-9}	5.1×10^{-4}	2.6×10^{-7}
			95th percentile	1.7×10^{-4}	6.8×10^{-8}	7.7×10^{-6}	3.9×10^{-9}	2.7×10^{-3}	1.4×10^{-6}
Design basis fire	1.7×10^{-5}	Unlikely	Mean	2.2×10^{-5}	8.6×10^{-9}	8.7×10^{-7}	4.4×10^{-10}	2.2×10^{-4}	1.1×10^{-7}
			95th percentile	7.4×10^{-5}	2.9×10^{-8}	3.3×10^{-6}	1.7×10^{-9}	1.2×10^{-3}	5.9×10^{-7}
Design basis explosion	2.7×10^{-4}	Extremely Unlikely	Mean	3.5×10^{-4}	1.4×10^{-7}	1.4×10^{-5}	7.1×10^{-9}	3.6×10^{-3}	1.8×10^{-6}
			95th percentile	1.2×10^{-3}	4.8×10^{-7}	5.4×10^{-5}	2.7×10^{-8}	1.9×10^{-2}	9.6×10^{-6}
Beyond-design-basis earthquake	1.1×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	2.0×10^{1}	7.9×10^{-3}	7.7×10^{-1}	3.8×10^{-4}	1.5×10^{2}	7.4×10^{-2}
			95th percentile	7.4×10^{1}	3.0×10^{-2}	2.8	1.4×10^{-3}	7.9×10^{2}	3.9×10^{-1}
Beyond-design-basis fire	2.4×10^{-2}	Beyond extremely unlikely	Mean	4.4×10^{-2}	1.8×10^{-5}	1.7×10^{-3}	8.5×10^{-7}	3.3×10^{-1}	1.6×10^{-4}
			95th percentile	1.7×10^{-1}	6.6×10^{-5}	6.2×10^{-3}	3.1×10^{-6}	1.8	8.7×10^{-4}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: ANL–W, Argonne National Laboratory–West.

Source: O'Connor 1998a.

Table K–25. Accident Impacts of Lead Assembly Fabrication at Hanford (27 m Stack Height)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely Unlikely	Mean	1.4×10^{-2}	5.6×10^{-6}	1.4×10^{-3}	6.8×10^{-7}	8.7×10^{-1}	4.3×10^{-4}
			95th percentile	4.0×10^{-2}	1.6×10^{-5}	4.2×10^{-3}	2.1×10^{-6}	5.5	2.7×10^{-3}
Design basis earthquake	3.9×10^{-5}	Unlikely	Mean	1.6×10^{-5}	6.5×10^{-9}	1.9×10^{-6}	9.6×10^{-10}	2.9×10^{-3}	1.4×10^{-6}
			95th percentile	4.8×10^{-5}	1.9×10^{-8}	6.3×10^{-6}	3.2×10^{-9}	1.7×10^{-2}	8.3×10^{-6}
Design basis fire	1.7×10^{-5}	Unlikely	Mean	7.1×10^{-6}	2.8×10^{-9}	8.4×10^{-7}	4.2×10^{-10}	1.2×10^{-3}	6.2×10^{-7}
			95th percentile	2.1×10^{-5}	8.4×10^{-9}	2.7×10^{-6}	1.4×10^{-9}	7.4×10^{-3}	3.6×10^{-6}
Design basis explosion	2.7×10^{-4}	Extremely Unlikely	Mean	1.1×10^{-4}	4.6×10^{-8}	1.4×10^{-5}	6.8×10^{-9}	2.0×10^{-2}	1.0×10^{-5}
			95th percentile	3.4×10^{-4}	1.4×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.2×10^{-1}	5.8×10^{-5}
Beyond-design-basis earthquake	1.1×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.9×10^{1}	7.5×10^{-3}	7.4×10^{-1}	3.7×10^{-4}	1.0×10^{3}	5.1×10^{-1}
			95th percentile	7.1×10^{1}	8×10^{-2}	2.7	1.3×10^{-3}	6.5×10^{3}	2.8
Beyond-design-basis fire	2.4×10^{-2}	Beyond extremely unlikely	Mean	4.1×10^{-2}	1.7×10^{-5}	1.6×10^{-3}	8.2×10^{-7}	2.2	1.1×10^{-3}
			95th percentile	1.6×10^{-1}	6.3×10^{-5}	5.9×10^{-3}	3.0×10^{-6}	1.4×10^{1}	6.2×10^{-3}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Source: O'Connor 1998b.

Table K–26. Accident Impacts of Lead Assembly Fabrication at Hanford (36 m Stack Height)

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to *Noninvolved* Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	1.1×10^{-2}	4.4×10^{-6}	1.2×10^{-3}	6.0×10^{-7}	8.5×10^{-1}	4.3×10^{-4}
			95th percentile	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Design basis earthquake	3.9×10^{-5}	Unlikely	Mean	9.1×10^{-6}	3.6×10^{-9}	1.7×10^{-6}	8.5×10^{-10}	2.8×10^{-3}	1.4×10^{-6}
			95th percentile	3.5×10^{-5}	1.4×10^{-8}	5.2×10^{-6}	2.6×10^{-9}	1.7×10^{-2}	8.5×10^{-6}
Design basis fire	1.7×10^{-5}	Unlikely	Mean	3.9×10^{-6}	1.6×10^{-9}	7.3×10^{-7}	3.7×10^{-10}	1.2×10^{-3}	6.1×10^{-7}
			95th percentile	1.5×10^{-5}	6.0×10^{-9}	2.3×10^{-6}	1.1×10^{-9}	7.4×10^{-3}	3.7×10^{-6}
Design basis explosion	2.7×10^{-4}	Extremely unlikely	Mean	6.4×10^{-5}	2.5×10^{-8}	1.2×10^{-5}	5.9×10^{-9}	2.0×10^{-2}	9.9×10^{-6}
			95th percentile	2.4×10^{-4}	9.8×10^{-8}	3.7×10^{-5}	1.8×10^{-8}	1.2×10^{-1}	5.9×10^{-5}
Beyond-design-basis earthquake	1.1×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.9×10^{1}	7.5×10^{-3}	7.4×10^{-1}	3.7×10^{-4}	1.0×10^{3}	5.1×10^{-1}
			95th percentile	7.1×10^{1}	2.8×10^{-2}	2.7	1.3×10^{-3}	6.5×10^{3}	2.8e+00
Beyond-design-basis fire	2.4×10^{-2}	Beyond extremely unlikely	Mean	4.1×10^{-2}	1.7×10^{-5}	1.6×10^{-3}	8.2×10^{-7}	2.2	1.1×10^{-3}
			95th percentile	1.6×10^{-1}	6.3×10^{-5}	5.9×10^{-3}	3.0×10^{-6}	1.4×10^{1}	6.2×10^{-3}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (single noninvolved worker at a distance of 1,000 m [3,281 ft] or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Source: O'Connor 1998b.

Table K–27. Accident Impacts of Lead Assembly Fabrication at LLNL

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)[a]	Probability of Cancer Fatality Given Dose to Noninvolved Worker[b]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[b]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[c]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	7.0×10^{-2}	2.8×10^{-5}	6.7×10^{-2}	3.3×10^{-5}	1.1×10^{1}	5.7×10^{-3}
			95th percentile	5.3×10^{-1}	2.1×10^{-4}	5.3×10^{-1}	2.7×10^{-4}	6.4×10^{1}	3.1×10^{-2}
Design basis earthquake	3.9×10^{-5}	Unlikely	Mean	1.8×10^{-4}	7.2×10^{-8}	2.2×10^{-4}	1.1×10^{-7}	5.5×10^{-2}	2.8×10^{-5}
			95th percentile	1.3×10^{-3}	5.3×10^{-7}	1.7×10^{-3}	8.5×10^{-7}	2.8×10^{-1}	1.5×10^{-4}
Design basis fire	1.7×10^{-5}	Unlikely	Mean	7.8×10^{-5}	3.1×10^{-8}	9.3×10^{-5}	4.7×10^{-8}	2.4×10^{-2}	1.2×10^{-5}
			95th percentile	5.7×10^{-4}	2.3×10^{-7}	7.4×10^{-4}	3.7×10^{-7}	1.2×10^{-1}	6.3×10^{-5}
Design basis explosion	2.7×10^{-4}	Extremely unlikely	Mean	1.3×10^{-3}	5.0×10^{-7}	1.5×10^{-3}	7.6×10^{-7}	3.9×10^{-1}	1.9×10^{-4}
			95th percentile	9.3×10^{-3}	3.7×10^{-6}	1.2×10^{-2}	6.0×10^{-6}	1.9	1.0×10^{-3}
Beyond-design-basis fire	2.4×10^{-2}	Beyond extremely unlikely	Mean	1.4×10^{-1}	5.7×10^{-5}	1.3×10^{-1}	6.7×10^{-5}	3.5×10^{1}	1.8×10^{-2}
			95th percentile	1.1	4.3×10^{-4}	1.1	5.3×10^{-4}	1.7×10^{2}	9.3×10^{-2}

[a] The closest point to the site boundary is 563 m (1,847 ft), which is less than 1,000 m (3,281 ft). Therefore, doses to the onsite worker are assessed at 1,000 m [3,281 ft] only in those directions where the site boundary is greater than 1,000 m (3,281 ft) away. For other directions, doses are assessed at the site boundary.

[b] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m (3,281 ft) or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: LLNL, Lawrence Livermore National Laboratory.

Note: A beyond-design-basis earthquake was not evaluated for Building 332 at LLNL because extensive analyses of the seismic hazard at the site and the response of the building to those hazards indicate that the scenario is beyond the range of "reasonably foreseeable." Current estimates are that the frequency of collapse is on the order of 1.0×10^{-7} per year or less.

Source: Murray 1998; O'Connor 1998c.

Table K–28. Accident Impacts of Lead Assembly Fabrication at LANL

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	2.2×10^{-2}	8.7×10^{-6}	1.1×10^{-2}	5.7×10^{-6}	1.5	7.5×10^{-4}
			95th percentile	6.5×10^{-2}	2.6×10^{-5}	2.8×10^{-2}	1.4×10^{-5}	6.6	3.2×10^{-3}
Design basis earthquake	3.9×10^{-5}	Unlikely	Mean	3.4×10^{-5}	1.4×10^{-8}	1.3×10^{-5}	6.5×10^{-9}	3.1×10^{-3}	1.5×10^{-6}
			95th percentile	1.1×10^{-4}	4.3×10^{-8}	4.1×10^{-5}	2.1×10^{-8}	1.4×10^{-2}	6.8×10^{-6}
Design basis fire	1.7×10^{-5}	Unlikely	Mean	1.5×10^{-5}	6.0×10^{-9}	5.7×10^{-6}	2.8×10^{-9}	1.3×10^{-3}	6.7×10^{-7}
			95th percentile	4.7×10^{-5}	1.9×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	5.9×10^{-3}	2.9×10^{-6}
Design basis explosion	2.7×10^{-4}	Extremely unlikely	Mean	2.4×10^{-4}	9.7×10^{-8}	9.2×10^{-5}	4.6×10^{-8}	2.2×10^{-2}	1.1×10^{-5}
			95th percentile	7.6×10^{-4}	3.0×10^{-7}	2.9×10^{-4}	1.5×10^{-7}	9.5×10^{-2}	4.8×10^{-5}
Beyond-design-basis earthquake	1.1×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	1.3×10^{1}	5.3×10^{-3}	4.4	2.2×10^{-3}	9.5×10^{2}	4.8×10^{-1}
			95th percentile	5.1×10^{1}	2.1×10^{-2}	1.4×10^{1}	7.0×10^{-3}	4.2×103	2.1
Beyond-design-basis fire	2.4×10^{-2}	Beyond extremely unlikely	Mean	2.9×10^{-2}	1.2×10^{-5}	9.7×10^{-3}	4.9×10^{-6}	2.1	1.1×10^{-3}
			95th percentile	1.1×10^{-1}	4.6×10^{-5}	3.1×10^{-2}	1.6×10^{-5}	9.2	4.6×10^{-3}

[a] Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[b] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Key: LANL, Los Alamos National Laboratory.

Source: O'Connor 1998d.

Table K–29. Accident Impacts of Lead Assembly Fabrication at SRS H-Area

Accident	Source Term (g)	Frequency (per year)	Meteorology	Dose to Noninvolved Worker (rem)	Probability of Cancer Fatality Given Dose to Noninvolved Worker[a]	Dose at Site Boundary (rem)	Probability of Cancer Fatality Given Dose at Site Boundary[a]	Population Dose Within 80 km (person-rem)	Latent Cancer Fatalities Within 80 km[b]
Criticality	1.0×10^{19} fissions	Extremely unlikely	Mean	5.2×10^{-3}	2.1×10^{-6}	3.4×10^{-4}	1.7×10^{-7}	3.0×10^{-1}	1.5×10^{-4}
			95th percentile	1.0×10^{-2}	4.0×10^{-6}	9.3×10^{-4}	4.6×10^{-7}	1.3	6.5×10^{-4}
Design basis earthquake	3.9×10^{-5}	Unlikely	Mean	3.5×10^{-6}	1.4×10^{-9}	4.4×10^{-7}	2.2×10^{-10}	1.3×10^{-3}	6.3×10^{-7}
			95th percentile	7.8×10^{-6}	3.1×10^{-9}	1.3×10^{-6}	6.7×10^{-10}	5.6×10^{-3}	2.7×10^{-6}
Design basis fire	1.7×10^{-5}	Unlikely	Mean	1.5×10^{-6}	6.1×10^{-10}	1.9×10^{-7}	9.5×10^{-11}	5.4×10^{-4}	2.7×10^{-7}
			95th percentile	3.4×10^{-6}	1.3×10^{-9}	5.8×10^{-7}	2.9×10^{-10}	2.4×10^{-3}	1.2×10^{-6}
Design basis explosion	2.7×10^{-4}	Extremely unlikely	Mean	2.5×10^{-5}	9.9×10^{-9}	3.1×10^{-6}	1.5×10^{-9}	8.8×10^{-3}	4.4×10^{-6}
			95th percentile	5.5×10^{-5}	2.2×10^{-8}	9.5×10^{-6}	4.7×10^{-9}	3.9×10^{-2}	1.9×10^{-5}
Beyond-design-basis earthquake	1.1×10^{1}	Extremely unlikely to beyond extremely unlikely	Mean	7.1	2.9×10^{-3}	2.0×10^{-1}	9.8×10^{-5}	5.1×10^{2}	2.6×10^{-1}
			95th percentile	2.6×10^{1}	1.0×10^{-2}	8.8×10^{-1}	4.4×10^{-4}	2.2×10^{3}	1.1
			95th percentile						
Beyond-design-basis fire	2.4×10^{-2}	Beyond extremely unlikely	Mean	1.6×10^{-2}	6.3×10^{-6}	4.4×10^{-4}	2.2×10^{-7}	1.1	5.7×10^{-4}
			95th percentile	5.8×10^{-2}	2.3×10^{-5}	2.0×10^{-3}	9.8×10^{-7}	4.9	2.4×10^{-3}

a Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

b Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) if exposed to the indicated dose. The value assumes that the accident has occurred.

Source: O'Connor 1998e.

K.7 REFERENCES

Coats, D.W. Jr., 1998, Lawrence Livermore National Laboratory, Livermore, CA, personal communication to B. Meyers, Hazards Mitigation Center, Lawrence Livermore National Laboratory, Livermore, CA, *B-332 Inc. III Seismic Safety, Plant Engineering,* April 2.

DOC (U.S. Department of Commerce), 1992, *Census of Population and Housing, 1990: Summary Tape File 3 on CD-ROM,* Bureau of the Census, Washington, DC, May.

DOE (U.S. Department of Energy), 1992, *Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore,* DOE/EIS-0157, August 1.

DOE (U.S. Department of Energy), 1993, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements,* Office of Environment, Safety and Health, Office of NEPA Oversight, Washington, DC, May.

DOE (U.S. Department of Energy), 1994a, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities,* vol. I and II, DOE Handbook DOE-HDBK-3010-94, Washington, DC, December.

DOE (U.S. Department of Energy), 1994b, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities,* DOE-STD-1020-94, Washington, DC, April.

DOE (U.S. Department of Energy), 1994c, *DWPF Final Safety Analysis Report (U),* Westinghouse Savannah River Company, Aiken, SC, May.

DOE (U.S. Department of Energy), 1994d, *F-Canyon Plutonium Solutions Environmental Impact Statement,* DOE/SPD EIS-0219, DOE Savannah River Operations Office, Aiken, SC, December.

DOE (U.S. Department of Energy), 1995, *Facility Safety,* DOE O 420.1, Washington, DC, October 13.

DOE (U.S. Department of Energy), 1996a, *Accident Analysis for Aircraft Crash Into Hazardous Facilities,* DOE-STD-3014, Washington, DC, October.

DOE (U.S. Department of Energy), 1996b, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement,* DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

EPA (U.S. Environmental Protection Agency), 1992, *Environmental Impact Statement,* "Incomplete or Unavailable Information," 40 CFR 1502.22, Washington, DC, July 1.

ICRP (International Commission on Radiological Protection), 1991, *1990 Recommendations of the International Commission on Radiological Protection,* ICRP Publication 60, Pergamon Press, Elmsford, NY.

Mishima, J., 1997, Science Applications International Corporation, Richland, WA, personal communication to J. Eichner, Science Applications International Corporation, Germantown, MD, *Particle Size of PuO_2 Generated by HYDOX-Ga Removal Process and Impact on Usability of DOE-HDBK-3010-94 ARF and RF Values,* December 15.

Murray, R.C., 1998, Lawrence Livermore National Laboratory, Livermore, CA, personal communication to B. Myers, Hazards Mitigation Center, Lawrence Livermore National Laboratory, Livermore, CA, *Collapse Probability of Building 332 Increment III Due to an Earthquake*, April 20.

NRC (U. S. Nuclear Regulatory Commission), 1990, *MELCOR Accident Consequence Code System (MACCS)*, NUREG/CR-4691, Office of Nuclear Regulatory Research, Division of Systems Research, Washington, DC, February.

O'Connor, D.G., et al., 1998a, *ANL-W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13478, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998b, *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13481, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998c, *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13480, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998d, *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13482, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

O'Connor, D.G., et al., 1998e, *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement*, ORNL/TM-13483, Lockheed Martin Energy Research Corporation, Oak Ridge, TN.

Smith, W.B., O. Wilkey, and D. Siebe, 1996, *Data Report for Plutonium Conversion Facility*, LA-UR-95-1721, Los Alamos National Laboratory, Los Alamos, NM, February 14.

UC (Regents of the University of California), 1998a, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Hanford Site*, LA-UR-97-2907, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998b, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Hanford*, UCRL-ID-128276, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998c, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford*, UCRL-ID-128275, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998d, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Hanford Site*, LA-UR-97-2064, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998e, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Savannah River Site*, LA-UR-97-2910, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998f, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site,* UCRL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998g, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in New Facilities at Savannah River Site,* UCRL-ID-128273, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998h, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Savannah River Site,* LA-UR-97-2066, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998i, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Savannah River Site,* UCRL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998j, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Savannah River Site,* UCRL-ID-128272, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents of the University of California), 1998k, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Pantex Plant,* LA-UR-97-2909, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998l, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Idaho National Engineering and Environmental Laboratory,* LA-UR-97-2908, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998m, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Idaho National Engineering and Environmental Laboratory,* LA-UR-97-2065, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents of the University of California), 1998n, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Pantex Plant,* LA-UR-97-2067, Los Alamos National Laboratory, Los Alamos, NM.

Next Section

Appendix L
Evaluation of Human Health Effects From Transportation

L.1 INTRODUCTION

The overland transportation of any commodity involves a risk to both transportation crew members and members of the public. This risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of certain materials, such as hazardous or radioactive waste, can pose an additional risk due to the unique nature of the material. In order to permit a complete appraisal of the environmental impacts of the proposed action and alternatives, the human health risks associated with the overland transportation of plutonium and uranium have been assessed.

This appendix provides an overview of the approach used to assess the human health risks that may result from the overland transportation. The appendix includes a discussion of the scope of the assessment, analytical methods used for the risk assessment (i.e., computer models), important assessment assumptions, and a determination of potential transportation routes. It also presents the results of the assessment. In addition, to aid in the understanding and interpretation of the results, specific areas of uncertainty are described, with an emphasis on how the uncertainties may affect comparisons of the alternatives.

The approach used in this appendix is modeled after that used in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (PEIS) (DOE 1996a). The fundamental assumptions used in this analysis are consistent with those used in that PEIS, and the same computer codes and generic release and accident data are used.

The risk assessment results are presented in this appendix in terms of "per-shipment" risk factors, as well as for the total risks associated with each alternative. Per-shipment risk factors provide an estimate of the risk from a single hazardous material shipment between a specific origin and destination. The total risks for a given alternative are found by multiplying the expected number of shipments by the appropriate per-shipment risk factors.

L.2 SCOPE OF ASSESSMENT

The scope of the overland transportation human health risk assessment, including the alternatives and options, transportation activities, potential radiological and nonradiological impacts, and transportation modes considered, is described below. Additional details of the assessment are provided in the remaining sections of the appendix.

- Proposed Action and Alternatives—The transportation risk assessment conducted for the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS) estimates the human health risks associated with the transportation of plutonium and other hazardous materials for a number of disposition alternatives.

- Radiological Impacts—For each alternative, radiological risks (i.e., those risks that result from the radioactive nature of the plutonium and other hazardous materials are assessed for both incident-free (i.e., normal) and accident transportation conditions. The radiological risk associated with incident-free transportation conditions would result from the potential exposure of people to external radiation in the vicinity of a loaded shipment. The radiological risk from transportation accidents would come from the potential release and dispersal of radioactive material into the environment during an accident and the subsequent exposure of people through multiple exposure pathways (i.e., exposure to contaminated ground or air, or ingestion of contaminated food).

All radiological impacts are calculated in terms of effective dose and associated health effects in the exposed populations. The radiation dose calculated is the total effective dose equivalent (NRC 1998), which is the sum of the effective dose equivalent from external radiation exposure and the 50-year committed effective dose equivalent from internal radiation exposure. Radiation doses are presented in units of roentgen equivalent man (rem) for individuals and person-rem for collective populations. The impacts are further expressed as health risks in terms of latent cancer fatalities (LCFs) and cancer incidence in exposed populations. The health risk conversion factors (expected health effects per dose absorbed) were taken from *International Commission on Radiological Protection Publication 60* (ICRP 1991).

- Nonradiological Impacts—In addition to the radiological risks posed by overland transportation activities, vehicle-related risks are also assessed for nonradiological causes (i.e., related to the transport vehicles and not the radioactive cargo) for the same transportation routes. The nonradiological transportation risks are independent of the radioactive nature of the cargo and would be incurred for similar shipments of any commodity. The nonradiological risks are assessed for both incident-free and accident conditions. Nonradiological risks during incident-free transportation conditions would be caused by potential exposure to increased vehicle exhaust emissions. The nonradiological accident risk refers to the potential occurrence of transportation accidents that directly result in fatalities unrelated to the cargo. State-specific transportation fatality rates are used in the assessment. Nonradiological risks are presented in terms of estimated fatalities.

- Transportation Modes—All overland shipments have been assumed to take place by truck transportation modes.

- Receptors—Transportation-related risks are calculated and presented separately for workers and members of the general public. The workers considered are truck crew members involved in the actual overland transportation. The general public includes all persons who could be exposed to a shipment while it is moving or stopped enroute. Potential risks are estimated for the collective populations of exposed people, as well as for the hypothetical maximally exposed individual. The collective population risk is a measure of the radiological risk posed to society as a whole by the alternative being considered. As such, the collective population risk is used as the primary means of comparing various alternatives.

L.3 PACKAGING AND REPRESENTATIVE SHIPMENT CONFIGURATIONS

Regulations that govern the transportation of radioactive materials are designed to protect the public from the potential loss or dispersal of radioactive materials as well as from routine radiation doses during transit. The primary regulatory approach to promote safety is through the specification of standards for the packaging of radioactive materials. Because packaging represents the primary barrier between the radioactive material being transported and radiation exposure to the public and the environment, packaging requirements are an important consideration for the transportation risk assessment. Regulatory packaging requirements are discussed briefly below and in Chapter 5. In addition, the representative packaging and shipment configurations assumed for the SPD EIS are described.

L.3.1 Packaging Overview

Although several Federal and State organizations are involved in the regulation of radioactive materials transportation, primary regulatory responsibility resides with the U.S. Department of Transportation (DOT) and the U.S. Nuclear Regulatory Commission (NRC). All transportation activities must take place in accordance with the applicable regulations of these agencies specified in Title 49 of the Code of Federal Regulations (CFR) Part 173 (DOT 1992a) and 10 CFR 71 (NRC 1996).

Transportation packaging for small quantities of radioactive materials must be designed, constructed, and maintained to contain and shield their contents during normal transport conditions. For large quantities and for more highly radioactive material, such as spent nuclear fuel or plutonium, they must contain and shield their contents in the event of severe accident conditions. The type of packaging used is determined by the total radioactive hazard presented by the material within the packaging; 10 CFR 71 (NRC 1996) provides the rules for this determination. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. Another packaging option, Strong and Tight, is still available for some domestic shipments.

Excepted packagings are limited to transporting materials with extremely low levels of radioactivity. Industrial packagings are used to transport materials that, because of their low concentration of radioactive materials, present a limited hazard to the public and the environment. Type A packagings are designed to protect and retain their contents under normal transport conditions and must maintain sufficient shielding to limit radiation exposure to handling personnel. These packagings are used to transport radioactive materials with higher concentrations or amounts of radioactivity than Excepted or Industrial packagings. Strong and Tight packagings are used in the United States for shipment of certain materials with low levels of radioactivity, such as natural uranium and rubble from the decommissioning of nuclear reactors. Type B packages are described in detail in Appendix L.3.1.6.

L.3.1.1 Uranium Hexafluoride Packaging

DOE would ship uranium hexafluoride from the Portsmouth Gaseous Diffusion Plant to a fuel fabrication facility in Model 30B cylinders, which are Type A packages (for the purposes of the SPD EIS). Uranium hexafluoride shipments are regulated under 49 CFR 173.420, which requires the packaging to be in accordance with ANSI N14.1, *Uranium Hexafluoride–Packaging for Transport*. Because uranium hexafluoride breaks down into hydrofluoric acid and uranyl fluoride when exposed to air, packages would be marked with the primary hazard label as "Radioactive Yellow-II" and a secondary hazard label as "Corrosive." The transport vehicle would be required to show the primary placard "Radioactive" and the secondary placard "Corrosive."

L.3.1.2 Uranium Dioxide Packaging

DOE would ship uranium oxide from the fuel fabrication facility to DOE's mixed oxide (MOX) facility in gasketed, open-head, 208-l (55-gal) drums with heavy plastic liners, which are Industrial Package Type 1 packages. Uranium oxide shipments are regulated under 49 CFR 173.425. Because uranium oxide is a low-specific activity material, no primary hazard label would be required, and because it is chemically stable, no secondary hazard label would be required. The transport vehicle would be required to show the primary placard "Radioactive" and no secondary placard.

L.3.1.3 Mixed Oxide Fuel Packaging

DOE will design the container for the MOX fuel assemblies. For analysis purposes, it is assumed that DOE would ship the unirradiated MOX fuel bundles to the reactor site(s) in Type B packages. Two conceptual packaging ideas are end-loading and lateral-loading packages (Ludwig et al. 1997). The fuel assembly weight per container is approximately 2800 kg (6,000 lb) for either pressurized water reactor (PWR) or boiling water reactor (BWR) fuel. The container could hold either four PWR or eight BWR assemblies.

L.3.1.4 Highly Enriched Uranium Packaging

DOE would ship highly enriched uranium (HEU) from the pit conversion facility to the Y–12 facility near Oak Ridge, Tennessee. The DOE-approved container type for these shipments is the DT–22.

L.3.1.5 Plutonium Packaging

DOE would ship all plutonium in Type B containers. DOE would ship nonpit plutonium from DOE sites (Hanford, Idaho National Engineering and Environmental Laboratory [INEEL], Los Alamos National Laboratory [LANL], Lawrence Livermore National Laboratory [LLNL], Rocky Flats Environmental Technology Site [RFETS], and Savannah River Site [SRS]) to the immobilization facility (Hanford or SRS) in a variety of containers, such as Type 3013, Type 2R, and Foodpac containers, which would be transported inside various casks, such as radial reflector, Model 60 FFTA DFA pins shipping or Specification 6M packages. DOE would ship plutonium pits from DOE sites to the pit conversion facility in DOE-approved FL containers and the piece parts resulting from pit disassembly in DOE-approved UC–609 and USA/9975 containers. Plutonium oxide produced at the pit disassembly and conversion facility (pit conversion facility) would be loaded into packaging that meets DOE-STD-3013-96, *Criteria for Safe Storage of Plutonium Metals and Oxides* (DOE 1996b) or equivalent. This package provides for safe storage of plutonium oxides for at least 50 years or until final disposition and serves as the primary containment vessel for shipping. DOE-STD-3013-96 specifies a design goal that the Type 3013 container could be shipped in a qualified shipping container without further reprocessing or repackaging. The Type 3013 primary containment vessel is designed for shipping and would be compatible with a Type B package. No Type B package has been specifically constructed or licensed for shipping DOE-STD-3013-96 primary containment vessels.

A Type B package is required when transporting commercial quantities of plutonium materials, including unirradiated MOX fuel assemblies. DOE is developing a conceptual design for a MOX container that optimizes safe, secure trailer (SST) load-carrying capacity and ensures compatibility with fuel-handling systems at commercial reactors (Ludwig et al. 1997).

L.3.1.6 Overview of Type B Containers

The transportation of highway-route controlled quantities of plutonium (more than a few grams, depending on activity level) requires the use of Type B packaging. In addition to meeting the standards for Type A packaging, Type B packaging must provide a high degree of assurance that, even in severe accidents, the integrity of the package will be maintained with essentially no loss of the radioactive contents or serious impairment of the shielding and maintain subcriticality capability. Type B packaging must satisfy stringent testing criteria specified in 10 CFR 71 (NRC 1996). The testing criteria were developed to simulate severe accident conditions, including impact, puncture, fire, and water immersion.

Beyond meeting DOT standards showing it can withstand normal conditions of transport without loss or dispersal of its radioactive contents or allowance of significant radiation fields, Type B packaging must also meet the 10 CFR 71 requirements administered by the NRC. The complete sequence of tests is listed below:

- Free-Drop Test—A 9-m (30-ft) free-drop onto a flat, essentially unyielding, horizontal surface, striking the surface in a position for which maximum damage to the package is expected.
- Puncture Test—A 1-m (40-in) drop onto the upper end of a 15-cm (6-in) diameter solid, vertical, cylindrical, mild steel bar (at least 20-cm [8-in] long) mounted on an essentially unyielding, horizontal surface.

- Thermal Test—Exposure to a heat flux of no less than that of a thermal radiation environment of 800 °C (1,475 °F) with an emissivity coefficient of at least 0.9 for a period of 30 minutes.

- Water Immersion Test—A separate, undamaged package specimen is subjected to water pressure equivalent to immersion under a head of water of at least 15-m (50-ft) for no less than 8 hours.

Effective April 1, 1996, 10 CFR 71 has been revised to require an additional immersion test in 200 m (660 ft) of water for Type B casks designed to contain material with activity levels greater than one million curies (Ci) (NRC 1996). Containers used for shipping plutonium will not necessarily be subject to this test because they will contain much less than one million curies. The packaging may also be required to undergo the crush test if it is considered a light-weight, low-density package as most drum-type packages are. The crush test consists of dropping a 500-kg (1100-lb) steel plate from 9 m (30 ft) onto the package, which is resting on an essentially unyielding surface.

Additional restrictions apply to package surface contamination levels, but these restrictions are not limiting for the transportation radiological risk assessment. For risk assessment purposes, it is important to note that all packaging of a given type is designed to meet the same performance criteria. Therefore, two different Type B designs would be expected to perform similarly during incident-free and accident transportation conditions. The specific containers selected, however, will determine the total number of shipments necessary to transport a given quantity of plutonium.

External radiation from a package must be below specified limits that minimize the exposure of the handling personnel and general public. For these types of shipments, the external radiation dose rate during normal transportation conditions must be maintained below the following limits of 49 CFR 173 (DOT 1992a):

- 10 mrem/hr at any point 2 m (6.6 ft) from the vertical planes projected by the outer lateral surfaces of the transport vehicle (referred to as the regulatory limit throughout this document)

- 2 mrem/hr in any normally occupied position in the transport vehicle

L.3.2 Safe, Secure Transportation

DOE anticipates that any transportation of plutonium pits, nonpit plutonium, plutonium oxide, MOX fuel, or HEU would be required to be made through use of the Transportation Safeguards System and shipped using SSTs. The SST is a fundamental component of the Transportation Safeguards System. The Transportation Safeguards System is operated by the DOE Transportation Safeguards Division of the Albuquerque Operations Office for the DOE Headquarters Office of Defense Programs. Based on operational experience between FY84 and FY93, the mean probability of an accident requiring the tow-away of the SST was 0.066 accident per million kilometers (0.11 accident per million miles). By contrast, the rate for commercial trucking in 1989 was about 0.3 accidents per million kilometers (0.5 accident per million miles). Commercial trucking accident rates (Saricks and Kvitek 1994) were used in the human health effects analysis. Since established in 1975, the Transportation Safeguards Division has accumulated more than 145 million km (90 million mi) of over-the-road experience transporting DOE-owned cargo with no accidents resulting in a fatality or release of radioactive material.

The SST is a specially designed component of an 18-wheel tractor-trailer vehicle. Although details of vehicle enhancements and some operational aspects are classified, key characteristics of the SST system include the following:

- Enhanced structural characteristics and a highly reliable tie-down system to protect cargo from impact
- Heightened thermal resistance to protect the cargo in case of fire
- Various deterrents to prevent unauthorized removal of cargo
- An armored tractor component that provides courier protection against attack and contains advanced communications equipment
- Specially designed escort vehicles containing advanced communications and additional couriers
- 24-hour-a-day real-time communications to monitor the location and status of all SST shipments via DOE's Security Communication system
- Couriers who are armed Federal Officers, receive rigorous specialized training, and who are closely monitored through DOE's Personnel Assurance Program
- Significantly more stringent maintenance standards than those for commercial transport equipment
- Conduct of periodic appraisals of the Transportation Safeguards System operations by the DOE Office of Defense Programs to ensure compliance with DOE orders and management directives.

L.3.3 Ground Transportation Route Selection Process

According to DOE guidelines, plutonium shipments must comply with both NRC and DOT regulatory requirements. Commercial shipments are also required by law to comply with both NRC and DOT requirements. NRC regulations cover the packaging and transport of plutonium, whereas DOT specifically regulates the carriers and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements. The highway routing of nuclear material is systematically determined according to DOT regulations 49 CFR 171–179 and 49 CFR 397 for commercial shipments. Specific routes cannot be publicly identified in advance for Transportation Safeguards Division shipments because they are classified to protect national security interests.

The DOT routing regulations require that shipment of a "highway route-controlled quantity" of radioactive material be transported over a preferred highway network including interstate highways, with preference toward interstate system bypasses around cities, and State-designated preferred routes. A State or Tribe may designate a preferred route to replace or supplement the interstate highway system in accordance with DOT guidelines (DOT 1992b).

Carriers of highway route-controlled quantities are required to use the preferred network, unless moving from origin to the nearest interstate or from the interstate to the destination, when making necessary repair or rest stops, or when emergency conditions render the interstate unsafe or impassible. The primary criterion for selecting the preferred route for a shipment is travel time. Preferred routing takes into consideration accident rate, transit time, population density, activities, time of day, and day of week.

The HIGHWAY computer code (Johnson et al. 1993) may be used for selecting highway routes in the United States. The HIGHWAY database is a computerized road atlas that currently describes about 386,400 km (240,000 mi) of roads. The Interstate System and all U.S. (U.S.-designated) highways are completely described in the database. In addition, most of the principal State highways and many local and community roads are also identified. The code is updated periodically to reflect current road conditions and has been benchmarked against reported mileages and observations of commercial truck firms. Features in the HIGHWAY code allow the user to select routes that conform to DOT regulations. Additionally, the HIGHWAY code contains data on the population densities along the routes. The distances and populations from the HIGHWAY code are part of the information used for the transportation impact analysis in the SPD EIS.

L.4 METHODS FOR CALCULATING TRANSPORTATION RISKS

The overland transportation risk assessment methodology is summarized in Figure L–1. After the alternatives were identified and goals of the shipping campaign were understood, the first step was to collect data on material characteristics and accident parameters. Physical, radiological, and packaging data were provided in reports from the DOE national laboratories. Accident parameters are largely based on the DOE-funded study of transportation accidents (Saricks and Kvitek 1994).

Representative routes that may be used for the shipment of plutonium were selected using the HIGHWAY code. These routes were selected for risk assessment purposes. They do not necessarily represent the actual routes that would be used to transport nuclear materials. Specific routes cannot be identified in advance because the routes would not be finalized until they had been reviewed and approved by NRC. The selection of the actual route would be responsive to environmental and other conditions that would be in effect or could be predicted at the time of shipment. Such conditions could include adverse weather conditions, road conditions, bridge closures, and local traffic problems. For security reasons, details about a route would not be publicized before the shipment.

The first analytic step in the ground transportation analysis was to determine the incident-free and accident risk factors, on a per-shipment basis, for transportation. Risk factors, as any risk estimate, are the product of the probability of exposure and the magnitude of the exposure. Accident risk factors were calculated for radiological and nonradiological traffic accidents. The probabilities, which are much lower than one, and the magnitudes of exposure were multiplied, yielding risk numbers. Incident-free risk factors were calculated for crew and public exposure to radiation emanating from the shipping container (cask) and public exposure to the chemical toxicity of the transportation vehicle exhaust. The probability of incident-free exposure is unity (one).

Radiological risk factors are expressed in units of rem. Later in the analysis, they will be multiplied by *International Commission on Radiation Protection Publication 60* (ICRP 1991) conversion factors and estimated number of shipments to give risk estimates in units of LCFs. The vehicle emission risk factors are calculated in latent fatalities, and the vehicle accident risk factors are calculated in fatalities.

For each alternative, risks were assessed for both incident-free transportation and accident conditions. For the incident-free assessment, risks were calculated for both collective populations of potentially exposed individuals and for maximally exposed individuals. The accident assessment consists of two components: (1) a probabilistic accident risk assessment that considers the probabilities and consequences of a range of possible transportation accident environments, including low-probability accidents that have high consequences and high-probability accidents that have low consequences, and (2) an accident consequence assessment that considers only the consequences of the most severe transportation accidents postulated.

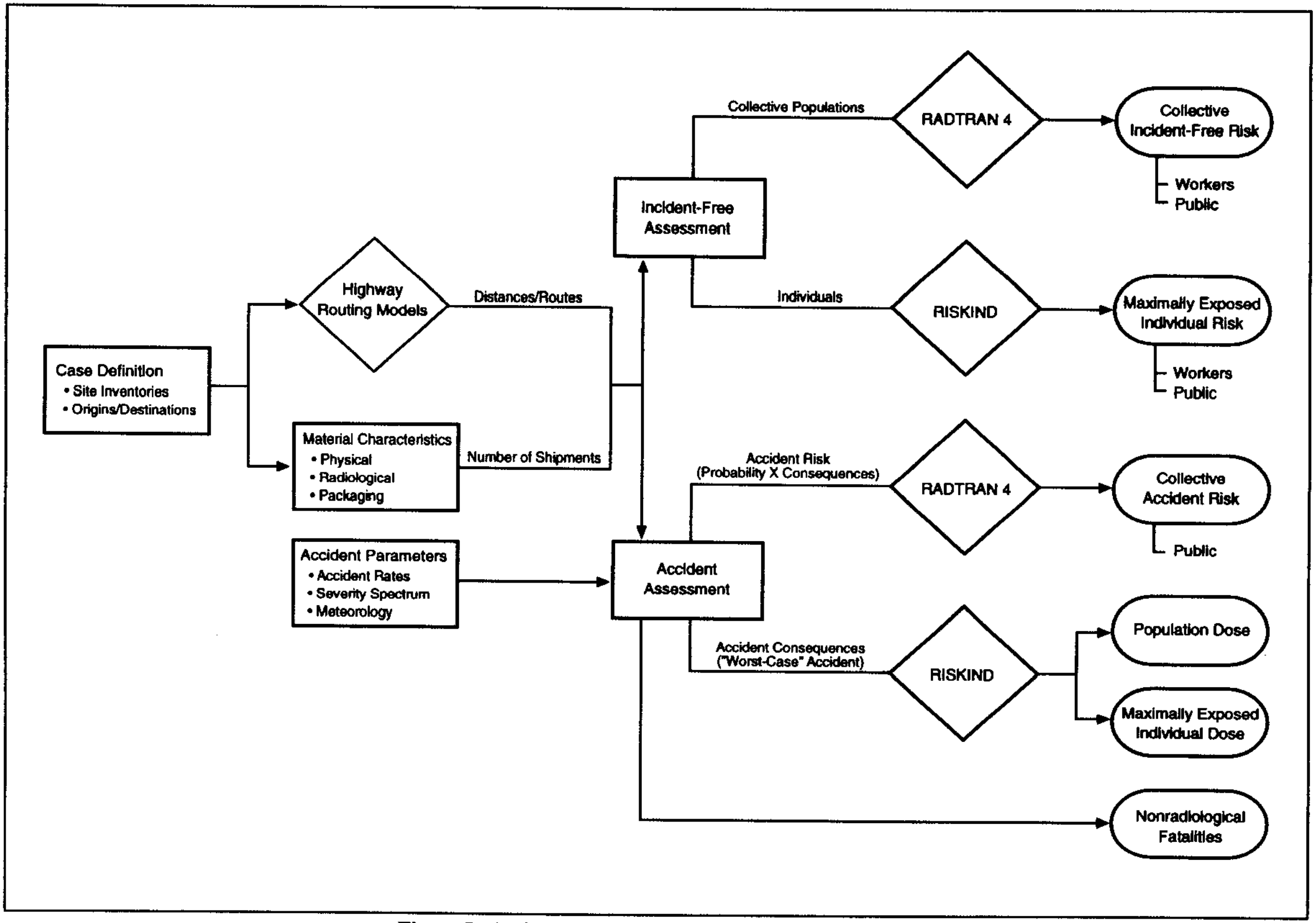


Figure L–1. Overland Transportation Risk Assessment

The RADTRAN 4 computer code (Neuhauser and Kanipe 1994) is used for incident-free and accident risk assessments to estimate the impacts on collective populations. RADTRAN 4 was developed by Sandia National Laboratories to calculate population risks associated with the transportation of radioactive materials by a variety of modes, including truck, rail, air, ship, and barge.

The RADTRAN 4 population risk calculations take into account both the consequences and probabilities of potential exposure events. The collective population risk is a measure of the total radiological risk posed to society as a whole by the alternative being considered. As such, the collective population risk is used as the primary means of comparing the various alternatives. The RISKIND computer code (Yuan et al. 1995) is used to estimate the incident-free doses to maximally exposed individuals and for estimating impacts for the accident consequence assessment. The RISKIND computer code was developed for DOE's Office of Civilian Radioactive Waste Management to analyze the exposure of individuals during incident-free transportation. In addition, the RISKIND code was designed to allow a detailed assessment of the consequences to individuals and population subgroups from severe transportation accidents under various environmental settings.

The RISKIND calculations were conducted to supplement the collective risk results calculated with RADTRAN 4. Whereas the collective risk results provide a measure of the overall risks of each alternative, the RISKIND calculations are meant to address areas of specific concern to individuals and population subgroups. Essentially, the RISKIND analyses are meant to address "What if" questions, such as "What if I live next to a site access road?" or "What if an accident happens near my town?"

If highly specialized analytic codes had been used to model SST behavior in an accident (*DOE-developed Analysis of Dispersal Risk Occurring in Transportation* [Claus et al. 1995:689–696] or ADROIT), the code would have provided a probabilistic risk analysis of special nuclear materials shipped in a SST. ADROIT is designed to provide a focused analysis of an energetic release caused by partial detonation of explosive material. The approach and the code could be tailored for the materials shipped in the SPD EIS. However, detailed thermal and mechanical models have not been created for most of the packages used in the SPD EIS.

L.5 ALTERNATIVES, PARAMETERS, AND ASSUMPTIONS

The transportation risk assessment is designed to ensure—through uniform and judicious selection of models, data, and assumptions—that relative comparisons of risk among the various alternatives are meaningful. The major input parameters and assumptions used in the transportation risk assessment are discussed below.

L.5.1 Transportation Alternatives

The proposed action would involve transporting plutonium and other nuclear materials between DOE and commercial sites. Except for the No Action Alternative, each alternative in the SPD EIS has extensive and unique requirements for the transportation of hazardous materials. In this section, the assumptions and logic used to model the intersite transportation requirements are described.

Alternatives 2 through 12 require transporting plutonium metal and pits from various DOE sites to the pit conversion facility at Hanford, INEEL, Pantex, or SRS. The pit conversion facility would disassemble pits and convert the plutonium metal into plutonium oxide. During the pit disassembly process, HEU would be recovered and shipped from the pit conversion facility to the Y–12 facility at Oak Ridge. In addition, some pit parts would be recovered and shipped to LANL. The plutonium oxide would be shipped to the MOX facility or the immobilization facility depending on the alternative. In many of the alternatives, the pit conversion facility is located on the same site as the MOX facility or immobilization facility, limiting the need for intersite transportation of the plutonium oxide. In these alternatives, the plutonium oxide would be transported between the facilities via a secure tunnel between the facilities.

In addition to reducing the number of trips required and the distance that would have to be traveled to transport surplus pits to the pit conversion facility, by placing the pit conversion facility at Pantex the dose associated with repackaging pits for intersite shipment could be reduced by nearly 40 percent. This is because pits can be transferred to the pit conversion facility at Pantex in their current storage containers (mainly the AL–R8 container) without having to be repackaged. If the pits are transported to another site, they have to be moved to a shipping container (e.g., FL-Type, 9975).

Based on estimates presented in the *Final EIS for the Continued Operation of Pantex*, 50 workers would be needed to repackage 12,000 pits from their current storage containers into containers that could also be used for shipping.[1] This effort would be completed over 10 years and the estimated annual dose received from repackaging activities would be about 50 mrem per worker. By locating the pit conversion facility at Pantex, it is expected that this dose could be reduced by approximately 20 mrem per worker to a level of 30 mrem per worker because the pits would not have to be repackaged for offsite shipment. The pits would be slowly moved from storage locations in storage containers on specially designed vehicles to the pit conversion facility. Over the 10-year operating life of the pit conversion facility, this would reduce the total estimated dose to involved Pantex workers by 10 person-rem from 25 person-rem to 15 person-rem. Under either scenario, the estimated number of excess cancer fatalities associated with repackaging activities would be 0.01 or less.

Alternatives 2 through 12 involve immobilization of nonpit plutonium at Hanford (Alternatives 2, 4, 8, 10, or 11) or SRS (Alternatives 3, 5, 6, 7, 9, or 12). This material would be transported from its current location at various DOE sites to the chosen immobilization facility. If the immobilization facility uses a ceramic process, uranium oxide would be required. One of the United States Enrichment Corporation's gaseous diffusion plants would fill cylinders with depleted uranium hexafluoride, which would be transported to a commercial facility for conversion to uranium oxide. (For the purpose of this analysis, the gaseous diffusion plant in Portsmouth, Ohio, and the nuclear fuel fabrication facility in Wilmington, North Carolina, have been chosen as representative sites for these activities.) The uranium oxide would be transported to the immobilization facility at Hanford or SRS. After the material is immobilized, it is assumed that the additional canisters of high level waste will be shipped to a geologic repository consistent with the assumptions made in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (WM PEIS) (DOE 1997a). Figure L–2 shows the transportation requirements for immobilization.

The production of MOX fuel (Alternatives 2 through 10) requires transporting plutonium oxide from the pit conversion facility to the MOX facility at Hanford, INEEL, Pantex, or SRS. However, in every alternative except Alternatives 4 and 5, the pit conversion facility and MOX facility are collocated so there would not be any intersite transportation required for the plutonium oxide as discussed above. In the case of Alternative 4, the pit conversion facility would be located at Pantex and the plutonium oxide would be shipped to Hanford. Under Alternative 5, the pit conversion facility would also be at Pantex but the plutonium oxide would be shipped to SRS. Uranium oxide needed to produce MOX fuel would be converted from uranium hexafluoride, originally from Portsmouth, at Wilmington, and then transported to the MOX facility. If MOX fuel rods are bundled with low-enriched uranium fuel rods, the uranium fuel rods may come from a separate fabrication facility. Transportation of the uranium fuel rods to the MOX facility is equivalent to transportation of uranium fuel to a commercial reactor site. This transportation activity is covered under the *Final Environmental*

[1] In the analysis presented in the *Pantex EIS* (DOE 1996i), pits are assumed to be repackaged in AT–400A containers. The amount of effort involved in repackaging a pit in an AT–400A container is more intense than the effort needed to repackage a pit in a FL-type container; therefore, the doses would be expected to be higher. Since the *Pantex EIS* was completed, it has been decided that surplus pits would not be repackaged in AT–400A containers. As a result, the dose estimates associated with repackaging pits as presented in the *Pantex EIS* are conservatively high for the SPD EIS. No effort has been made to reestimate the dose associated with repackaging pits. The doses presented in the SPD EIS are based on using the AT–400A container, and therefore represent upper bounds on the expected dose to involved workers.

Statement on the Transportation of Radioactive Material by Air and Other Modes (NRC 1977). The MOX fuel would be transported to a U.S. nuclear reactor for power production. (For the purposes of this analysis, it is assumed that the reactor is 4,000 km (2,500 mi) from the MOX facility.) Figure L–3 shows the transportation requirements for MOX fuel fabrication.

Alternatives 2 through 10 include the production of MOX fuel. If this alternative is chosen by DOE, a lead fuel assembly campaign may precede the actual production of MOX. Plutonium oxide at LANL would be shipped to one of five DOE facilities (Argonne National Laboratory–West [ANL–W], Hanford, LLNL, LANL, or SRS). Low-enriched uranium (LEU) oxide would be produced from LEU hexafluoride, originally from Portsmouth, at Wilmington, and then transported to the lead assembly fabrication facility. From the fabrication facility, the MOX fuel lead assemblies would be transported overland to a U.S. reactor. After power production in the reactor, the spent MOX fuel lead assemblies would be transported to a DOE site (either ANL–W or Oak Ridge National Laboratory) for examination. Figure L–4 shows the transportation requirements for the lead assemblies.

L.5.2 Representative Routes and Populations

Representative overland truck routes have been selected for the origin and destination points identified in Figures L–2, L–3, and L–4 are shown in Table L–1. The routes (which were determined for risk assessment purposes) were selected consistent with current routing practices and all applicable routing regulations and guidelines. They do not necessarily represent the actual routes that would be used to transport plutonium and other hazardous materials in the future. Specific routes cannot be identified in advance, as explained in Appendix L.3.3.

Route characteristics that are important to the radiological risk assessment include the total shipment distance and the population distribution along the route. The specific route selected determines both the total potentially exposed population and the expected frequency of transportation-related accidents. Route characteristics are summarized in Table L–1. The population densities along each route are derived from 1990 U.S. Bureau of Census data and projected forward to the year 2010 using State-specific projections. Rural, suburban, and urban areas are characterized according to the following breakdown: rural population densities range from 0 to 54 persons per square kilometer (0 to 139 person per square mile); the suburban range is from 55 to 1,284 persons per square kilometer (140 to 3,326 persons per square mile); and the urban includes all population densities greater than 1,284 persons per square kilometer (3,326 persons per square mile). The exposed population includes all persons living within 800 m (0.5 mi) of each side of the road.

L.5.3 Distance Traveled by Alternative

Table L–2 shows the number of shipments, the total mileage traveled by the trucks carrying nuclear materials, and the affected populations. The affected population is designed to show the number of people actually or potentially exposed to nuclear material shipments. The measure is calculated by multiplying the number of shipments by the number of people living within 800 m (0.5 mi) of the route used to transport the material. The highest possible lead test assembly mileages and populations from Table L–2 are used in the alternative totals. The number of trips in Table L–2 comes from the SPD EIS data reports (UC 1998a through n).

Because the reactor sites are not identified in the SPD Draft EIS, a maximum possible distance between the PIE and MOX facilities, and the reactor site of 4000 km (2,486 mi) is assumed. If reactors near the PIE and MOX facilities are chosen to use MOX fuel, this number could be significantly lower. The rural, suburban, and urban density breakdown for this entirely hypothetical route is based on typical U.S. values (Neuhauser and Kanipe 1994).

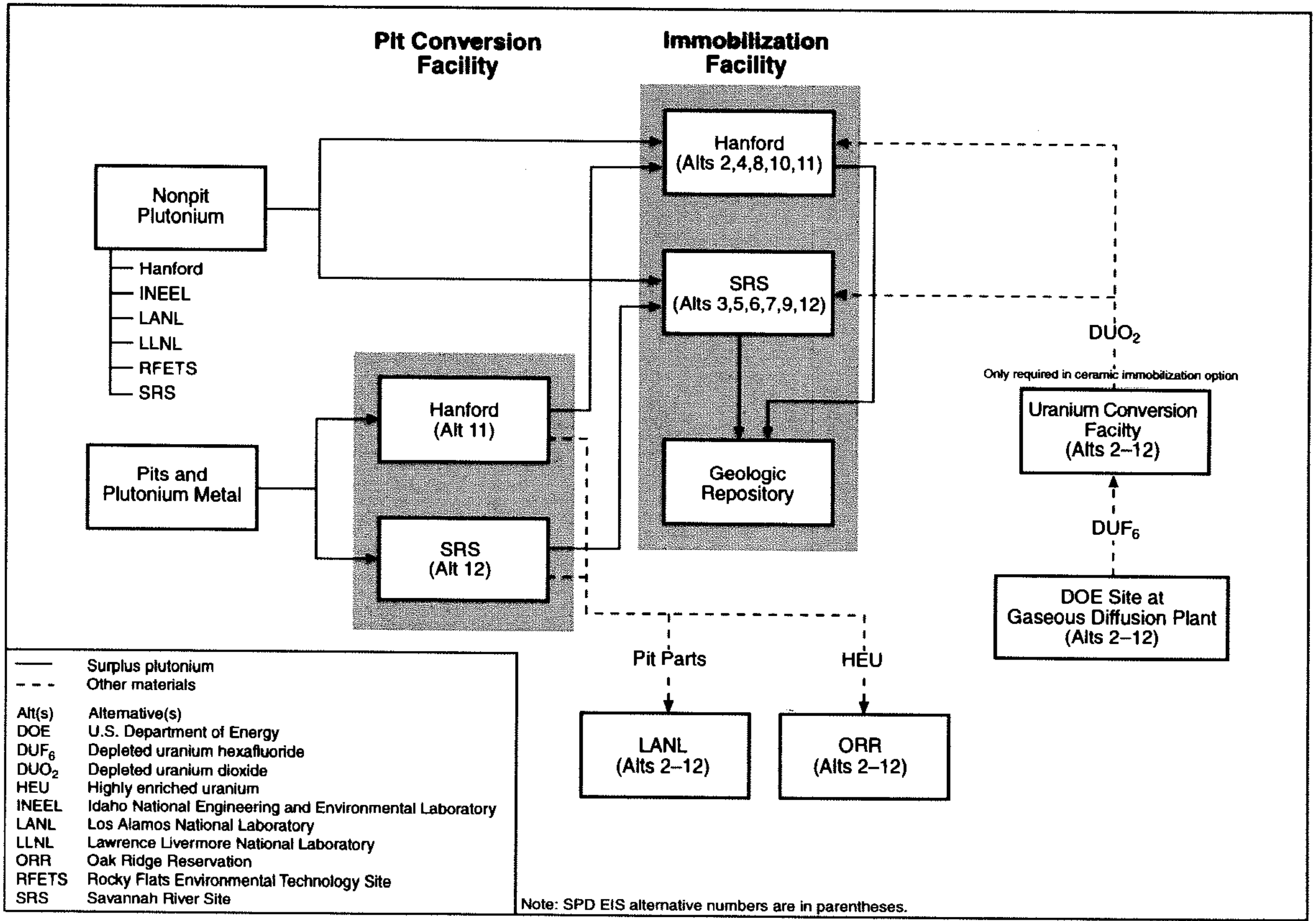


Figure L–2. Transportation Requirements for Plutonium Conversion and Immobilization

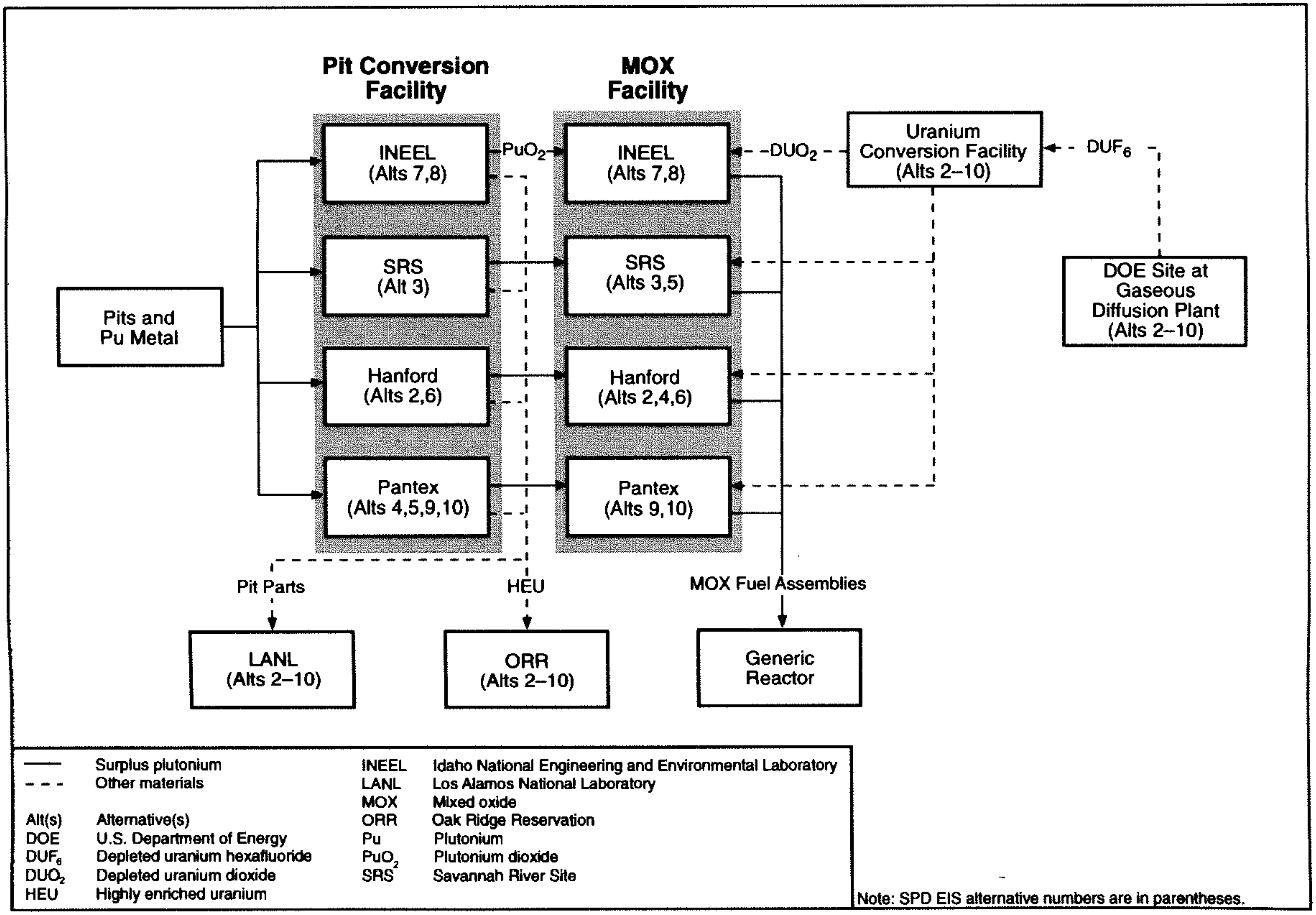
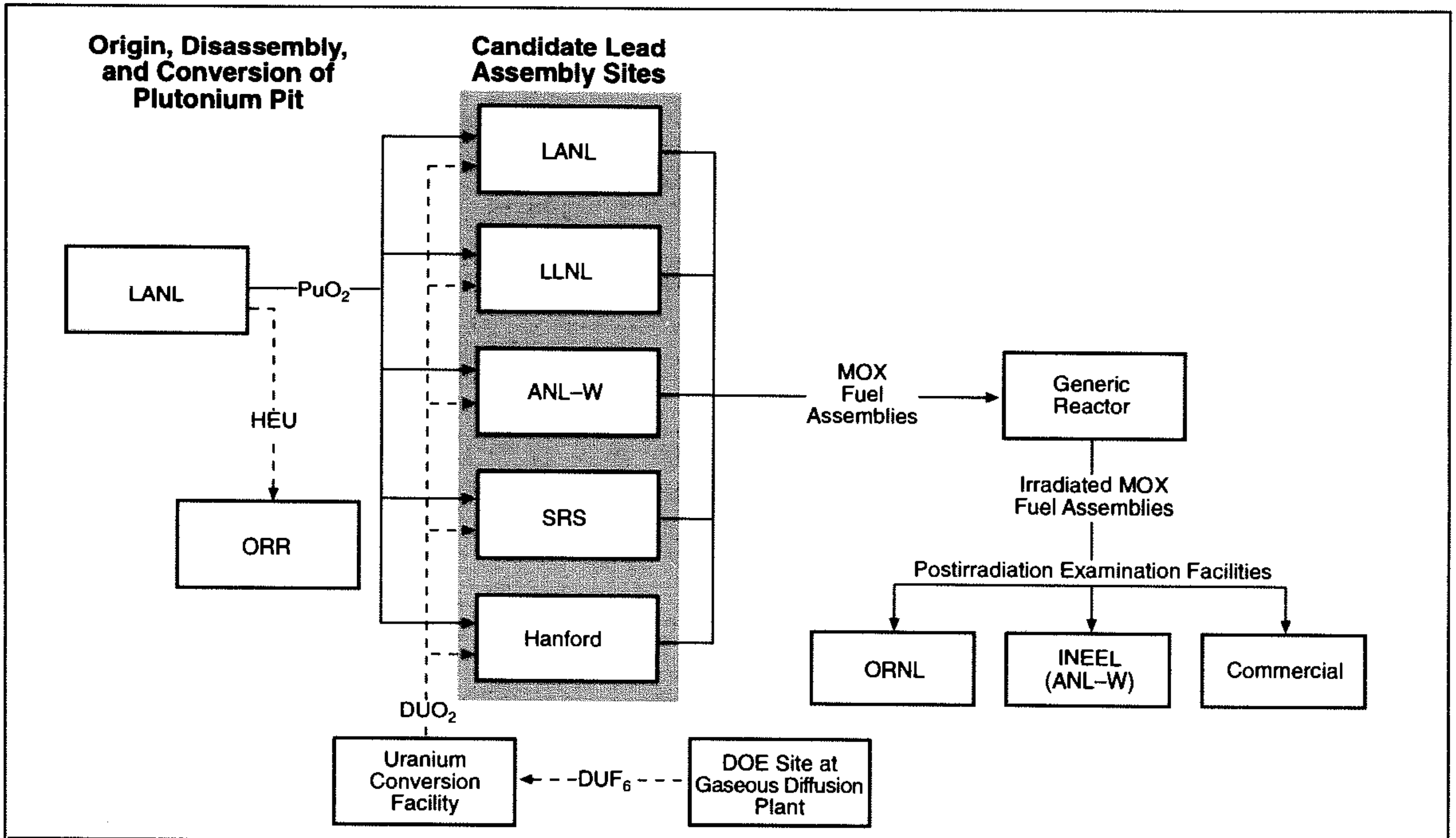


Figure L–3. Transportation Requirements for MOX Fuel Fabrication



——	Surplus plutonium
- - -	Other materials
ANL–W	Argonne National Laboratory–West
DOE	U.S. Department of Energy
DUF_6	Depleted uranium hexafluoride
DUO_2	Depleted uranium dioxide
HEU	Highly enriched uranium
INEEL	Idaho National Engineering and Environmental Laboratory
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
MOX	Mixed oxide
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PuO_2	Plutonium dioxide
SRS	Savannah River Site

Figure L–4. Transportation Requirements for MOX Lead Fuel Assembly

Table L–1. Potential Shipping Legs Evaluated in the SPD EIS

From	To	Distance (km)	Percentage in Zones: Rural	Suburban	Urban	Population Density ($person/km^2$): Rural	Suburban	Urban	Affected Population
ANL–W	INEEL	34	100	0	0	2	0	0	84
ANL–W	Hanford	1,035	91.7	7.6	0.6	9	570	2,883	113,482
ANL–W	Pantex	2,395	90.1	8.3	1.6	6	561	2,963	380,038
ANL–W	SRS	376	82.8	15.4	1.8	9	453	2,787	767,529
Hanford	INEEL	967	91.6	7.9	0.6	8	559	2,898	107,214
Hanford	ORR	3,981	87.6	11.1	1.3	8	461	2,830	604,916
Hanford	Pantex	3,032	90.6	8.0	1.4	6	574	2,979	450,511
Hanford	Onsite	24	100	0	0	10	0	0	538
Hanford	Geologic repository[a]	1,907	87.8	10.3	1.9	4	485	2,098	397,534
Hanford	LANL	2,511	90.2	8.6	1.2	4	402	2,085	361,442
INEEL	SRS	3,719	82.7	15.4	1.8	9	450	2,788	757,940
INEEL	ORR	3,312	86.7	11.9	1.4	6	344	2,188	518,875
INEEL	LANL	1,841	89.6	9.1	1.4	4	391	2,093	286,387
LANL	Pantex	647	90.7	6.8	2.5	6	676	3,061	132,446
LANL	LLNL	1,218	88.8	7.8	3.4	5	634	3,634	346.679
LANL	INEEL	1,841	89.6	9.1	1.4	6	553	2,962	286,387
LANL	Hanford	2,511	90.2	8.6	1.2	6	569	2,952	361,442
LANL	SRS	2,787	80.8	16.9	2.4	12	455	2,786	684,441
LANL	ORR	2,390	85.8	12.3	1.9	8.2	342	2,171	439,696
LANL	ANL–W	1,873	89.1	9.5	1.4	4.5	386	2,085	296,222
LLNL	Hanford	1,429	76.0	20.5	3.5	12	487	2,868	478,115
LLNL	INEEL	1,566	85.7	10.3	4.0	6	713	3,546	552,834
LLNL	Pantex	2,327	89.8	6.7	3.5	5	674	3,525	643,591
LLNL	SRS	4,416	80.6	16.4	3.0	10	482	3,165	1,284,987
LLNL	NTS	1,143	85.8	8.6	5.6	3.6	512	2,693	506,575
Pantex	ORR	1,762	84.4	14.0	1.6	12	392	2,657	302,418
Pantex	SRS	2,169	78.1	19.6	2.3	14	426	2,706	543,092
Pantex	INEEL	2,363	90.2	8.2	1.6	6	561	2,988	373,420
Pantex	WIPP	713	93.1	6.0	0.9	2.5	498	1,879	78,394
Pantex	NTS	1,997	94.0	4.8	1.2	3	453	2,204	228,159
Pantex	LANL	647	90.7	6.8	2.5	4.3	480	2,175	132,446
Portsmouth, OH	Fuel fabrication[b]	1,014	63.5	34.6	1.7	20	380	2,446	301,445
RFETS	INEEL	1,178	91.4	7.4	1.2	6	505	3,329	156,394
RFETS	Pantex	1,255	87.2	10.0	2.9	5	634	3,143	319,338
RFETS	Hanford	1,848	91.6	7.4	1.0	6	547	3,228	232,380
RFETS	SRS	2,609	78.1	19.3	2.5	11	439	2,741	674,965
SRS	ORR	575	68.7	30.5	0.8	18	374	2,306	132,959
SRS	Hanford	4,389	84.2	14.2	1.6	9	467	2,823	835,727
SRS	Onsite	6	100	0	0	10	0	0	134
SRS	Geologic repository[a]	3,936	83.2	19.9	1.9	6	365	2,192	893,080
SRS	LANL	2,787	80.8	16.9	2.4	9.4	353	2,166	684,441
Fuel fabrication[b]	SRS	581	72.8	26.8	0.3	23	301	2,202	97,034
Fuel fabrication[b]	Pantex	2,577	76.2	22.4	1.4	14	392	2,690	651,769

Table L–1. Potential Shipping Legs Evaluated in the SPD EIS (Continued)

From	To	Distance (km)	Percentage in Zones: Rural	Suburban	Urban	Population Density (person/km^2): Rural	Suburban	Urban	Affected Population
Fuel fabrication[b]	Hanford	4,796	82.6	16.1	1.2	10	435	2,806	856,223
Fuel fabrication[b]	ANL–W	4,165	81.0	17.7	1.3	8	329	2,175	787,474
Fuel fabrication[b]	LLNL	3,032	82.5	15.1	2.4	7	350	2,445	745,149
Fuel fabrication[b]	LANL	3,201	78.0	19.8	1.6	10	325	2,166	693,848
Generic 4,000 km		4,000	84.0	15.0	1.0	6	719	3,861	969,600

[a] Assumed to be located at Yucca Mountain, NV, for the purposes of analysis.
[b] Assumed to be located at Wilmington, NC, for the purposes of analysis.

Key: ANL–W, Argonne National Laboratory–W; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory; NTS, Nevada Test Site; ORR, Oak Ridge Reservation; RFETS, Rocky Flats Environmental Technology Site; WIPP, Waste Isolation Pilot Plant.

Table L–2. Summary SPD EIS Transportation Requirements

Alternative	Number of Trips	Cumulative Distance (km)	Affected Population (Millions)
2	2,302	6.7 M	6.3
3	2,459	6.8 M	8.1
4	2,242	6.2 M	8.0
5	2,407	6.8 M	11.7
6	2,467	7.9 M	9.0
7	2,467	7.4 M	10.8
8	2,302	6.2 M	8.1
9	2,027	5.9 M	9.8
10	1,862	4.8 M	7.6
11A	1,973	3.4 M	6.0
11B	1,913	2.8 M	7.0
12A/B	2,130	4.1 M	7.7
12C/D	2,078	4.2 M	10.7
Lead assemblies			
LANL	15	55 K	2.9
ANL–W	27	80 K	3.3
SRS	27	84 K	3.0
Hanford	27	89 K	3.5
LLNL	27	73 K	3.8

Key: ANL–W, Argonne National Laboratory–W; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory.

L.5.4 Shipment External Dose Rates

The dose and corresponding risk to populations and maximally exposed individuals during incident-free transportation conditions are directly proportional to the assumed shipment external dose rate. The Federal regulations for maximum allowable dose rates for exclusive-use shipments were presented in Appendix L.3.1.

The actual shipment dose rate is a complex function of the composition and configuration of shielding and containment used in the cask, the geometry of the loaded shipments, and characteristics of the material shipped. DOE has years of experience handling the materials that would be required to be shipped under the alternatives assessed in the SPD EIS, and has regularly conducted radiation level measurements while handling these materials. The maximum predicted dose from individual packages, based on experience at DOE facilities, would yield a dose rate less than the Federal regulatory limit in every case. Spent nuclear fuel and nonpit plutonium were conservatively assumed to have dose rates equal to the regulatory limit of 10 mrem/hr at 2 m (6.6 ft) from the vehicle. This DOE experience was used in the preparation of the dose rates given in the data reports (UC 1998a through n) and used in the analysis.

L.5.5 Health Risk Conversion Factors

The health risk conversion factors used to estimate expected cancer fatalities were taken from *International Commission on Radiation Protection Publication 60* (ICRP 1991): 0.0005 and 0.0004 fatal cancer cases per person-rem for members of the public and workers, respectively. Cancer fatalities occur during the lifetimes of the exposed populations and, thus, are called latent cancer fatalities.

L.5.6 Accident Involvement Rates

For the calculation of accident risks, vehicle accident and fatality rates are taken from data provided in other reports (Saricks and Kvitek 1994). Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with the accident-involvement count as the numerator of the fraction and vehicular activity (total travel distance) as its denominator. Accident rates are generally determined for a multiyear period. For assessment purposes, the total number of expected accidents or fatalities is calculated by multiplying the total shipment distance for a specific case by the appropriate accident or fatality rate.

For truck transportation, the rates presented are specifically for heavy combination trucks involved in interstate commerce (Saricks and Kvitek 1994). Heavy combination trucks are rigs composed of a separable tractor unit containing the engine and one to three freight trailers connected to each other. Heavy combination trucks are typically used for radioactive waste shipments. The truck accident rates are computed for each State based on statistics compiled by the DOT Office of Motor Carriers for 1986 to 1988. Saricks and Kvitek present accident involvement and fatality counts; estimated kilometers of travel by State; and the corresponding average accident involvement, fatality, and injury rates for the 3 years investigated. Fatalities are deaths (including crew members) attributable to the accident or that occurred at any time within 30 days thereafter. SST accident rates are based on operational experience and influence factors (Phillips et al. 1994).

L.5.7 Container Accident Response Characteristics and Release Fractions

The transportation accident model assigns accident probabilities to a set of accident categories. Eight accident-severity categories defined in the NRC's *Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes,* NUREG-0170 (NRC 1977), were used. The least severe categories (Category I and II) represent low magnitudes of crush force, accident-impact velocity, fire duration, and/or puncture-impact speed. The most severe category (Category VIII) represents a large crush force, high accident-impact velocity, long fire duration, and a high puncture-impact speed. The fraction of material released and material aerosolized, and the fraction of that material that is respirable (particles smaller than 10 microns), was assigned based on the accident categories and container types. Because all plutonium shipments will use the previously described Type B containers and the SST system, even severe accidents release, at the most, a portion of the material being transported. The risks associated with other materials are significantly lower.

Next Section

L.6 RISK ANALYSIS RESULTS

L.6.1 Per-Shipment Risk Factors

Per-shipment risk factors have been calculated for the collective populations of exposed persons and for the crew for all anticipated routes and shipment configurations. The radiological risks are presented in doses per shipment for each unique route, material, and container combination. Doses are calculated for the crew, off-link public (i.e., people living along the route), on-link public (i.e., pedestrians and drivers along the route), and public at rest and fueling stops (i.e., stopped cars, buses and trucks, workers, and other bystanders). The accident risk factors are called "dose risk" because the values incorporate the spectrum of accident severity probabilities and associated consequences. Separate risk factors are provided for fatalities resulting from hydrocarbon emissions (known to contain carcinogens) and transportation accidents (fatalities resulting from impact).

L.6.2 Evaluation of Shipment Risks

Tables L–3 and L–4 show the risks and maximum risks, respectively, of transporting materials for the lead assemblies alternatives. As shown, the risks include the risk of transporting uranium dioxide, uranium hexafluoride, plutonium oxide, fuel assemblies and spent fuel. Table L–5 shows the results of similar calculations which give the risks for each alternative. The risk estimates in Table L–5 include the maximum risk for the lead assembly transportation (Alternatives 2 through 10), plutonium pit shipments, pit material shipments (HEU and nonplutonium bearing pit parts), uranium hexafluoride, uranium dioxide, fuel assemblies and nonpit plutonium. The data in Tables L–2 and L–5 are not presented in more detail because much of the shipping activity is classified. The risks are calculated by multiplying the per-shipment factors by the number of shipments and, in the case of the radiological doses, by the health risk conversion factors.

Table L–3. Risks of Materials Transport to Lead Assembly Facilities

	Depleted UO_2 and LEU Fuel Assemblies From FFF					PuO_2 From LANL				
	Routine Transport Impacts					Routine Transport Impacts				
	Radiological			Accident Risks		Radiological			Accident Risks	
Site	Crew	Public	Nonrad[a]	Rad	Nonrad	Crew	Public	Nonrad[a]	Rad	Nonrad
LANL	5.6E-6	4.5E-5	2.0E-5	3.8E-4	2.5E-4	–	–	–	–	–
ANL–W	7.3E-6	5.8E-5	2.2E-5	1.6E-4	3.2E-4	2.1E-6	2.2E-6	8.2E-5	2.6E-4	1.8E-4
SRS	9.8E-7	7.9E-6	1.3E-6	1.2E-5	4.3E-5	3.2E-6	4.2E-6	2.1E-4	6.0E-4	2.7E-4
Hanford	8.4E-6	6.7E-5	2.3E-5	1.7E-4	3.7E-4	2.8E-6	2.9E-6	9.4E-5	3.2E-4	2.4E-4
LLNL	8.5E-6	6.8E-5	4.7E-5	3.4E-4	3.8E-4	1.4E-6	1.4E-6	1.3E-4	3.3E-4	1.2E-4

[a] Toxic emissions.

Key: ANL–W, Argonne National Laboratory–West; FFF, Uranium Fuel Fabrication Facility; LANL, Los Alamos National Laboratory; LEU, low-enriched uranium; LLNL, Lawrence Livermore National Laboratory; Rad, radiological; Nonrad, nonradiological.

Note: All risks are expressed in latent cancer fatalities during the implementation of the proposed action, except for the Nonrad Accident Risks column, which is a number of fatalities.

Table L–4. Maximum Risks of Materials Transport to Lead Assembly Facilities

	Routine Transport Impacts			Accident Risks	
	Radiological				
Shipment	Crew	Public	Nonradiological[a]	Radiological	Nonradiological
Depleted UO_2 and LEU fuel assemblies from FFF and PuO_2 from LANL	1.1E-5	7.0E-5	2.1E-4	6.7E-4	6.1E-4
Depleted UF_6 from gaseous diffusion plant to FFF	2.5E-8	2.0E-7	3.4E-6	5.2E-5	4.0E-5
Lead assemblies to reactor site (4,000 km [2,486 mi])	3.3E-7	2.1E-7	4.2E-5	2.1E-6	1.3E-4
Spent fuel to postirradiation examination site	5.8E-4	5.1E-3	8.3E-5	2.7E-3	2.5E-4
Cumulative total	5.9E-4	5.2E-3	3.4E-4	3.4E-3	1.0E-3

[a] Toxic emissions.

Key: FFF, Uranium Fuel Fabrication Facility; LANL, Los Alamos National Laboratory; LEU, low-enriched uranium.

Note: All risks are expressed in latent cancer fatalities during the implementation of the proposed action, except for the Nonradiological Accident Risks column, which is a number of fatalities.

Table L–5. Total Risks for All SPD EIS Alternatives

				Routine Transport Impacts				Accident Risks
				Radiological		Nonradiological		Radiological
Alter-native	Pit Conversion	MOX	Immobilization	Crew	Public	Emis.	Traffic	Accident
2	Hanford	Hanford	Hanford	0.010	0.0190	0.019	0.072	0.010
3	SRS	SRS	SRS	0.021	0.0302	0.025	0.073	0.011
4	Pantex	Hanford	Hanford	0.010	0.0190	0.018	0.068	0.011
5	Pantex	SRS	SRS	0.021	0.0302	0.025	0.073	0.012
6	Hanford	Hanford	SRS	0.021	0.0320	0.026	0.089	0.011
7	INEEL	INEEL	SRS	0.021	0.0317	0.025	0.084	0.011
8	INEEL	INEEL	Hanford	0.010	0.0192	0.019	0.070	0.010
9	Pantex	Pantex	SRS	0.021	0.0309	0.020	0.061	0.010
10	Pantex	Pantex	Hanford	0.010	0.0179	0.013	0.053	0.010
11A	Hanford	NA	Hanford	0.024	0.0307	0.010	0.051	0.0005
11B	Pantex	NA	Hanford	0.024	0.0309	0.009	0.048	0.0015
12A/B	SRS	NA	SRS	0.049	0.0634	0.019	0.074	0.0009
12C/D	Pantex	NA	SRS	0.049	0.0635	0.018	0.074	0.0023

Key: NA, not applicable.

Note: All risks are expressed in latent cancer fatalities during the implementation of the proposed action, except for the Nonradiological Accident Risks column, which is a number of fatalities.

L.6.3 Maximally Exposed Individuals

The risks to maximally exposed individuals under incident-free transportation conditions have been estimated for hypothetical exposure scenarios. The estimated dose to inspectors and the public is presented in Table L–6 on a per-event basis (person-rem per event). Note that the potential exists for individual exposures if multiple exposure events occur. For instance, the dose to a person stuck in traffic next to a shipment for 30 minutes is calculated to be 11 mrem. (This conservatively assumes the person in a car is 1.2 m (4 ft) from the edge

Table L–6. Estimated Dose to Maximally Exposed Individuals During Incident-Free Transportation Conditions[a,b]

Receptor	Dose to Maximally Exposed Individual
Workers	
Crew member	0.1 rem/yr[c]
Inspector	0.0029 rem/event
Public	
Resident	4.0×10^{-7} rem/event
Person in traffic construction	0.011 rem/event
Person at service station	0.001 rem/event

a The exposure scenario assumptions are described in Appendix L.6.3.
b Doses are calculated assuming that the shipment external dose rate is equal to the maximum expected dose 10 mrem/hr at 2 m (6.6 ft) from the package.
c Dose to truck drivers could exceed the legal limit of 100 mrem/yr in the absence of administrative controls.

of the truck.) If the exposure duration was longer, the dose would rise proportionally. In addition, a person working at a truck service station could receive a significant dose if trucks were to use the same stops repeatedly. The dose to a person fueling a truck could be as much as 1 mrem. Administrative controls could be instituted to control the location and duration of truck stops if multiple exposures were to happen routinely. However, it is DOE's normal practice to have SST guard force members (trained, monitored radiation workers) perform fueling and routine on-road maintenance checks (i.e., check oil or windshield wiper fluid).

The cumulative dose to a resident was calculated assuming all shipments passed his or her home. The cumulative doses assume that the resident is present for every shipment and is unshielded at a distance of 30 m (98 ft) from the route. Therefore, the cumulative dose is only a function of the number of shipments passing a particular point and is independent of the actual route being considered. The maximum dose to this resident, would be about 1 mrem. The annual individual dose can be estimated by assuming that shipments would occur uniformly over a 15-year time period.

The accident consequence assessment is intended to provide an estimate of the maximum potential impacts posed by the most severe potential transportation accidents involving a shipment. The accident consequence results are presented in Table L–7 for the maximum severity accidents involving plutonium oxide shipments, and Table L–8 for maximum severity accidents involving plutonium pits. Table L–7 applies to alternatives in which the pit conversion facility is located at Pantex, and large amounts of plutonium oxides are shipped to a MOX or conversion facility. Table L–8 applies to alternatives in which plutonium pits and metals are shipped to a pit conversion facility at a site other than Pantex. In either table, the accident frequency in rural locations is about 1×10^{-7}/yr (once in 10 million years), and all other accidents are much less likely. The impacts represent the most severe accidents hypothesized.

The hypothetical accidents described in Tables L–7 and L–8 involve either a long-term fire, or tremendous impact or crushing forces. In the case of crushing forces, a fire would have to be burning in order to spread the plutonium as modeled. These accidents are more likely on rural interstates where speeds are higher, and where the vehicles spend most of their travel time. NUREG-0170 (NRC 1977) describes the analytic approach in more detail.

The population doses are for a uniform population density within an 80-km (50-mi) radius (Neuhauser and Kanipe 1994). The location of the maximally exposed individual is determined based on atmospheric conditions at the time of the accident and the buoyant characteristics of the released plume. The locations of maximum exposure would be 100 m (330 ft) and 500 m (1,650 ft) from the accident site for neutral (average)

Table L–7. Estimated Dose to the Population and to Maximally Exposed Individuals During the Most Severe Accident Conditions (Plutonium Oxide) [a, b]

	Neutral Conditions [c]				Stable Conditions [f]			
	Population [d]		Maximally Exposed Individual [e]		Population [d]		Maximally Exposed Individual [e]	
Mode and Accident Location	Dose (person-rem)	Consequences (Cancer Fatalities)	Dose (rem)	Consequences (Probability of Cancer Fatality)	Dose (person-rem)	Consequences (Cancer Fatalities)	Dose (rem)	Consequences (Probability of Cancer Fatality)
Truck								
Urban	53,200	27	159	0.08	9,400	4.7	5.4	0.003
Suburban	11,600	6	159	0.08	2,050	1	5.4	0.003
Rural	145	0.07	159	0.08	135	0.07	5.4	0.003

[a] The most severe accidents correspond to the NUREG-0170 accident severity category VIII (NRC 1977).
[b] Buoyant plume rise resulting from fire for a severe accident was included in the exposure model.
[c] Neutral weather conditions result in moderate dispersion and dilution of the release plume. Neutral conditions were taken to be Pasquill stability Class D with a wind speed of 4 m/sec (9 mph). Neutral conditions occur approximately 50 percent of the time in the United States.
[d] Populations extend at a uniform density to a radius of 80 km (50 mi) from the accident site. Population exposure pathways include acute inhalation, acute cloudshine, groundshine, resuspended inhalation, resuspended cloudshine, and ingestion of food, including initially contaminated food (RISKIND assumes that all food is grown in rural areas) (Yuan et al. 1995). It is assumed that decontamination or mitigative actions are taken.
[e] The maximally exposed individual is assumed to be at the location of maximum exposure. The locations of maximum exposure would be 100 m (330 ft) and 500 m (1650 ft) from the accident site under neutral and stable atmospheric conditions, respectively. Individual exposure pathways include acute inhalation, acute cloudshine, and groundshine during passage of the plume. No ingested dose is considered. Note that the maximally exposed individual receives more dose than the population in a rural location. This analytic phenomena is caused by probabilistic calculations. It is very unlikely that an individual will be nearby in a rural population zone.
[f] Stable weather conditions result in minimal dispersion and dilution of the release plume and are thus unfavorable. Stable conditions were taken to be Pasquill stability Class F with a wind speed of 1 m/sec (2.2 mph). Stable conditions occur approximately one-third of the time in the United States.

and stable conditions, respectively. The dose to the maximally exposed individual is independent of the location of the accident. No acute or early fatalities would be expected from radiological causes.

L.6.4 Waste Transportation

Under all of the alternatives being considered in the SPD EIS, some transportation would be required to support routine shipments of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities located on the sites. All DOE sites have plans and procedures for handling and transporting waste. This transportation would be handled in the same manner as other site waste shipments, and would not represent a large increase in the amounts of waste already being generated at these sites and analyzed in the WM PEIS (DOE 1997a). The shipments would not represent any additional risks beyond the ordinary waste shipments at these sites, as analyzed in the WM PEIS (DOE 1997a).

However, in four specific cases, waste is being generated that is not covered in the WM PEIS (DOE 1997a): (1) transuranic (TRU) waste generated at Pantex from the pit conversion facility; (2) low-level waste (LLW) generated at Pantex from the pit conversion facility; (3) LLW generated at Pantex from the MOX facility, and (4) LLW generated at LLNL during fabrication of lead assemblies.

In the case of TRU waste generated at Pantex, this waste was not covered by the WM PEIS Record of Decision (ROD) because there was not any TRU waste at Pantex at the time the ROD was issued, and none was anticipated to be generated by ongoing site operations. Location of the pit conversion and MOX facilities at

Table L–8. Estimated Dose to the Population and to Maximally Exposed Individuals During the Most Severe Accident Conditions (Plutonium Pits)[a, b]

	Neutral Conditions [c]				Stable Conditions [f]			
	Population[d]		Maximally Exposed Individual[e]		Population[d]		Maximally Exposed Individual[e]	
Mode and Accident Location	Dose (person-rem)	Consequences (Cancer Fatalities)	Dose (rem)	Consequences (Probability of Cancer Fatality)	Dose (person-rem)	Consequences (Cancer Fatalities)	Dose (rem)	Consequences (Probability of Cancer Fatality)
Truck								
Urban	10,640	5	32	0.016	1,880	0.9	1.1	0.0006
Suburban	2,320	1	32	0.016	410	0.2	1.1	0.0006
Rural	29	0.01	32	0.016	27	0.01	1.1	0.0006

a The most severe accidents correspond to the NUREG-0170 accident severity category VIII (NRC 1977).
b Buoyant plume rise resulting from fire for a severe accident was included in the exposure model.
c Neutral weather conditions result in moderate dispersion and dilution of the release plume. Neutral conditions were taken to be Pasquill stability Class D with a wind speed of 4 m/sec (9 mph). Neutral conditions occur approximately 50 percent of the time in the United States.
d Populations extend at a uniform density to a radius of 80 km (50 mi) from the accident site. Population exposure pathways include acute inhalation, acute cloudshine, groundshine, resuspended inhalation, resuspended cloudshine, and ingestion of food, including initially contaminated food (RISKIND assumes that all food is frown in rural areas) (Yuan et al. 1995). It is assumed that decontamination or mitigative actions are taken.
e The maximally exposed individual is assumed to be at the location of maximum exposure. The locations of maximum exposure would be 100 m (330 ft) and 500 m (1650 ft) from the accident site under neutral and stable atmospheric conditions, respectively. Individual exposure pathways include acute inhalation, acute cloudshine, and groundshine during passage of the plume. No ingested dose is considered. Note that the maximally exposed individual receives more dose than the population in a rural location. This analytic phenomena is caused by probabilistic calculations. It is very unlikely that an individual will be nearby in a rural population zone.
f Stable weather conditions result in minimal dispersion and dilution of the release plume and are thus unfavorable. Stable conditions were taken to be Pasquill stability Class F with a wind speed of 1 m/sec (2.2 mph). Stable conditions occur approximately one-third of the time in the United States.

Pantex would result in the generation of TRU waste as described in Appendix 4.17.2.2. Shipment of TRU waste to WIPP was analyzed using the methodology and parameters found in Appendix E of the *Draft Waste Isolation Pilot Plant Disposal Phase Draft Supplemental Environmental Impact Statement* (DOE 1996c). In order to support the transportation of TRU waste from Pantex to WIPP, 76 additional shipments have been analyzed in the SPD EIS.

A fairly large increase in the amount of LLW at Pantex (i.e., 25 percent of the site's current storage capacity) would be expected if the pit conversion facility is located at Pantex. Currently, this type of waste is shipped to the Nevada Test Site (NTS) for disposal. In order to support the transportation of pit conversion facility LLW from Pantex to NTS, 21 additional shipments have been analyzed in the SPD EIS. The impacts have been calculated from LLW transportation impacts presented in the WM PEIS (DOE 1997a).

An additional increase in the amount of LLW at Pantex (i.e., 14 additional percent, for a total of 39 percent of the site's current storage capacity) would be expected if the pit conversion facility and MOX plant are located at Pantex. Currently, this type of waste is shipped to NTS for disposal. In order to support the transportation of MOX LLW from Pantex to NTS, 38 additional shipments have been analyzed in the SPD EIS. The impacts have been calculated from LLW transportation impacts presented in the WM PEIS (DOE 1997a).

Further, an increase in the LLW at LLNL would be expected if the lead assembly MOX assembly is done at LLNL. Currently, this type of waste is shipped to the NTS for disposal. In order to support transportation of lead assembly LLW from LLNL to NTS, 44 additional shipments have been analyzed in the SPD EIS. The impacts have been calculated from LLW transportation impacts presented in the WM PEIS (DOE 1997a).

Table L–9 shows the impacts of transporting LLW and TRU waste. The radiological risks to the public are larger for TRU than for LLW because of the larger amount of radioactive material in the TRU. The dose to the crew are about the same, because the truck carrying TRU will require some shielding or spacing to ensure that the dose rate to the truck crew is less than 2 mrem/hr.

Table L–9. Impacts of Shipping Low-Level and Transuranic Waste

					Routine Transport Impacts				Accidental Risks
					Radiological		Nonradiological		Radiological
Waste Type	Origin	Destination	Trips	Kilometers Traveled	Crew	Public	Emission	Traffic	
TRU	Pantex, pit conversion facility	WIPP	76	54,000	0.0008	0.0025	0.00013	0.0015	1.1×10^{-6}
LLW	Pantex, pit conversion facility	NTS	38	76,000	0.0011	0.0015	0.00018	0.0029	5.8×10^{-7}
LLW	Pantex, MOX	NTS	21	42,000	0.0006	0.0008	0.00010	0.0016	3.2×10^{-7}
LLW	LLNL	NTS	44	50,000	0.0007	0.0010	0.00056	0.0020	3.9×10^{-7}

Key: LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.
Note: All risks are expressed in latent cancer fatalities during the implementation of the proposed actions except for the Nonradiological Accidental Traffic column, which is a number of fatalities.

L.6.5 Consequences of Sabotage or Terrorist Attack During Transportation

This section provides an evaluation of impacts that could potentially result from a malicious act on a shipment of hazardous or radioactive material during shipment. In no instance, even in severe cases such as those discussed below, could a nuclear explosion or permanent contamination of the environment leading to condemnation of land occur. Because of the Transportation Safeguards System described in Appendix L.3.2, DOE considers sabotage or terrorist attack on an SST to be unlikely enough such that no further risk analysis is required.

The *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (DOE 1996d) analyzed the spectrum of attacks on spent nuclear fuel casks. They fall into three categories or scenarios: (1) exploding a bomb near a shipping cask, (2) attacking a cask with a shaped charge, or an armor-piercing weapon (i.e., an antitank weapon), and (3) hijacking (stealing) a shipping cask. None of the scenarios considered would lead to a criticality accident. DOE determined that, due to the security measures that would be in place for any spent nuclear fuel shipments, such attacks would be unlikely to occur. At a minimum, the extent or effects of any such attacks, would be mitigated by the security measures. Additionally, the SPD EIS is considering a comparatively few shipments (if the lead assembly program is implemented) of spent nuclear fuel. Other materials, including uranium hexaflouride, uranium dioxide, TRU waste, and LLW, are commonly shipped, and do not represent particularly attractive targets for sabotage or terrorist attacks.

L.7 CUMULATIVE IMPACTS OF TRANSPORTATION

L.7.1 Radiological Impacts

The cumulative impacts of the transportation of radioactive material consist of impacts from (a) historical shipments of radioactive waste and spent nuclear, (b) reasonably foreseeable actions that include transportation of radioactive material, (c) general radioactive materials transportation that is not related to a particular action, and (d) the alternatives evaluated in the SPD EIS. The assessment of cumulative transportation impacts concentrates on the cumulative impacts of offsite transportation, because offsite transportation yields potential radiation doses to a greater portion of the general population than does onsite transportation. The collective dose to the general population and workers was the measure used to quantify cumulative transportation impacts. This measure of impact was chosen because it may be directly related to LCFs using a cancer risk coefficient, and because of the difficulty in identifying a maximally exposed individual for shipments throughout the United States spanning the period 1943 through 2048 (106 years). The year 1943 corresponds to the start of operations at the Hanford Site and the Oak Ridge Reservation.

Collective doses from historical shipments of spent nuclear fuel to NTS were summarized in (Jones and Maheras 1994). Data for these shipments were available for 1971 through 1993 and were linearly extrapolated back to 1951, the start of operations at NTS, because data before 1971 were not available. The results of this analysis are summarized in Table L–10. Collective doses from historical shipments of low-level waste, mixed low-level waste, and transuranic waste were also estimated (DOE 1996e). Over the time period 1974 through 1994, there were about 8,400 of these shipments; these shipments were estimated to result in a collective occupational dose of 82 person-rem and a collective dose for the general population of 100 person-rem.

Collective doses from other historical shipments of radioactive material were evaluated in the *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995a). These include historical shipments associated with the INEEL, SRS, Hanford, Oak Ridge, and Naval spent nuclear fuel and test specimens.

There are considerable uncertainties in these historical estimates of collective dose. For example, the population densities and transportation routes used in the dose assessments were based on census data for 1990 and the U.S. highway and rail system as it existed in the 1990s. Using census data for 1990 tends to overestimate historical collective doses because the U.S. population has continuously increased over the time covered in these assessments. Basing collective dose estimates on the U.S. highway and rail system as it existed in the 1990s may slightly underestimate doses for shipments that occurred in the 1940s, 1950s, and 1960s, because a larger portion of the transport routes would have been on non-interstate highways where the population may have been closer to the road. Data were not available that correlated transportation routes and population densities for the 1940s, 1950s, 1960s, and 1970s; therefore, it was necessary to use more recent data to make dose estimates. By the 1970s, the structure of the interstate highway system was largely fixed and most shipments would have been made on interstates.

Shipment data were linearly extrapolated for years when data were unavailable, which also results in uncertainty. However, this technique was validated by linearly extrapolating the data in the *Historical Overview of Domestic Spent Fuel Shipments–Update* (SAIC 1991) for 1973 through 1989 to estimate the number of shipments that took place during the time period 1964 through 1972 (also contained in SAIC 1991). The data in the historical overview could not be used directly because only shipment counts are presented for 1964 through 1982, and no origins or destinations were listed for years before 1983. Based on the data in the historical overview, linearly extrapolating the data for 1973 through 1989 overestimates the shipments for 1964 through 1972 by 20 percent when compared to the actual shipment counts for 1964 through 1972.

Transportation impacts may also result from reasonably foreseeable projects, such as the transportation impacts contained in other DOE National Environmental Policy Act analyses. The results of these analyses are summarized in Table L–10. For some of these analyses, a preferred alternative was not identified or a ROD has not been issued. In those cases, the alternative that was estimated to result in the largest transportation impact was included in Table L–10.

There are also reasonably foreseeable projects that involve limited transportation of radioactive material: (a) shipment of submarine reactor compartments from the Puget Sound Naval Shipyard to Hanford for burial, (b) return of cesium 137 isotope capsules to Hanford, (c) shipment of uranium billets from Hanford to the United Kingdom, and (d) shipment of low specific activity nitric acid from Hanford to the United Kingdom. While this is not an exhaustive list of projects that may involve limited transportation of radioactive material, it does illustrate that the transportation impacts associated with these types of projects are extremely low when compared to major projects or general transportation.

There are also general transportation activities that take place that are unrelated to the alternatives evaluated in the SPD EIS or to reasonably foreseeable actions. Examples of these activities are shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial low-level radioactive waste to commercial disposal facilities. The NRC evaluated these types of shipments based on a survey of radioactive materials transportation published in 1977 (NRC 1977). Categories of radioactive material evaluated in NRC 1977 included: (a) limited quantity shipments, (b) medical, (c) industrial, (d) fuel cycle, and (e) waste.

The NRC estimated that the annual collective worker dose for these shipments was 5,600 person-rem. The annual collective general population dose for these shipments was estimated to be 4,200 person-rem. Because comprehensive transportation doses were not available, these collective dose estimates were used to estimate transportation collective doses for 1943 through 1982 (40 years). These dose estimates included spent nuclear fuel and radioactive waste shipments made by truck and rail.

Based on the transportation dose assessments in NRC 1977, the cumulative transportation collective doses for 1943 through 1982 were estimated to be 220,000 person-rem for workers and 170,000 person-rem for the general population.

In 1983, another survey of radioactive materials transportation in the United States was conducted (Javitz et al. 1985). This survey included NRC and Agreement State licensees. Both spent nuclear fuel and radioactive waste shipments were included in the survey. Weiner, LaPlante, and Hageman (1991a:661–666, 1991b:665–660) used the survey by Javitz et al. (1985) to estimate collective doses from general transportation. The transportation dose assessments in Weiner, LaPlante, and Hageman (1991a:661–666, 1991b:665–660) were used to estimate transportation doses for 1983 through 2048 (66 years). Weiner, LaPlante, and Hageman (1991a:661–666) evaluated eight categories of radioactive material shipments by truck: (a) industrial, (b) radiography, (c) medical, (d) fuel cycle, (e) research and development, (f) unknown, (g) waste, and (h) other. Based on a median external exposure rate, an annual collective worker dose of 1,400 person-rem and an annual collective general population dose of 1,400 person-rem were estimated. Over the 66-year time period from 1983 through 2048, both the collective worker and general population doses were estimated to be 92,000 person-rem.

Weiner, LaPlante, and Hageman (1991b:655–660) also evaluated six categories of radioactive material shipments by plane: (a) industrial, (b) radiography, (c) medical, (d) research and development, (e) unknown, and (f) waste. Based on a median external exposure rate, an annual collective worker dose of 290 person-rem and an annual collective general population dose of 450 person-rem were estimated. Over the 66-year time

Table L–10. Cumulative Transportation-Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2048) (person-rem)

Category	Collective Dose	
	Occupational Dose	General Population Dose
Historical shipments (DOE 1995a)	**250**	**130**
Radioactive waste to Nevada Test Site (DOE 1996e)	82	100
Reasonably foreseeable actions		
Nevada Test Site expanded use (DOE 1996e)	–	150[b]
Spent nuclear fuel management (DOE 1995a, 1996d)	360	810
Waste Management PEIS (DOE 1997a)[a]	16,000	20,000
Waste Isolation Pilot Plant	790	5,900
Mo-99 production (DOE 1996f)	240	520
Tritium supply and recycling (DOE 1995b)	–	–
Surplus highly enriched uranium disposition (DOE 1996g)	400	520
Storage and Disposition of Fissile Materials (DOE 1996a)	–	2,400[b]
Stockpile Stewardship (DOE 1996h)	–	38[b]
Pantex (DOE 1996i)	250[c]	490[c]
West Valley (DOE 1996j)	1,400	12,000
S3G and D1G prototype reactor plant disposal (DOE 1997b)	2.9–6.8	2.2–5.4
S1C prototype reactor plant disposal (DOE 1996k)	6.7	1.9
Container system for naval spent nuclear fuel (USN 1996a)	11	15
Cruiser and submarine reactor plant disposal (USN 1996b)	5.8	5.8
Submarine reactor compartment disposal (USN 1984)	–	0.053
Return of cesium 137 capsules (DOE 1994)	0.42	5.7
Uranium billets (DOE 1992)	0.50	0.014
Nitric acid (DOE 1995c)	0.43	3.1
General transportation		
1943 to 1982 (NRC 1977)	220,000	170,000
1983 to 2048 (Weiner, LaPlante, and Hageman 1991a:661–666; 1991b:655–660)	110,000	120,000
Shipments for alternatives evaluated in the SPD EIS	10	50
Summary		
Historical	330	230
Reasonably foreseeable actions	19,000	43,000
General transportation (1943 to 2048)	330,000	290,000
Shipments for alternatives evaluated in the SPD EIS	10	50
Total collective dose (rounded to nearest thousand)	349,000	333,000
Total latent cancer fatalities	140	170

[a] Includes mixed low-level waste and low-level waste; transuranic waste included in DOE 1997a.
[b] Includes public and occupational collective doses.
[c] Includes all highly enriched uranium shipped to Y–12.

period from 1983 through 2048, the collective worker dose was estimated to be 19,000 person-rem and the general population collective dose was estimated to be 30,000 person-rem.

Like the historical transportation dose assessments, the estimates of collective doses because of general transportation also exhibit considerable uncertainty. For example, data for 1975 were applied to general transportation activities from 1943 through 1982. This approach probably overestimates doses because the amount of radioactive material that was transported in the 1950s and 1960s was less than the amount shipped in the 1970s. For example, in 1968, the shipping rate for radioactive material packages was estimated to be 300,000 packages per year (Patterson 1968:199–209); in 1975 this rate was estimated to be 2,000,000 packages per year (NRC 1977). However, because comprehensive data that would enable a more realistic transportation dose assessment are not available, the dose estimates developed by NRC were used.

Total collective worker doses from all types of shipments (historical, reasonably foreseeable actions, and general transportation) were estimated to be approximately 350,000 person-rem (140 LCFs), for the period of time 1943 through 2048 (106 years). Total general population collective doses were also estimated to be 330,000 person-rem (170 LCFs). The majority of the collective dose for workers and the general population was because of general transportation of radioactive material. The total number of LCFs over the time period 1943 through 2048 was estimated to be 310. Over this same period of time (106 years), about 54,060,000 people would die from cancer, based on 510,000 LCFs per year (DOC 1993). It should be noted that the estimated number of transportation-related LCFs would be indistinguishable from other LCFs, and the transportation-related LCFs would be 0.0000057 percent of the total number of expected LCFs during this timeframe.

L.7.2 Accident Impacts

For transportation accidents involving radioactive material, the dominant risk is from accidents that are unrelated to the cargo (i.e., traffic or vehicular accidents). Fatalities involving the shipment of radioactive materials were surveyed for 1971 through 1993 using the Radioactive Material Incident Report database. For 1971 through 1993, 21 vehicular accidents involving 36 fatalities occurred. These fatalities resulted from vehicular accidents and were not associated with the radioactive nature of the cargo; no radiological fatalities because of transportation accidents have ever occurred in the United States. During the same period of time, over 1,100,000 persons were killed in vehicular accidents in the United States (National Safety Council 1994). About 100 additional vehicular accident fatalities were estimated to result from the transportation of radioactive material (i.e., the transportation associated with reasonably foreseeable actions and general radioactive materials transportation). During the 39-year time period from 2010 through 2048, approximately 1,600,000 people would be expected to be killed in vehicular accidents in the United States. The vehicular accident fatalities associated with radioactive materials transportation would be expected to be 0.006 percent of the total number of vehicular accident fatalities

L.8 UNCERTAINTY AND CONSERVATISM IN ESTIMATED IMPACTS

The sequence of analyses performed to generate the estimates of radiological risk for the transportation includes: (1) determination of the inventory and characteristics, (2) estimation of shipment requirements, (3) determination of route characteristics, (4) calculation of radiation doses to exposed individuals (including estimation of environmental transport and uptake of radionuclides), and (5) estimation of health effects. Uncertainties are associated with each of these steps. Uncertainties exist in the way that the physical systems being analyzed are represented by the computational models, in the data required to exercise the models (due to measurement errors, sampling errors, natural variability, or unknowns simply caused by the future nature of the actions being analyzed), and in the calculations themselves (e.g., approximate algorithms used by the computers).

In principle, one can estimate the uncertainty associated with each input or computational source and predict the resultant uncertainty in each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final, or absolute, result; however, conducting such a full-scale quantitative uncertainty analysis is often impractical and sometimes impossible, especially for actions to be initiated at an unspecified time in the future. Instead, the risk analysis is designed to ensure, through uniform and judicious selection of scenarios, models, and input parameters, that relative comparisons of risk among the various alternatives are meaningful. In the transportation risk assessment, this design is accomplished by uniformly applying common input parameters and assumptions to each alternative. Therefore, although considerable uncertainty is inherent in the absolute magnitude of the transportation risk for each alternative, much less uncertainty is associated with the relative differences among the alternatives in a given measure of risk.

In the following sections, areas of uncertainty are discussed for the assessment steps enumerated above. Special emphasis is placed on identifying whether the uncertainties affect relative or absolute measures of risk. The degree of conservatism of the assumption is addressed. Where practical, the parameters that most significantly affect the risk assessment results are identified.

L.8.1 Uncertainties in Material Inventory and Characterization

The inventories and the physical and radiological characteristics are important input parameters to the transportation risk assessment. The potential amount of transportation for any alternative is determined primarily by the projected nuclear material inventory and assumptions concerning shipment capacities. The physical and radiological characteristics are important in determining the amount of material released during accidents and the subsequent doses to exposed individuals through multiple environmental exposure pathways.

Uncertainties in the inventory and characterization will be reflected to some degree in the transportation risk results. If the inventory is overestimated (or underestimated), the resulting transportation risk estimates also will be overestimated (or underestimated) by roughly the same factor. However, the same inventory estimates are used to analyze the transportation impacts of each of the SPD EIS alternatives. Therefore, for comparative purposes, the observed differences in transportation risks among alternatives are believed to represent unbiased, reasonably accurate estimates from current information in terms of relative risk comparisons.

No detailed characterization of surplus nonpit plutonium was included in the evaluation of each shipment of this material. Such information typically would not be compiled until actual shipments were being planned. Only global, conservative assumptions were used in the impact analysis. DOE assumed a maximum of 4.5 kg (9.9 lb) of plutonium per package, and 40 packages per SST. This leads to a conservative estimate of radiological accident risks for shipment of surplus nonpit plutonium for each alternative. However, since such shipments have been shown to have lower radiological accident risks than shipments of either plutonium oxides from pits or lead assembly spent fuel, the overall effect would be very small.

L.8.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments

The amount of transportation required for each alternative is based, in part, on assumptions concerning the packaging characteristics and shipment capacities for commercial trucks and safe secure transports. Changes in loading, tiedown, or packaging practices could affect estimates. Representative shipment capacities have been defined for assessment purposes based on probable future shipment capacities. In reality, the actual shipment capacities may differ from the predicted capacities, so that the projected number of shipments, and consequently the total transportation risk, would change. However, although the predicted transportation risks would increase or decrease accordingly, the relative differences in risks among alternatives would remain about the same. The maximum amount of material allowed in Type B containers is set by conservative safety analyses.

L.8.3 Uncertainties in Route Determination

Representative routes have been determined between all origin and destination sites considered in the SPD EIS. The routes have been determined consistent with current guidelines, regulations, and practices, but may not be the actual routes that would be used in the future. In reality, the actual routes could differ from the representative ones in terms of distances and total population along the routes. Moreover, since radioactive materials could be transported over an extended period of time starting at some time in the future, the highway infrastructures and the demographics along routes could change. These effects have not been accounted for in the transportation assessment; however, it is not anticipated that these changes would significantly affect relative comparisons of risk among the alternatives considered in the SPD EIS. Specific routes cannot be identified in advance for the Transportation Safeguards Division shipments because the routes are classified to protect national security interests.

L.8.4 Uncertainties in the Calculation of Radiation Doses

The models used to calculate radiation doses from transportation activities introduce a further uncertainty in the risk assessment process. It is generally difficult to estimate the accuracy or absolute uncertainty of the risk assessment results. The accuracy of the calculated results is closely related to the limitations of the computational models and to the uncertainties in each of the input parameters that the model requires. The single greatest limitation facing users of RADTRAN, or any computer code of this type, is the scarcity of data for certain input parameters.

Uncertainties associated with the computational models are minimized by using state-of-the-art computer codes that have undergone extensive review. Because there are numerous uncertainties that are recognized but difficult to quantify, assumptions are made at each step of the risk assessment process that are intended to produce conservative results (i.e., overestimate the calculated dose and radiological risk). Because parameters and assumptions are applied to all alternatives, this model bias is not expected to affect the meaningfulness of relative comparisons of risk; however, the results may not represent risks in an absolute sense.

The single largest contributor to the collective population doses calculated with RADTRAN was found to be the dose to members of the public at truck stops. Currently, RADTRAN uses a simple point-source approximation for truck-stop exposures and assumes that the total stop time for a shipment is proportional to the shipment distance. The parameters used in the stop model were based on a survey of a very limited number of radioactive material shipments that examined a variety of shipment types in different areas of the country. It was assumed that stops occur as a function of distance, with a stop rate of 0.011 hr/km (0.018 hr/mi). For non-SST shipments, was further assumed that an average of 50 people at each stop are exposed at a distance of 20 m (66 ft). In RADTRAN, the population dose is directly proportional to the external shipment dose rate and the number of people exposed, and inversely proportional to the square of the distance. For this assessment, it was assumed that many shipments (nonpit plutonium and spent nuclear fuel) would have external dose rates at the regulatory limit of 10 mrem/hr at 2 m (6.6 ft). In practice, the external dose rates would vary from shipment to shipment. The stop rate assumed results in an hour of stop time per 100 km (62 mi) of travel.

Based upon the qualitative discussion with shippers, the parameter values used in the assessment appear to be conservative. However, data do not exist to quantitatively assess the degree of control, the location, frequency, and duration of truck stops. However, based on the regulatory requirements of 10 CFR 73 for continuous escort of the material and the requirement for two drivers, it is clear that the trucks would be on the move much of the time until arrival at the destination. Therefore, the calculated impacts are extremely conservative. By using these conservative parameters, the calculations in the SPD EIS are consistent with the RADTRAN published values.

Shielding of exposed populations is not considered. For all incident-free exposure scenarios, no credit has been taken for shielding of exposed individuals. In reality, shielding would be afforded by trucks and cars sharing the transport routes, rural topography, and the houses and buildings in which people reside. Incident-free exposure to external radiation could be reduced significantly depending on the type of shielding present. For residential houses, shielding factors (i.e., the ratio of shielded to unshielded exposure rates) have been estimated to range from 0.02 to 0.7, with a recommended value of 0.33. If shielding were to be considered for the maximally exposed resident living near a transport route, the calculated doses and risks would be reduced by approximately 70 percent. Similar levels of shielding may be provided to individuals exposed in vehicles.

Postaccident mitigative actions are not considered for dispersal accidents. For severe accidents involving the release and dispersal of radioactive materials in the environment, no postaccident mitigative actions, such as interdiction of crops or evacuation of the accident vicinity, have been considered in this risk assessment. Postaccident mitigative measures to reduce groundshine doses (evacuation and/or decontamination) are assumed to occur 24 hours after the accident in RADTRAN analyses. Additionally, RADTRAN assumes that highly contaminated crops are not ingested (Neuhauser 1994). Since RISKIND is modeling the worst credible accident, these measures are not considered. In reality, mitigative actions would take place following an accident in accordance with U.S. Environmental Protection Agency (EPA) radiation protection guides for nuclear incidents (EPA 1991). The effects of mitigative actions on population accident doses are highly dependent upon the severity, location, and timing of the accident. For this risk assessment, ingestion doses are only calculated for accidents occurring in rural areas (the calculated ingestion doses, however, assumes all food grown on contaminated ground is consumed and is not limited to the rural population). Interdiction of foodstuffs would act to reduce, but not eliminate, this contribution.

L.9 REFERENCES

Claus, David B., et al., 1995, *Proceedings of the 11th International Conference on Packaging and Transportation of Radioactive Materials* (PATRAM 1995), "ADROIT: A New Model for Analyzing Risk Associated with Transportation of Nuclear Explosives and Nuclear Materials," vol.II.

DOC (U.S. Department of Commerce), 1993, *Statistical Abstract of the United States: 1993*, (113th edition), Bureau of the Census, Washington, DC.

DOE (U.S. Department of Energy), 1992, *Environmental Assessment for the Shipment of Low Enriched Uranium Billets to the United Kingdom from the Hanford Site, Richland, Washington*, DOE/EA-0787, Washington, DC.

DOE (U.S. Department of Energy), 1994, *Environmental Assessment for Return of Isotope Capsules to the Waste Encapsulation and Storage Facility*, DOE/EA-0942, Washington, DC.

DOE (U.S. Department of Energy), 1995a, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, Office of Environmental Management, Idaho Operations Office, Idaho Falls, ID, April.

DOE (U.S. Department of Energy), 1995b, *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling*, DOE/EIS-0161, Office of Reconfiguration, Washington, DC, October 19.

DOE (U.S. Department of Energy), 1995c, *Environmental Assessment: Disposition and Transportation of Surplus Radioactive Low Specific Activity Nitric Acid, Hanford Site, Richland, Washington*, DOE/EA-1005, Washington, DC.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy); 1996b, *Criteria for Safe Storage of Plutonium Metals and Oxides*, DOE-STD-3013-96, Washington, DC, September.

DOE (U.S. Department of Energy), 1996c, *Waste Isolation Pilot Plant Disposal Phase Draft Supplement Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, NM, November.

DOE (U.S. Department of Energy, 1996d, *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, DOE/EIS-0218F, Office of Environmental Management, Washington, DC, February.

DOE (U.S. Department of Energy), 1996e, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, NV, August.

DOE (U.S. Department of Energy), 1996f, *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes, Environmental Impact Statement*, DOE/EIS-0249F, Washington, DC.

DOE (U.S. Department of Energy), 1996g, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement*, DOE/EIS-0240, Office of Fissile Materials Disposition, Washington, DC, June.

DOE (U.S. Department of Energy), 1996h, *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996i, *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*, DOE/EIS-0225, Albuquerque Operations Office, Albuquerque, NM, November.

DOE (U.S. Department of Energy), 1996j, *Draft Environmental Impact Statement for Completion of the West Valley Demonstration Project and Closure or Long-Term Management of Facilities at the Western New York Nuclear Service Center*, DOE/EIS-0226-D, Washington, DC.

DOE (U.S. Department of Energy), 1996k, *Final Environmental Impact Statement S1C Prototype Reactor Plant Disposal*, DOE/EIS-0275, Office of Naval Reactors, Windsor, CT.

DOE (U.S. Department of Energy), 1997a, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Washington, DC.

DOE (U.S. Department of Energy), 1997b, *Draft Environmental Impact Statement, Disposal of the S3G and D1G Prototype Reactor Plants*, Office of Naval Reactors, Schenectady, NY.

DOT (U.S. Department of Transportation), 1992a, *Shippers—General Requirements for Shipments and Packagings*, 49 CFR 173, Washington, DC, October 1.

DOT (U.S. Department of Transportation), 1992b, *Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Materials*, DOT/RSPA/HMS/92-02, August.

EPA (U.S. Environmental Protection Agency), 1991, *Manual of Protective Actions for Nuclear Incidents*, EPA/520/1-75-001-A, Washington, DC.

ICRP (International Commission on Radiological Protection), 1991, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP, Publication 60, Elmsford, NY.

Javitz, H. S., T. R. Lyman, C. Maxwell, E. L. Myers, and C. R. Thompson, 1985, *Transport of Radioactive Material in the United States: Results of a Survey to Determine the Magnitude and Characteristics of Domestic, Unclassified Shipments of Radioactive Materials*, SAND84-7174, Sandia National Laboratories.

Johnson, P. E., D. S. Joy, D. B. Clark, and J. M. Jacobi, 1993, *HIGHWAY 3.1, An Enhanced Transportation Routing Model: Program Description, Methodology, and Revised User's Manual*, ORNL/TM-12124, Oak Ridge National Laboratory, Oak Ridge, TN, March.

Jones, S., and S. J. Maheras, 1994, *Summary of Doses and Health Effects From Historical Offsite Spent Nuclear Fuel Shipments to the Nevada Test Site*, Engineering Design File (EDF) EIS-TRANS-31.

Ludwig, S.B., R.E. Best, S.P. Schmid, and B.E. Welch, 1997, *Transportation and Packaging Issues Involving the Disposition of Surplus Plutonium, as MOX Fuel in Commercial LWRs*, ORNL/TM-13427, Oak Ridge National Laboratory, Oak Ridge, TN, August.

National Safety Council, 1994, *Accident Facts, 1994 Edition*, Itasca, IL.

Neuhauser, K. S., and F. L. Kanipe, 1994, *RADTRAN 4 Volume II: Technical Manual*, rev. 1, SAND89-2370 Sandia National Laboratories, Albuquerque, NM, May.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes*, vol. 1 and 2, NUREG-0170, Washington, DC, December.

NRC (U.S. Nuclear Regulatory Commission), 1996, *Packaging and Transportation of Radioactive Material*, 10 CFR 71, Washington, DC, January 1.

NRC (U.S. Nuclear Regulatory Commission), 1998, *Standards for Protection Against Radiation*, 10 CFR 20, Washington, DC, January 1.

Patterson, D. E., 1968, *Proceedings of the Second International Symposium on Packaging and Transportation of Radioactive Materials, October 14-18, 1968, Gatlinburg, Tennessee*, "The Accident Experience of the USAEC in the Shipment of Radioactive Material," CONF-681001.

Phillips, J. S., et al., 1994, *Determination of Influence Factors and Accident Rates for the Armored Tractor/Safe Secure Trailor*, SAND93-0111, Sandia National Laboratories, Albuquerque, NM, April.

SAIC (Science Applications International Corporation), 1991, *Historical Overview of Domestic Spent Fuel Shipments—Update*, DE91 016051.

Saricks, C., and T. Kvitek, 1994, *Longitudinal Review of State-Level Accident Statistics for Carriers of Intrastate Freight*, ANL/ESD/TM-68, Argonne National Laboratory, Argonne, IL, March.

UC (Regents of the University of California), 1998a, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Hanford Site*, LA-UR-97-2907, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regent of the University of California) 1998b, *Fissle Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Hanford*, UCRL-ID-128276, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents for the University of California) 1998c, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Hanford*, UCRL-ID-128275, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents for the University of California) 1998d, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Hanford Site*, LA-UR-97-2064, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents for the University of California) 1998e, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Savannah River Site,* LA-UR-97-2910, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents for the University of California) 1998f, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in New Facilities at Savannah River Site,* UCRL-ID-128271, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents for the University of California) 1998g, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in New Facilities at Savannah River Site,* UCRL-ID-128273, Lawrence Livermore National Laboratory, Livermore, CA.

UC (Regents for the University of California) 1998h, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Savannah River Site,* LA-UR-97-2066, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents for the University of California) 1998i, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Ceramic in Existing Facilities at Savannah River Site,* UCRL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA

UC (Regents for the University of California) 1998j, *Fissile Materials Disposition Program, EIS Data Call Input Report: Plutonium Immobilization Plant Using Glass in Existing Facilities at Savannah River Site,* UCRL-ID-128274, Lawrence Livermore National Laboratory, Livermore, CA

UC (Regents for the University of California) 1998k, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Pantex,* LA-UR-97-2909, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents for the University of California) 1998l, *Pit Disassembly and Conversion Facility, Environmental Impact Statement Data Report—Idaho National Engineering and Environmental Laboratory,* LA-UR-97-2908, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents for the University of California) 1998m, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Idaho National Engineering and Environmental Laboratory,* LA-UR-97-2065, Los Alamos National Laboratory, Los Alamos, NM.

UC (Regents for the University of California) 1998n, *Response to the Surplus Plutonium Disposition Environmental Impact Statement Data Call for a Mixed Oxide Fuel Fabrication Facility Located at the Pantex Plant,* LA-UR-97-2067, Los Alamos National Laboratory, Los Alamos, NM.

USN (U.S. Department of the Navy), 1984, *Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants,* PB90-193855.

USN (U.S. Department of the Navy), 1996a, *Department of the Navy Final Environmental Impact Statement for a Container System for the Management of Naval Spent Nuclear Fuel,* DOE/EIS-0251, Arlington, VA.

USN (U.S. Department of the Navy), 1996b, *Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants,* Bremerton, WA.

Weiner, R. F., P. A. LaPlante, and J. P. Hageman, 1991a, *Risk Analysis,* "An Approach to Assessing the Impacts of Incident-Free Transportation of Radioactive Materials: II. Highway Transportation," vol. 11, no. 4.

Weiner, R. F., P. A. LaPlante, and J. P. Hageman, 1991b, *Risk Analysis,* "An Approach to Assessing the Impacts of Incident-Free Transportation of Radioactive Materials: I. Air Transportation," vol. 11, no. 4.

Yuan, Y. C., S. Y. Chen, B. M. Riwer, and D. J. LePoire, 1995, *RISKIND—A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel,* ANL/EAD-1, Argonne National Laboratory, Argonne, IL, November.

Appendix M
Analysis of Environmental Justice

M.1 INTRODUCTION

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs Federal agencies to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority and low-income populations.

The Council on Environmental Quality has oversight responsibility for documentation prepared in compliance with the National Environmental Policy Act (NEPA). In December 1997, the Council released guidance on environmental justice (CEQ 1997). The Council's guidance was adopted as the basis for the analysis of environmental justice contained in the *Surplus Plutonium Disposition Environmental Impact Statement* (EIS).

M.2 DEFINITIONS AND APPROACH

The following definitions were used in the analysis of environmental justice (CEQ 1997):

- Low-income population: Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the U.S. Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

- Minority: Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

- Minority population: Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. In identifying minority communities, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a geographically dispersed/transient set of individuals (such as migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood, census tract, or other similar unit that is to be chosen so as to not artificially dilute or inflate the affected minority population. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.

- Disproportionately high and adverse human health effects: When determining whether human health effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practical:

  a. Whether the health effects, which may be measured in risks and rate, are significant (as employed by NEPA), or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death; and

b. Whether the risk or rate of hazard exposure by a minority population or low-income population to an environmental hazard is significant (as employed by NEPA) and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group; and

c. Whether health effects occur in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

- Disproportionately high and adverse environmental effects: When determining whether environmental effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practical:

  a. Whether there is or will an impact on the natural or physical environment that significantly (as employed by NEPA) and adversely affects a minority or low-income population. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities or low-income communities, when those impacts are interrelated to impacts on the natural or physical environment; and

  b. Whether environmental effects are significant (as employed by NEPA) and are or may be having an adverse impact on minority populations or low-income populations that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and

  c. Whether the environmental effects occur or would occur in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Data for the analysis of minorities were extracted from Table P12 of Summary Tape File 3A published on CD ROM by the United States Bureau of the Census (DOC 1992). Data for the analysis of low-income populations were extracted from Table P121 of Standard Tape File 3A.

Potentially affected areas examined in the SPD EIS include the areas surrounding proposed facilities for plutonium disposition located at four candidate sites: the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), the Pantex Plant (Pantex), and the Savannah River Site (SRS). Minority and low-income populations residing within a 1.6-km (1-mi) corridor centered on representative transportation routes were also included in the evaluation of environmental justice.

M.3 SPATIAL RESOLUTION

For the purposes of enumeration and analysis, the Census Bureau has defined a variety of areal units (DOC 1992). Areal units of concern in this document include (in order of increasing spatial resolution): States, counties, census tracts, block groups, and blocks. The "block" is generally the smallest of these entities and offers the finest spatial resolution. This term refers to a relatively small geographical area bounded on all sides by visible features such as streets and streams, or by invisible boundaries such as city limits or property lines. During the 1990 census, the Census Bureau subdivided the United States and its territories into 7,017,425 blocks. For comparison, the number of counties, census tracts, and block groups used in the 1990 census were 3,248; 62,276; and 229,192; respectively. While blocks offer the finest spatial resolution, economic data required for identification of low-income populations are not available at the block-level of spatial resolution. In the analysis below, block groups are used throughout as the areal unit. Block groups generally contain between 250 and 500 housing units (DOC 1992:A-4).

During the decennial census, the Census Bureau collects data from individuals and then aggregates the data according to residence in geographical areas such as a counties or block groups. Boundaries of the areal units are selected to coincide with geographical features, such as streams and roads, or political boundaries, such as county and city borders. Boundaries used for aggregation of the census data usually do not coincide with boundaries used in the calculation of health effects. As discussed in Chapter 4 of the SPD EIS, radiological health effects due to an accident at one of the facilities for plutonium disposition are evaluated for persons residing within a distance of 80 km (50 mi) of the accident site. In general, the boundary of the circle with an 80-km (50-mi) radius centered at the accident site will not coincide with boundaries used by the Census Bureau for enumeration of the population in the potentially affected area. Some block groups lie completely inside or outside of the area included in the calculation of health effects. However, block groups intersecting the boundary of the potentially affected area are only partly included. Partial inclusion of block groups is illustrated in Figure M–1. This figure shows the block group structure near Idaho Falls, Idaho. The 80-km (50-mi) radius shown in this figure denotes the boundary used for calculation of health effects in the event of a radiological release at the Fuel and Materials Examination Facility (FMEF) at INEEL. Block groups that are unshaded in Figure M–1 lie within an 80-km (50-mi) radius centered at FMEF, and the total population of these block groups is included in the population count. Block groups shaded in gray lie outside of the circle, and the population of the shaded block groups is excluded from the population count. However, block groups such as those that are cross-hatched in Figure M–1 lie only partly within the circle. Because the geographical distribution of persons residing within a block group is not available from the census data, partial inclusions introduce uncertainties into the estimate of the population at risk.

In order to evaluate populations at risk in partially included block groups, it was assumed that residents are uniformly distributed throughout the area of each block group. For example, if 85 percent of the area of a block group lies within 80 km (50 mi) of the accident site, then it was assumed that 85 percent of the population residing in that block group would be at risk. An upper bound for the population at risk was obtained by including the total population of partially included block groups in the population at risk. Similarly, a lower bound for the population at risk was obtained by excluding the population of partially included blocks from the population at risk. As a general rule, if the areas of geographic units defined by the Census Bureau are small in comparison with the potentially affected area, then the uncertainties due to partial inclusions will be relatively small. Uncertainties in the estimates of populations surrounding facilities for plutonium disposition are described in Appendix M.5.1 below.

M.4 POPULATION PROJECTIONS

In Chapter 4 and Appendixes J, K, and L of the SPD EIS, health effects were calculated for populations projected to reside in potentially affected areas during the year 2010. Extrapolations of the total population for individual States are available from both the Census Bureau and various State agencies (Campbell 1996). The Census Bureau also projects populations by ethnic and racial classification in 1-year intervals for the years from 1995 to 2025. Data used to project minority populations in the SPD EIS were extracted from the Census Bureau's web site (www.census.gov/population/www/projections/stproj.html). Minority populations determined from the 1990 census data were taken as a baseline. Then it was assumed that percentage changes in the minority and majority populations of each block group for a given year (compared with the 1990 baseline data) will be the same as percentage changes in the State minority and majority populations projected for the same year. An advantage to this assumption is that the projected populations are obtained with consistent methodology regardless of the State and associated block group involved in the calculation. A disadvantage is that the methodology is insensitive to localized demographic changes that could alter the projection for a specific area.

The Census Bureau uses the cohort-component method to estimate future populations for each State (Campbell 1996). The set of cohorts is composed of: (1) age groups from 1 year or less to 85 years or more (in 1-year intervals), (2) male and female populations in each age group, and (3) the following racial and ethnic groups in each age group—Hispanic, non-Hispanic Asian, non-Hispanic Black, non-Hispanic Native American, and non-Hispanic White. Components of the population change used in the demographic accounting system are births, deaths, net State-to-State migration, and net international migration. If P(t) denotes the number of individuals in a given cohort at time "t", then:

$$P(t) = P(t_0) + B - D + DIM - DOM + IIM - IOM$$

where:

$P(t_0)$	=	Cohort population at time $t_0 \leq t$, where t_0 denotes the year 1990.
B	=	Births expected during the period from t_0 to t.
D	=	Deaths expected during the period from t_0 to t.
DIM	=	Domestic migration expected into the State during the period from t_0 to t.
DOM	=	Domestic migration expected out of the State during the period from t_0 to t.
IIM	=	International migration expected into the State during the period from t_0 to t.
IOM	=	International migration expected out of the State during the period from t_0 to t.

Estimated values for the components shown on the right side of the equation are based on past data and various assumptions regarding changes in the rates for birth, mortality, and migration (Campbell 1996). The Census Bureau does not project populations of individuals who identified themselves as "Other Race" during the 1990 census. This population group is less than 2 percent of the total population in each of the States. In order to project total populations in the environmental justice analysis, population projections for the "Other Race" group were made under the assumption that the growth rate for the "Other Race" population will be identical to the growth rate for the combined minority and White (non-Hispanic) populations.

M.5 RESULTS FOR THE SITES

M.5.1 Population Estimates

Table M–1 shows total populations, minority populations, and percentage minority populations that resided within 80 km (50 mi) of the various sites at the time of the 1990 census. The 80-km (50-mi) distance defines the radius of potential radiological effects for calculations of radiation dose to the general population (see Chapter 4 of the SPD EIS). Tables M–2 and M–3 show similar data for projected populations in 1997 and 2010. As discussed above, minority populations residing in potentially affected areas in 1990 were adopted as a baseline. Populations in 1997 and 2010 were then projected from the baseline data under the assumption that percentage changes in the majority and minority populations residing in the affected areas will be identical to those projected for State populations. The Census Bureau estimates that the national minority percentage will increase from approximately 24 percent in 1990 to 27 percent in 1997, and nearly 33 percent by 2010 (Campbell 1996). Percentage minority populations residing within 80 km (50 mi) of facilities at Hanford and SRS are projected to exceed the national percentage by year 2010. Percentage minority populations surrounding facilities at INEEL and Pantex were less than the national minority percentage in 1990 and are projected to remain so through the year 2010. In Tables M–1 through M–3, the sum of percentages shown in even-numbered columns beginning in column 6 may total slightly more or less than 100 percent due to roundoff.

Table M–4 illustrates the uncertainties in the population estimates for the year 2010 due to the partial inclusion of block groups within the boundaries of potentially affected areas. Column 2 of the table lists the number of block groups that are partly within the circle of 80-km (50-mi) radius centered at the various facilities. Column 3 shows the number of block groups that lie completely within the circle. Potentially affected areas surrounding Hanford and SRS include two States. Columns 2 and 3 show the number of partial or total inclusions for the affected States. Column 4 of the table, denoted as "T/P," shows the number of totally included block groups divided by the number of partially included block groups. In order to minimize the uncertainties in the population estimate, it is desirable that this ratio be as large as possible. Column 5 shows upper bounds for the estimates of the total population listed in column 6. As discussed above, upper bounds were obtained by including the total population of all block groups that lie at least partially within the affected area. Lower bounds for the estimate of total population shown in column 7 were obtained by including only the populations of totally included block groups. Analogous statements apply to columns 8 through 10.

As would be expected from the value of T/P shown in column 4, uncertainties in the total population estimate for Pantex were the smallest among the four sites (+2.4 percent and -2.7 percent), as were the uncertainties in the estimate of the minority population at risk near Pantex (+1.9 percent and -1.9 percent). Uncertainties in the population estimates for INEEL were the largest among the four sites (+17.2 percent and -15.2 percent for total population; +17.3 percent and -15.0 percent for minority population). None of the uncertainties shown in Table M–4 are large enough to noticeably affect the conclusions regarding radiological health effects or environmental justice.

M.5.2 Geographical Dispersion of Minority and Low-Income Populations

Figures M–2 through M–9 show the geographical distributions of minority and low-income populations at risk in the vicinity of the various candidate sites. Distributions shown in these figures are based on baseline population data for 1990. Even-numbered figures show the geographical distribution of minority populations in potentially affected areas within a distance of 80 km (50 mi) of candidate facilities. Block groups are shaded to indicate the percentage of the total population comprised of minorities. According to the decennial census of 1990, minorities comprised 24.2 percent of the total population of the contiguous United States. Block groups unshaded in the even-numbered figures are those for which the percentage of minority residents is less than the national percentage minority population. Areas shaded in gray show block groups for which the percentage of minority residents exceeds the national minority percentage by less than a factor of two. Diagonally hatched block groups shown in the even-numbered figures are those for which the percentage of minority residents exceeds the national minority percentage by a factor of two or more.

Table M-1. Racial and Ethnic Composition of Minority Populations Residing Within 80 km of Candidate Sites in 1990

Candidate Site	Total Pop.	Minority Pop.	Percent Minority Pop.	Asian or Pacific Islander Pop.	Percent Asian or Pacific Islander Pop.	Black Pop.	Percent Black Pop	Hispanic Pop.	Percent Hispanic Pop.	Native American Pop.	Percent Native American Pop.	Other Race	Percent Other Race Pop.	White Pop.	Percent White Pop.
Hanford 400 Area	270,387	68,562	25.4	3,818	1.4	2,667	1.0	58,608	21.7	3,469	1.3	364	0.1	201,461	74.5
Hanford 200 East	329,576	88,294	26.8	4,654	1.4	3,954	1.2	72,962	22.1	6,724	2.0	548	0.2	240,734	73.0
INEEL	117,712	11,655	9.9	1,154	1.0	381	0.3	7,100	6.0	3,020	2.6	135	0.1	105,922	90.0
Pantex	264,651	50,508	19.1	3,450	1.3	11,131	4.2	33,722	12.7	2,204	0.8	363	0.1	213,780	80.8
SRS Building 221-F	596,224	225,743	37.9	5,859	1.0	212,251	35.6	6,361	1.1	1,272	0.2	175	0.0	370,306	62.1
SRS APSF	599,099	227,238	37.9	5,867	1.0	213,715	35.7	6,377	1.1	1,279	0.2	175	0.0	371,686	62.0
SRS DWPF	613,363	236,531	38.6	5,943	1.0	222,831	36.3	6,456	1.1	1,301	0.2	175	0.0	376,657	61.4

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Table M-2. Projected Racial and Ethnic Composition of Minority Populations Residing Within 80 km of Candidate Sites in 1997

Candidate Site	Total Pop.	Minority Pop.	Percent Minority Pop.	Asian or Pacific Islander Pop.	Percent Asian or Pacific Islander Pop.	Black Pop.	Percent Black Pop	Hispanic Pop.	Percent Hispanic Pop.	Native American Pop.	Percent Native American Pop.	Other Race	Percent Other Race Pop.	White Pop.	Percent White Pop.
Hanford 400 Area	324,640	98,586	30.4	5,640	1.7	3,153	1.0	85,642	26.4	4,151	1.3	418	0.1	225,636	69.5
Hanford 200 East	396,420	126,166	31.8	6,885	1.7	4,666	1.2	106,551	26.9	8,064	2.0	631	0.2	269,623	68.0
INEEL	145,117	16,785	11.6	1,627	1.1	590	0.4	10,793	7.4	3,775	2.6	166	0.1	128,166	88.3
Pantex	292,004	62,845	21.5	5,107	1.7	12,801	4.4	42,490	14.6	2,447	0.8	414	0.1	228,745	78.3
SRS Building 221-F	670,749	264,583	39.4	9,222	1.4	244,530	36.5	9,310	1.4	1,521	0.2	201	0.0	405,965	60.5
SRS APSF	673,691	266,064	39.5	9,232	1.4	246,082	36.5	9,330	1.4	1,420	0.2	201	0.0	407,426	60.5
SRS DWPF	688,352	275,654	40.0	9,332	1.4	255,459	37.1	9,422	1.4	1,441	0.2	201	0.0	412,497	59.9

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Table M-3. Projected Racial and Ethnic Composition of Minority Populations Residing Within 80 km of Candidate Sites in 2010

Candidate Site	Total Pop.	Minority Pop.	Percent Minority Pop.	Asian or Pacific Islander Pop.	Percent Asian or Pacific Islander Pop.	Black Pop.	Percent Black Pop	Hispanic Pop.	Percent Hispanic Pop.	Native American Pop.	Percent Native American Pop.	Other Race	Percent Other Race Pop.	White Pop.	Percent White Pop.
Hanford 400 Area	415,828	159,713	38.4	8,890	2.1	3,730	0.9	142,017	34.2	5,076	1.2	497	0.1	255,618	61.5
Hanford 200 East	509,231	202,832	39.8	10,880	2.1	5,498	1.1	176,634	34.7	9,820	1.9	751	0.1	305,648	60.0
INEEL	183,564	27,650	15.1	2,400	1.3	948	0.5	18,745	10.2	5,557	3.0	209	0.1	155,705	84.8
Pantex	330,300	83,963	25.4	7,625	2.3	15,917	4.8	57,665	17.5	2,755	0.8	490	0.1	245,847	74.4
SRS Building 221-F	780,170	327,585	42.0	13,919	1.8	298,013	38.2	14,087	1.8	1,566	0.2	235	0.0	452,350	58.0
SRS APSF	784,832	330,624	42.1	13,934	1.8	299,707	38.2	14,116	1.8	2,867	0.4	235	0.0	453,973	57.8
SRS DWPF	800,529	340,704	42.6	14,078	1.8	309,475	38.7	14,247	1.8	2,904	0.4	235	0.0	459,590	57.4

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Table M-4. Uncertainties in Estimates of Total and Minority Populations for the Year 2010

Candidate Site	No. of Partially Included Block Groups	No. of Fully Included Block Groups	T/P	Upper Bound for Total Population	Estimate of Total Population	Lower Bound for Total Population	Upper Bound for Minority Population	Estimate of Minority Population	Lower Bound for Minority Population
Hanford									
400 Area	8(OR) 39(WA)	31(OR) 233(WA)	5.6	422,872	415,828	397,570	161,697	159,713	153,854
200 East	13(OR) 42(WA)	6(OR) 365(WA)	6.7	519,364	509,136	482,861	205,420	202,832	196,212
INEEL	39	91	2.3	215,134	183,565	155,726	32,443	27,650	23,498
Pantex	22	483	22.0	338,218	330,300	321,477	85,566	83,963	82,332
SRS									
Building 221-F	28(GA) 52(SC)	244(GA) 272(SC)	6.5	796,547	780,169	747,818	334,183	327,584	314,445
APSF	27(GA) 54(GA)	244(GA) 274(SC)	6.4	801,428	784,832	749,619	337,446	330,624	315,919
DWPF	31(GA) 57(SC)	232(GA) 291(SC)	5.9	815,864	800,530	758,866	347,365	340,704	324,062

Key: APSF, Actinide Packaging and Reprocessing Facility; DWPF, Defense Waste Processing Facility; GA, Georgia; OR, Oregon; SC, South Carolina; WA, Washington.

Odd-numbered figures show the geographical distribution of low-income populations potentially at risk from implementation of the proposed action or alternatives. According to the decennial census of 1990, 13.4 percent of the population of the contiguous United States reported incomes less than the poverty threshold. Block groups unshaded in Figures M–1, M–5, M–7, and M–9 are those for which the percentage of low-income residents is less than the national percentage of persons reporting an income less than the poverty threshold. Areas shaded in gray show block groups for which the percentage of low-income residents exceeds the national low-income percentage by less than a factor of two. Diagonally hatched block groups shown in the odd-numbered figures are those for which the percentage of low-income residents exceeds the national low-income percentage by a factor of two or more.

M.5.3 Environmental Effects on Minority and Low-Income Populations Residing Near Candidate Sites

The analysis of environmental effects on populations residing within 80 km (50 mi) of proposed facilities is presented in Chapter 4 of the SPD EIS. This analysis shows that no radiological fatalities are likely to result from implementation of the proposed action or alternatives. Radiological risks to the public are small regardless of the racial and ethnic composition of the population, and regardless of the economic status of individuals comprising the population. Nonradiological risks to the general population are also small regardless of the racial and ethnic composition or economic status of the population. Thus, disproportionately high and adverse impacts on minority and low-income populations residing near the various facilities are not likely to result from implementation of the proposed action or alternatives.

M.6 RESULTS FOR TRANSPORTATION ROUTES

Table M–5 shows minority populations residing along 1.6-km (1-mi) corridors centered on routes that are representative of those that could be used for the transportation of nuclear materials under the proposed action or alternatives. Table M–6 shows similar data for low-income populations. Population data for Tables M–5 and M–6 were extracted from Tables P–12 and P–121 of the STF–3A files (DOC 1992). Distances from a given origin to a given destination are similar but not identical to corresponding distances shown in Appendix L. This is because distances listed in Appendix L were calculated with the HIGHWAY computer code, while distances shown in Tables M–5 and M–6 were obtained from a Geographical Information System analysis using TigerLine data and STF3A files prepared by the Census Bureau. Both techniques use block group spatial resolution, and the differences are generally less than 5 percent.

Total and minority populations residing in the highway corridors are listed in Columns 4 and 5, respectively, of Table M–5. Column 6 shows minority populations residing within highway corridors as a percentage of the total population. Although total and minority populations residing within the corridors generally tend to increase with increasing distance, the relationship is clearly route-dependent.

As discussed in Appendix L of the SPD EIS, implementation of the proposed action or alternatives would not result in significant radiological or nonradiological risks to populations residing along highway transportation routes. Although the percentage minority or low-income populations residing along highway routes can vary by as much as a factor of four, results of the analysis presented in Chapter 4 are independent of the racial and ethnic composition of populations within the corridors, as well as the economic status of populations at risk within the corridors. Implementation of the proposed action or alternatives is not likely to result in disproportionately high and adverse effects on minority or low-income populations residing within representative transportation corridors.

Table M–5. Minority Populations Residing Along Transportation Routes for Surplus Plutonium

Origin	Destination	Distance (km)	Total Population Along Route	Minority Population Along Route	Percentage Minority Population Along Route
ANL–W	Hanford	1,035	82,418	9,356	11.4
ANL–W	Pantex	2,395	281,386	82,566	29.3
ANL–W	SRS	3,756	580,985	122,415	21.1
Fuel fabrication	Hanford	4,760	601,233	95,417	15.9
Fuel fabrication	INEEL	4,092	556,388	88,331	15.9
Fuel fabrication	LANL	3,201	506,962	126,460	24.9
Fuel fabrication	Pantex	2,563	430,359	87,635	20.4
Fuel fabrication	SRS	578	75,050	30,702	40.9
Hanford	Geological repository	1,888	248,006	31,424	12.7
Hanford	INEEL	949	117,587	27,404	36.7
Hanford	LANL	2,515	276,768	71,860	26.0
Hanford	ORR	3,993	434,235	62,000	14.3
Hanford	Pantex	3,040	342,903	92,151	26.9
INEEL	ORR	3,316	389,496	59,174	15.2
INEEL	SRS	3,702	574,433	123,656	21.5
LANL	ANL–W	1,868	230,510	60,265	26.1
LANL	INEEL	1,840	227,759	65,563	28.8
LANL	LLNL	1,218	454,603	224,303	49.3
LANL	Pantex	647	85,252	35,326	41.4
LANL	SRS	2,779	521,907	163,376	31.3
LLNL	Fuel fabrication	4,838	771,701	257,880	33.4
LLNL	Geological repository	1,140	414,432	192,001	46.3
LLNL	Hanford	1,428	380,755	50,764	13.3
LLNL	INEEL	1,559	373,040	72,575	19.5
LLNL	Pantex	2,302	476,701	226,661	47.5
LLNL	SRS	4,395	856,464	403,622	47.1
Pantex	Geological repository	1,986	186,981	66,118	135.4
Pantex	INEEL	2,365	293,805	85,783	29.2
Pantex	ORR	1,753	245,038	59,671	24.4
Pantex	SRS	2,165	441,441	126,441	28.6
Pantex	WIPP	538	121,377	37,477	30.9
Portsmouth, OH	Fuel fabrication	977	239,221	40,636	17.0
RFETS	Hanford	1,848	141,585	23,178	16.4
RFETS	INEEL	1,170	104,960	17,791	17.0
RFETS	Pantex	1,252	252,177	81,450	32.3
RFETS	SRS	2,954	540,944	123,248	22.8
SRS	Hanford	4,377	615,204	126,016	20.5
SRS	ORR	568	109,074	15,614	14.3

Key: ANL–W, Argonne National Laboratory–West; LANL, Los Alamos National Laboratory; Lawrence Livermore National Laboratory; ORR, Oak Ridge Reservation; RFETS, Rocky Flats Environmental Technology Site; WIPP, Waste Isolation Pilot Plant.

Next Section

Table M–6. Low-Income Populations Residing Along Transportation Routes for Surplus Plutonium

Origin	Destination	Distance (km)	Total Population Along Route	Low-Income Population Along Route	Percentage Low-Income Population Along Route
ANL–W	Hanford	1,035	82,418	10,016	12.2
ANL–W	Pantex	2,395	281,386	44,102	15.7
ANL–W	SRS	3,756	580,985	60,473	10.4
Fuel fabrication	Hanford	4,760	601,233	61,518	10.2
Fuel fabrication	INEEL	4,092	245,038	44,137	18.0
Fuel fabrication	LANL	3,201	506,962	73,801	14.6
Fuel fabrication	Pantex	2,563	430,359	64,909	15.1
Fuel fabrication	SRS	578	75,050	10,673	14.2
Hanford	Geological repository	1,888	248,006	28,699	11.6
Hanford	INEEL	961	74,624	9,468	12.7
Hanford	LANL	2,515	276,768	42,384	15.3
Hanford	ORR	3,993	434,235	42,696	9.8
Hanford	Pantex	3,040	342,903	53,293	15.5
INEEL	ORR	3,316	389,496	39,171	10.1
INEEL	SRS	3,702	574,433	61,713	10.7
LANL	ANL–W	1,868	230,510	35,476	15.4
LANL	INEEL	1,840	227,759	35,984	15.8
LANL	LLNL	1,218	454,603	59,814	13.2
LANL	Pantex	647	85,252	12,635	14.8
LANL	SRS	2,779	521,907	80,398	15.4
LLNL	Fuel fabrication	4,838	771,701	103,519	13.4
LLNL	Geological repository	1,140	414,732	48,663	11.7
LLNL	Hanford	1,428	380,755	38,761	10.2
LLNL	INEEL	1,559	373,040	34,078	9.1
LLNL	Pantex	2,302	476,701	62,602	13.1
LLNL	SRS	4,395	856,464	136,322	15.9
Pantex	Geological repository	1,986	186,981	30,207	16.2
Pantex	INEEL	2,365	293,805	46,898	16.0
Pantex	ORR	1,753	245,038	44,137	18.0
Pantex	SRS	2,165	441,441	68,339	15.5
Pantex	WIPP	538	121,377	26,269	21.6
Portsmouth, OH	Fuel fabrication	977	239,221	33,268	13.9
RFETS	Hanford	1,848	141,585	15,985	11.3
RFETS	INEEL	1,170	104,960	10,424	9.9
RFETS	Pantex	1,252	252,177	41,478	16.4
RFETS	SRS	2,954	540,944	58,752	10.9
SRS	Hanford	4,377	615,204	65,311	10.6
SRS	ORR	568	109,074	13,061	12.0

Key: ANL–W, Argonne National Laboratory–West; LANL, Los Alamos National Laboratory; Lawrence Livermore National Laboratory; ORR, Oak Ridge Reservation; RFETS, Rocky Flats Environmental Technology Site; WIPP, Waste Isolation Pilot Plant.

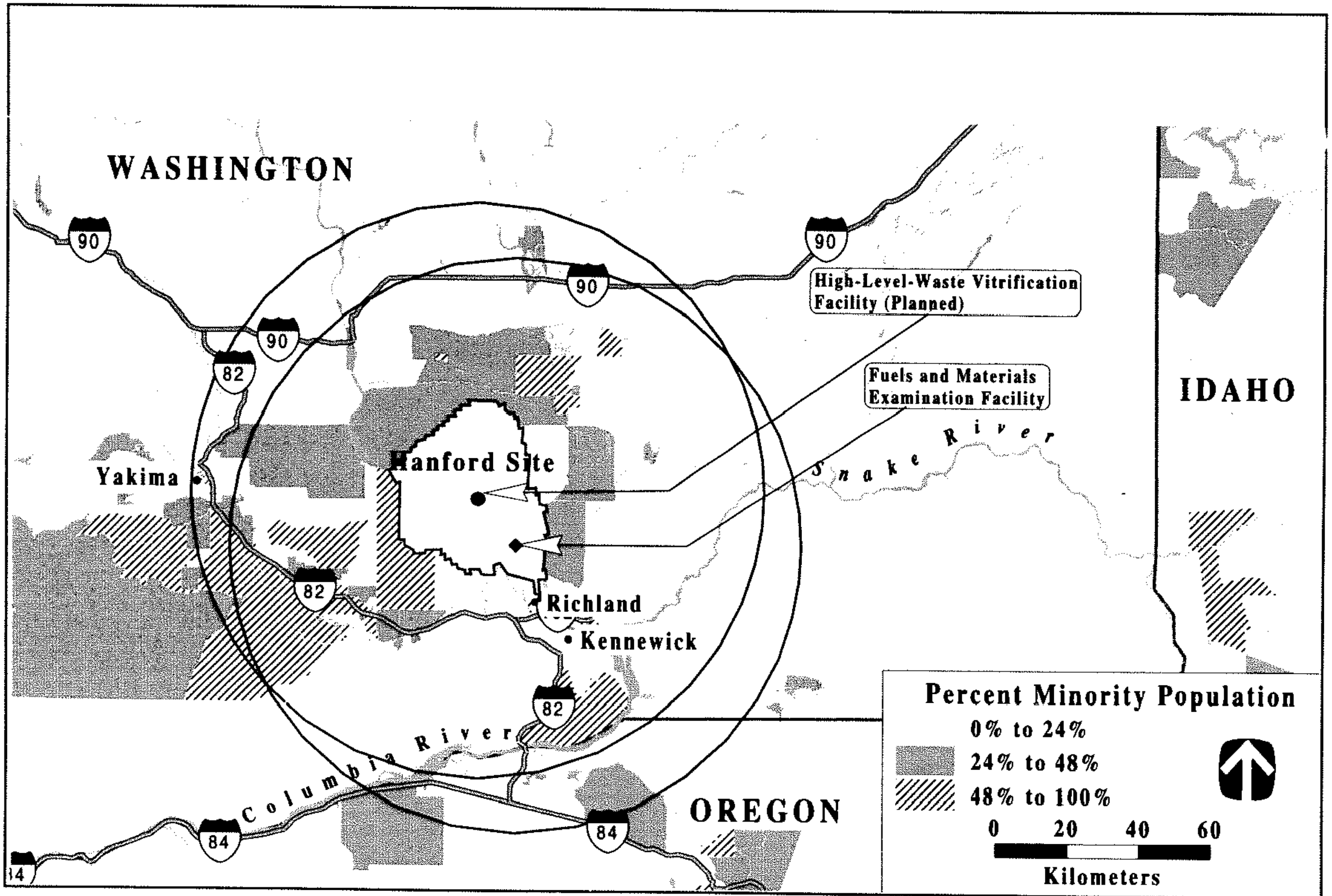


Figure M–2. Geographical Distribution of the Minority Population Residing Within 80 km (50 mi) of the Proposed Facilities at Hanford

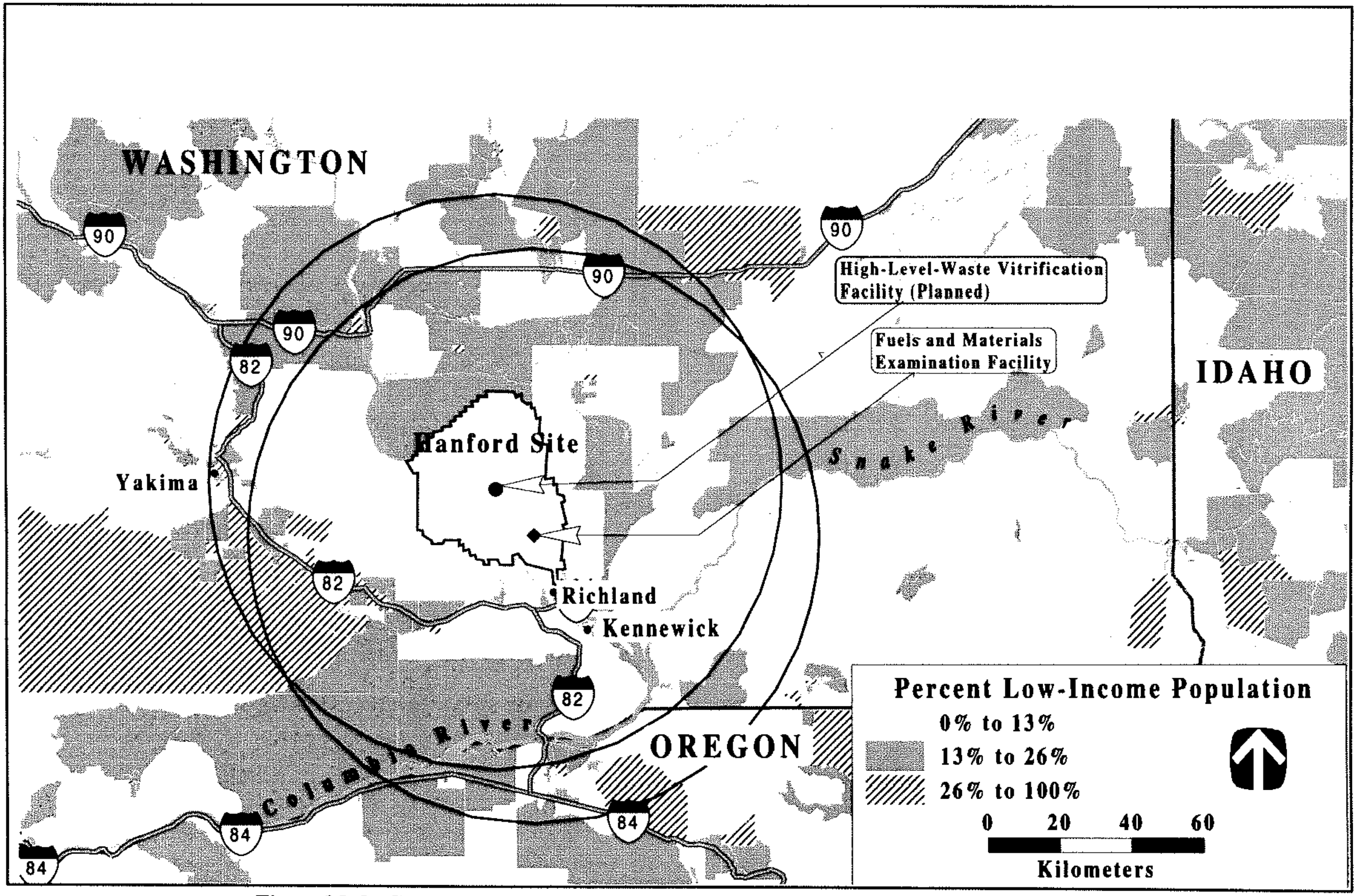


Figure M–3. Geographical Distribution of the Low-Income Population Residing Within 80 km (50 mi) of the Proposed Facilities at Hanford

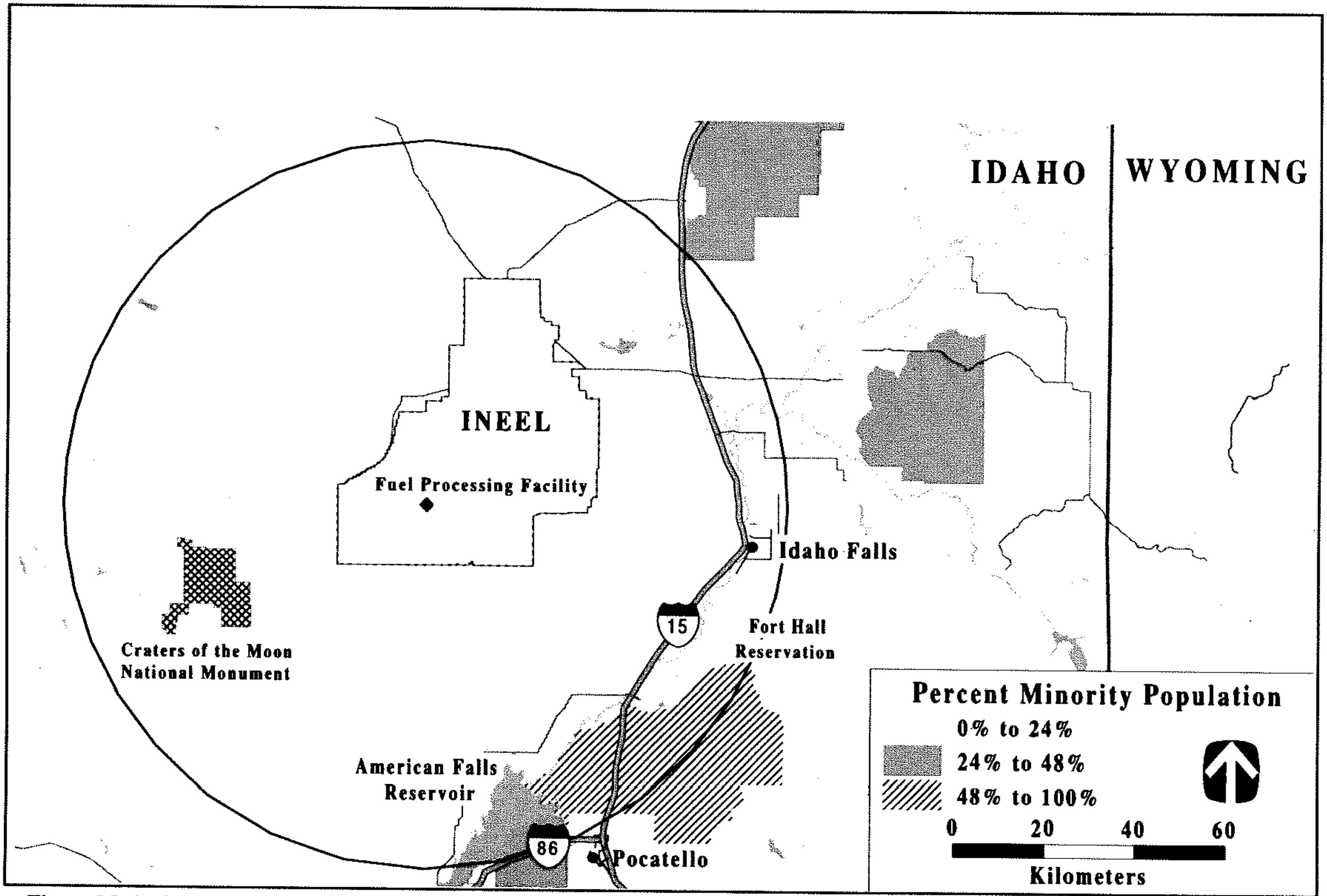


Figure M–4. Geographical Distribution of the Minority Population Residing Within 80 km (50 mi) of the Fuel Processing Facility at INEEL

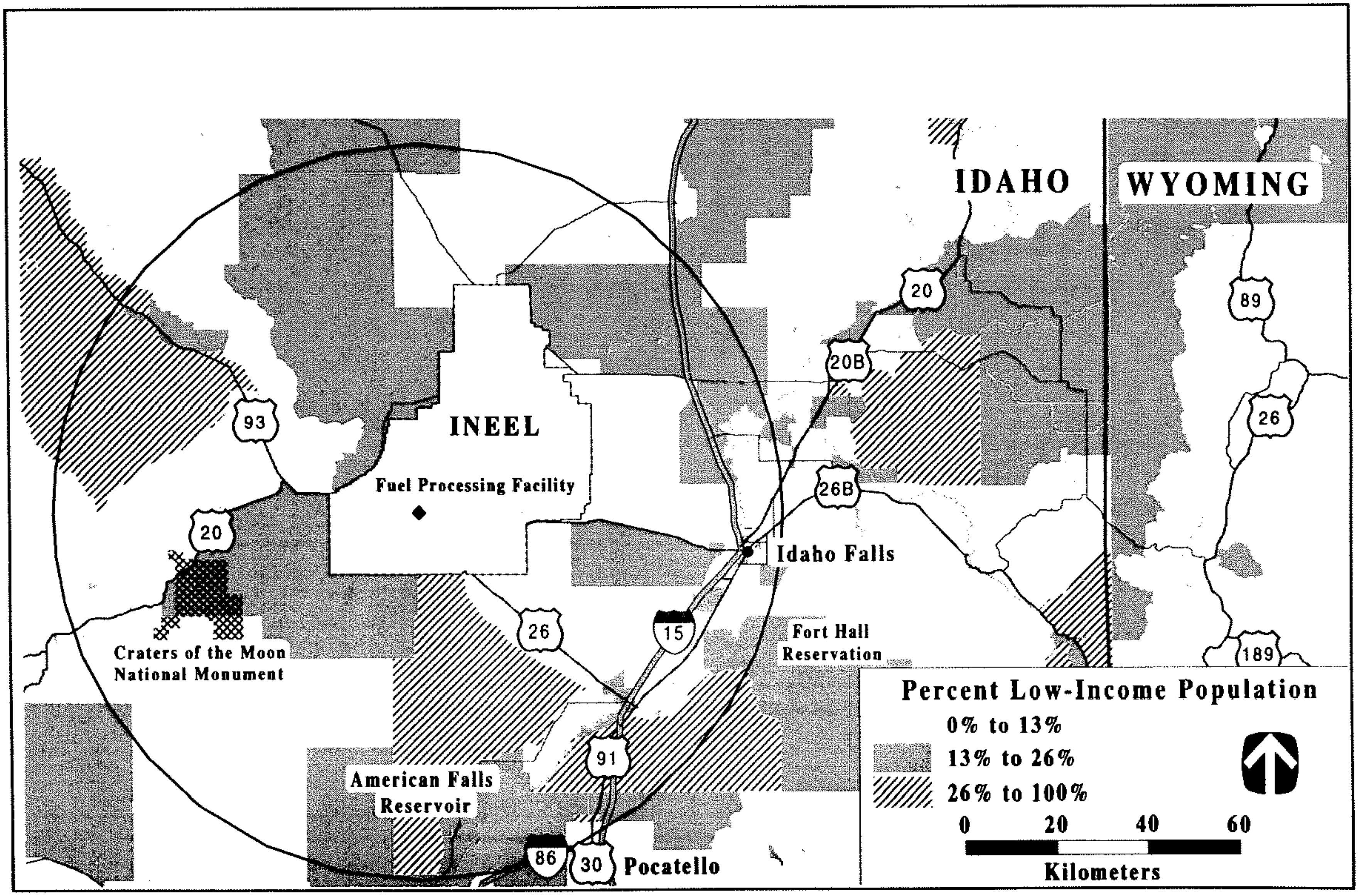


Figure M–5. Geographical Distribution of the Low-Income Population Residing Within 80 km (50 mi) of the Fuel Processing Facility at INEEL

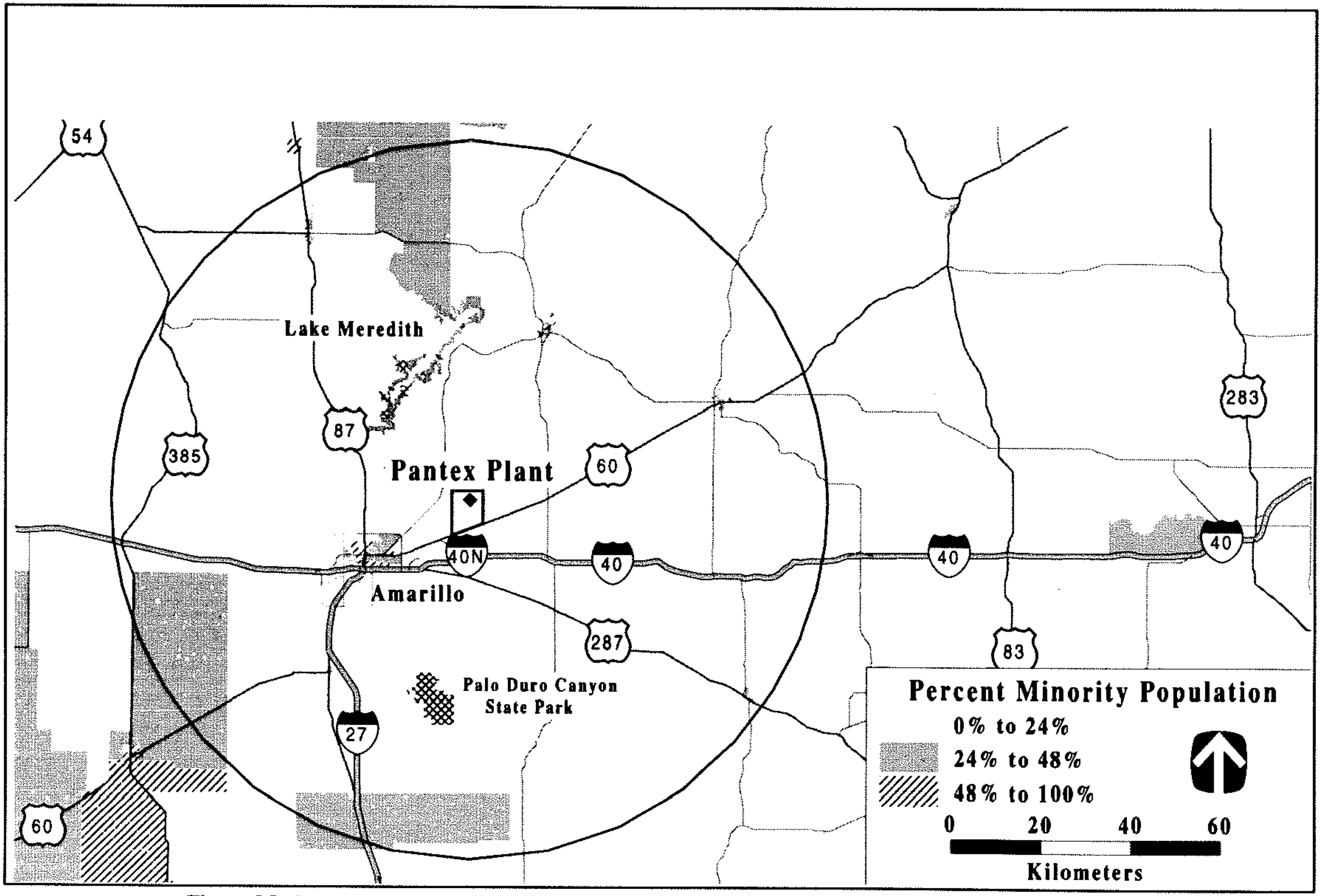


Figure M–6. Geographical Distribution of the Minority Population Residing Within 80 km (50 mi) of the Potentially Affected Area at Pantex

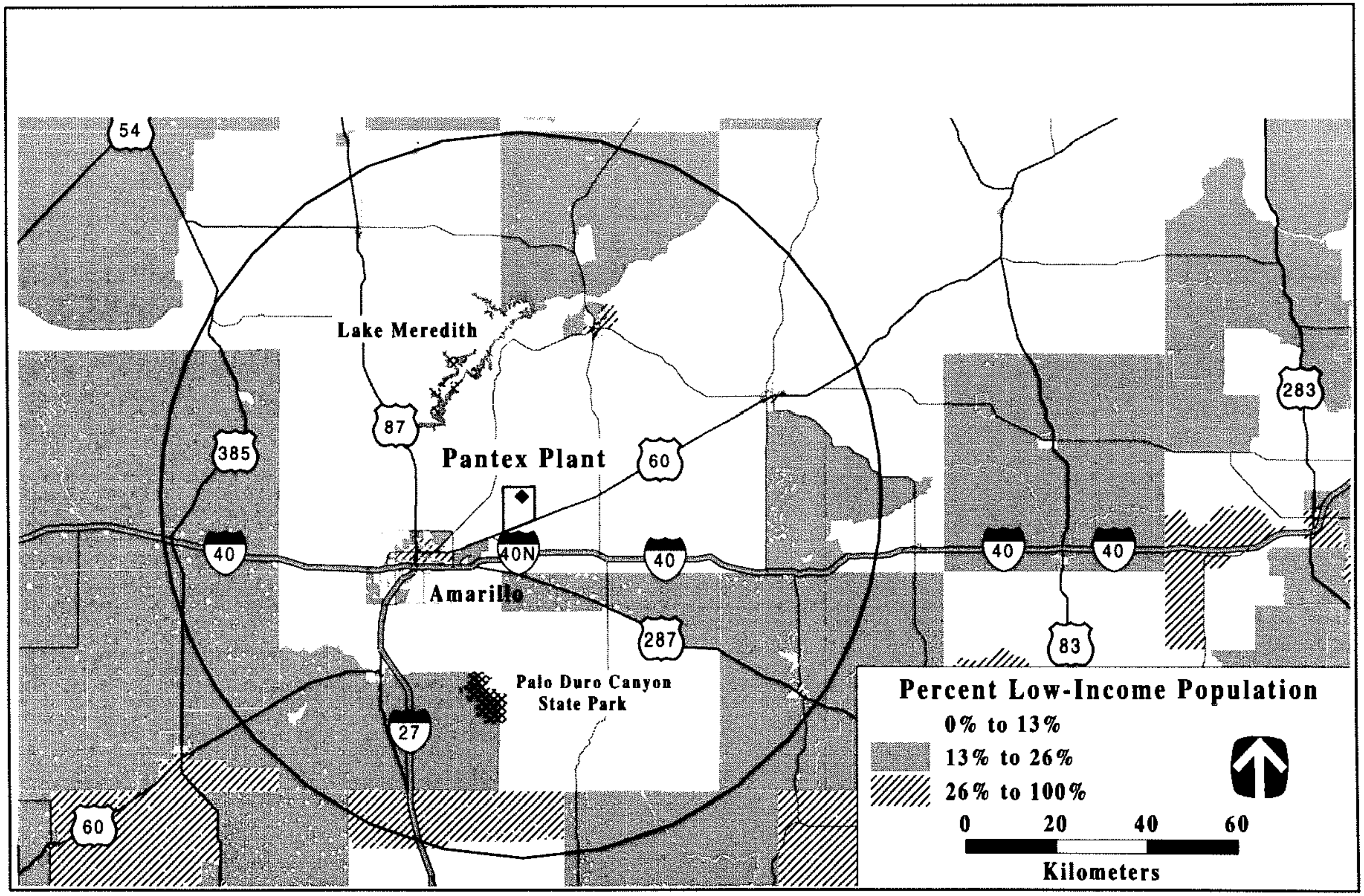


Figure M–7. Geographical Distribution of the Low-Income Population Residing Within 80 km (50 mi) of the Potentially Affected Area at Pantex

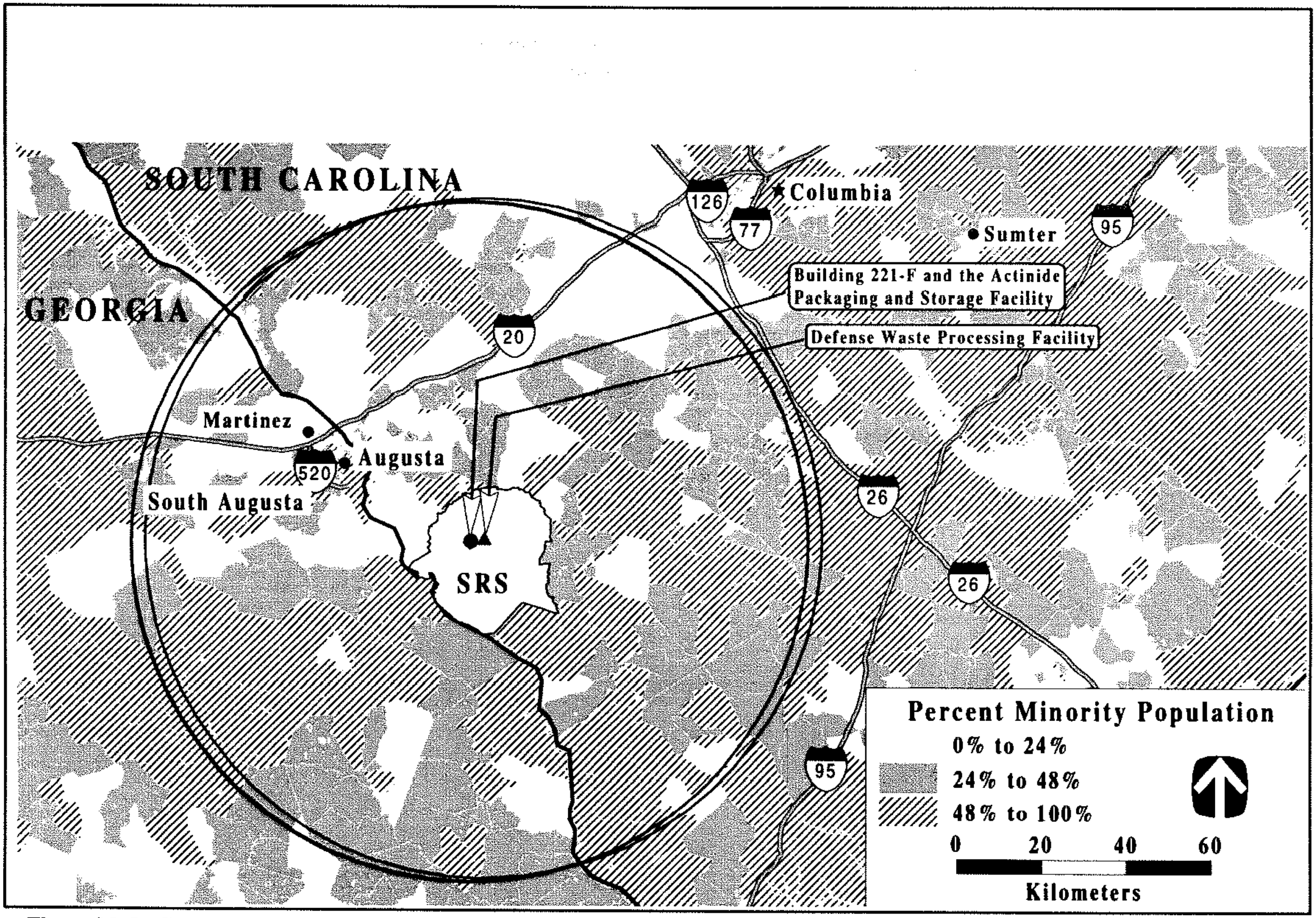


Figure M–8. Geographical Distribution of the Minority Population Residing Within 80 km (50 mi) of the Proposed Facilities at SRS

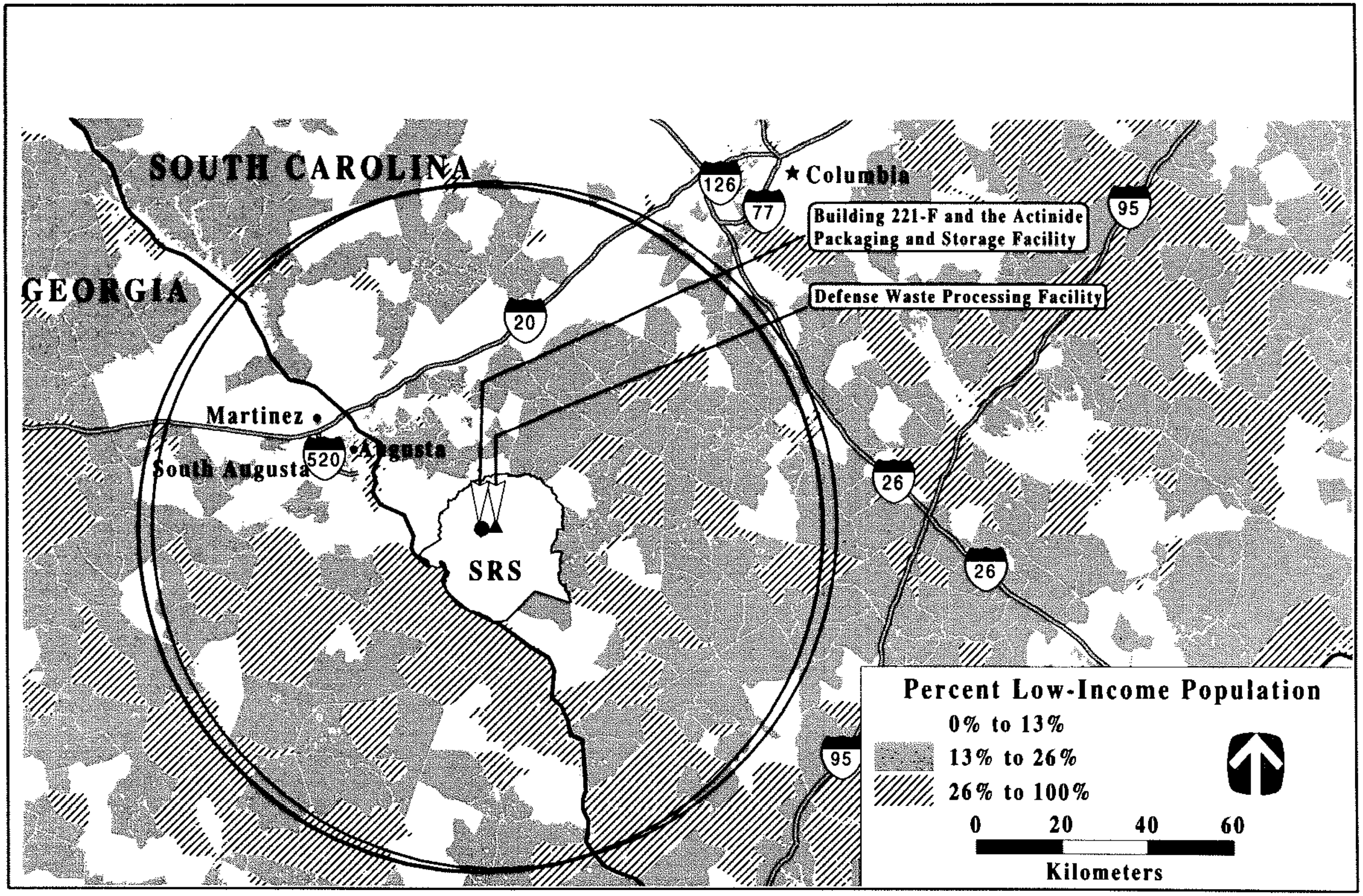


Figure M–9. Geographical Distribution of the Low-Income Population Residing Within 80 km (50 mi) of the Proposed Facilities at SRS

M.7 REFERENCES

Campbell, Paul, 1996, *Population Projections: 1995-2025*, U. S. Department of Commerce, Bureau of the Census, October.

CEQ (Council on Environmental Quality), 1997, *Environmental Justice, Guidance Under the National Environmental Policy Act*, Exuecutive Office of the President, Washington, DC, December 10.

DOC (U. S. Department of Commerce), 1992, *Census of Population and Housing, 1990: Summary Tape File 3 on CD-ROM*, Bureau of the Census, May.

Next Section

Appendix N
Plutonium Polishing

N.1 PLUTONIUM-POLISHING PROCESS

This appendix describes a polishing process by which impurities, in particular gallium, could be removed from the plutonium feed for mixed oxide (MOX) fuel fabrication. DOE has not proposed implementing this polishing process; it is considered only a contingency at this time subject to inclusion only if scheduled research and development activities demonstrate that the plutonium dioxide powder produced in the pit conversion process would not consistently be able to meet specifications for MOX fuel. If additional purification were needed, either solvent extraction or ion exchange would be the technology selected, and this capability would be incorporated into either the pit conversion or MOX facility. Therefore, both purification methods; and the additional support steps of plutonium dissolution and conversion back to an oxide powder, which would be the same regardless of whether solvent extraction or ion exchange would be used for purification, are evaluated in this appendix. If implemented, the plutonium-polishing module would be an integrated step in either the pit conversion or MOX facility, and all of the plutonium dioxide would be processed through the module.

N.2 PLUTONIUM-POLISHING MODULE SPACE REQUIREMENTS

The plutonium-polishing module would require about 1,950 m^2 (21,000 ft^2) on two levels. This processing area would be built in a hardened space of thick-walled concrete that would meet the standards for processing special nuclear materials. Because the plutonium-polishing module would be adjacent to or integrated in either the pit conversion or the MOX facility, major utility additions would not be required. However, an additional space of about 500 m^2 (5,400 ft^2) would be required for utilities; heating, ventilation, and air conditioning systems; and the control room and an analytical laboratory. About 315 m^2 (3,400 ft^2) of nonhardened space would be needed for offices, change rooms, and support facilities to accommodate the additional staff.

Process activities would be performed in gloveboxes, with inert atmospheres where required. All powder handling would be performed in enclosed equipment to contain the oxide dust. Batch loading between equipment would be done through powder valves, thereby isolating the equipment from the atmosphere of the process containment glovebox.

N.3 PROCESS DESCRIPTION

Figure N–1 is a flow diagram for the plutonium-polishing process. This process would include three elements: dissolution of the plutonium in nitric acid; removal of impurities by means of chemical separation (solvent extraction or ion exchange); and conversion of the plutonium back to an oxide powder by precipitation. The plutonium-polishing module would also include acid recovery steps by which nearly all the nitric acid would be recovered and reused in the process.

N.3.1 Dissolution

To begin the process, plutonium dioxide feedstock would be placed inside a feed preparation glovebox, weighed, and transferred in small quantities to one of the dissolver glovebox lines, where it would be dissolved in near-boiling, concentrated nitric acid with a hydrofluoric acid catalyst. After the plutonium dioxide was dissolved, the solution would be cooled, chemically treated and filtered, then transferred to the impurity removal step, either solvent extraction or ion exchange.

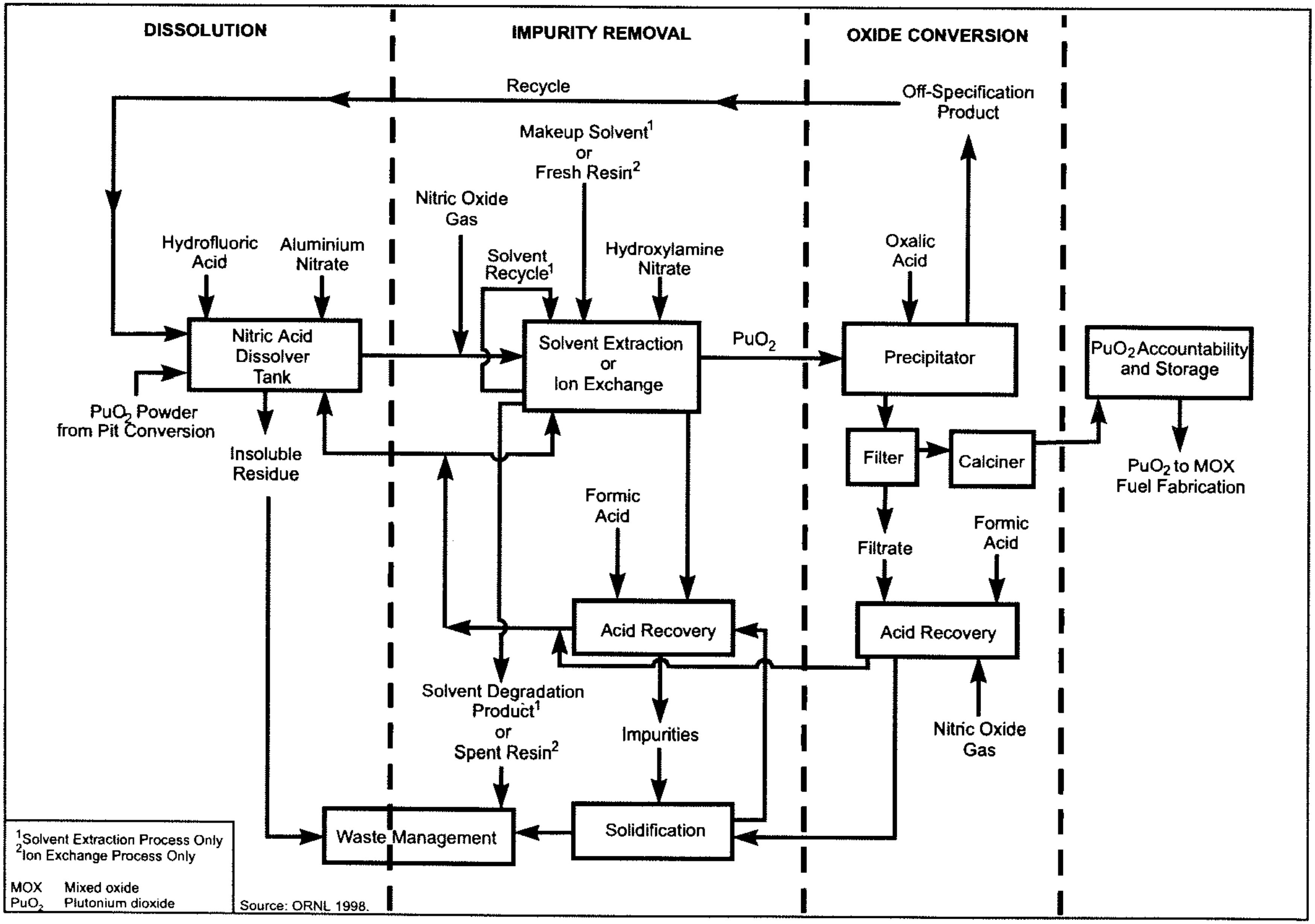


Figure N–1. Plutonium-Polishing Process

N.3.2 Impurity Removal

N.3.2.1 Solvent Extraction

Solvent extraction involves separating materials in solution according to their different preferences for a water-based (aqueous) or a hydrocarbon-based (solvent) solution. When the two solutions come into contact under the right physical and chemical conditions, one of the substances migrates from the solution in which they coexist (the feed solution) into the other (the solvent). After separation, the desired material (i.e., the product) is removed from its solution (either the feed stream or the solvent stream, depending on its preference). In this case, the plutonium would migrate from the feed solution (concentrated nitric acid) into the hydrocarbon solvent, while the gallium and other impurities would remain in the feed stream. The plutonium would then be removed from the solvent stream by contact with a second aqueous solution (dilute nitric acid), into which it would once again migrate. This process would occur in a series of centrifugal contactors, chambers which are designed to contain the materials and facilitate the contact between the aqueous and solvent streams. The dilute nitric acid stream containing the plutonium would be collected in a holding tank pending conversion. The impurities would be removed from the processed feed solution, solidified, and disposed of as waste. The solvent would be cleaned, and both it and the purified feed solution would be returned to the process for reuse.

N.3.2.2 Ion Exchange

Ion exchange operates on a similar principle: separation of substances by migration of one substance out of a solution containing both the substance of interest and impurities. In ion exchange, however, the solution is passed through columns filled with minute resin beads. Either the substance of interest or the impurities attach to the resin. In this case, the impurities would remain in solution in the feed stream, while the plutonium ions would attach themselves to the resin. The plutonium would then be removed from the resin by passing a second solution through the resin column. This stream would move on for the conversion step. The impurities remaining in the feed stream would be removed, solidified, and disposed of as waste; the purified feed stream would be returned to the process for reuse.

To begin this process, the feed solution (concentrated nitric acid containing the dissolved plutonium dioxide) would be transferred to the ion exchange glovebox for processing. The feed solution would be passed through parallel ion exchange columns to load the plutonium. Dilute nitric acid would subsequently be used to remove the plutonium from the resin columns. The stream containing the plutonium would be transferred to a holding tank to await the conversion step. The impurities would be removed from the used acids, solidified, and disposed of as waste, the purified acid stream would be returned to the process for reuse.

N.3.3 Oxide Conversion

Following impurity removal, the plutonium would be converted from a nitrate solution to an oxide powder through an oxalate precipitation, filtration, and calcination process. The plutonium-bearing dilute nitric acid solution would be transferred from the impurity removal holding tank to precipitation feed adjustment tanks, then fed into one of several precipitation tanks, where oxalic acid would be added. The resulting slurry would be mixed and allowed to settle, then would be transferred through mesh filters to filter boats.

The wet cake in the filter boats would be washed with a dilute oxalic/nitric acid solution. The filter boats would be transferred to a furnace for air drying, then calcining (heating at high temperatures, but below 700 °C [1,292 °F]). The resulting plutonium dioxide would then be transferred into storage containers, and stored pending transfer to MOX fuel fabrication.

N.3.4 Waste Management

Both the solvent extraction and ion exchange processes produce an aqueous acidic waste solution containing the separated impurities (e.g., gallium, americium, aluminum, and fluorides). This waste stream is treated by evaporation to recover nitric acid, and the concentrated impurities are solidified for disposal. The liquid wastes from the various impurity removal processes would be transferred to a waste feed tank for evaporation and chemical treatment as required. The evaporator condensate would be treated to produce concentrated acid and acidified water for process reuse. The evaporator concentrate would be chemically denitrated, and the off-gas from the denitrator scrubbed to produce concentrated nitric acid.

Solid wastes generated from process operations would include glovebox gloves, failed equipment, tools, wipes, and glovebox and high-efficiency particulate air (HEPA) filters. These materials would be removed from the process glovebox lines and transferred to a waste packaging glovebox. Nonprocess materials would be decontaminated to remove residual plutonium. The waste materials would then be packaged, assayed, and disposed of as appropriate.

N.4 POTENTIAL IMPACTS OF CONSTRUCTION AND OPERATION OF A PLUTONIUM-POLISHING MODULE

Because the plutonium-polishing module, if needed, would be added to either the pit conversion or MOX facility, impacts of its implementation would be an increment above those contributed by the facility to which it would be added. Although identified and evaluated as if the plutonium-polishing module were a discrete unit, these impacts would occur only if this module were actually added to one of the facilities. If added, the module would be completely integrated into facility operations, sharing security, services, common spaces, and other site and facility infrastructure. The impacts of the plutonium-polishing module presented in this appendix would bound the impacts of a polishing capability integrated with either of the disposition facilities. The resource areas evaluated are those where the greatest potential exists for effects on the environment. Other resource areas, such as geology and soils, and ecological resources, are not included in this appendix because the evaluations for the disposition facilities indicate that there would be little or no impact at the candidate sites on these resources, regardless of the disposition alternative being considered; and any incremental impact of the plutonium-polishing module would be negligible. Data tables are provided in Attachment 1 of this appendix.

N.4.1 Construction

The need for plutonium polishing would be identified prior to initiation of disposition facility construction, so the polishing capability would be an integral part of that construction. More building materials, fuel for equipment and vehicles, and water would be required to build the larger facility, and additional construction workers would be needed over the 3-year construction period. Water usage for sanitary and construction-related purposes could increase by as much as 2.2 million l/yr (580,000 gal/yr) during construction. As many as 112 additional construction workers would be needed annually, with the greatest total number of workers present during the second year of construction.

The volume of hazardous and nonhazardous solid wastes generated during construction of a pit conversion or MOX facility with plutonium-polishing capability would be approximately 20 percent greater than the volume of wastes which would be generated by construction of either of these facilities without plutonium polishing. These wastes would be typical of those generated during construction of an industrial facility, and would be managed largely at offsite facilities. It is unlikely that this additional waste load would have a major impact on the waste management systems at any of the candidate sites.

Nonhazardous liquid waste would primarily be sanitary wastewater, and would be managed as part of the overall facility wastewater. Including the plutonium-polishing capability in new construction would increase the wastewater generation by 8 to 20 percent, depending on the site and facility. This wastewater would be collected either in portable toilets that would be emptied and managed offsite through a contracted service, or would be processed in the existing onsite wastewater treatment facilities. As discussed in Chapter 4, existing site wastewater treatment facilities at all candidate sites have sufficient capacity to accept this additional volume of wastewater.

N.4.2 Operations

Analysis of the incremental impacts of operation of the plutonium-polishing module at each candidate site was based on the bounding plutonium disposition alternative (i.e., the alternative involving the most disposition activity, absent polishing) for that site. For the Hanford Site (Hanford) and the Savannah River Site (SRS), this would be the collocation of all three proposed disposition facilities; for the Idaho National Engineering and Environmental Laboratory (INEEL) and the Pantex Plant (Pantex), collocation of the pit conversion and MOX facilities. These are the same alternatives that were analyzed for Cumulative Impacts in Section 4.32 of the SPD EIS.

N.4.2.1 Resource Requirements

A staff of 85 would be required to support operation of the plutonium-polishing module. This additional direct employment would result in 152 to 288 indirect jobs at the candidate sites; the fewest at SRS and the most at Pantex. This additional employment would likely be filled from the existing community at each of the sites; however, community resources would be sufficient to absorb any potential in-migration.

Plutonium-polishing activities would increase electrical consumption at the candidate sites by about 5,500 MWh/yr. This would result in a 9 percent increase in the projected disposition facility needs at Hanford and SRS, and a 20 percent increase in facility demand at INEEL and Pantex. Water usage would not be appreciably increased. As discussed in Chapter 4 of the SPD EIS, sufficient electrical capacity is available at all candidate sites to support all disposition activities, including plutonium polishing.

The 930 m^2 (10,000 ft^2) that would be added to the footprint of the disposition facilities would not appreciably increase the amount of land disturbed at any of the candidate sites. However, areas of archaeological significance at SRS could be impacted. Section 4.26 of the SPD EIS describes the potential impacts of siting the disposition facilities at SRS and associated mitigation activities. Tables N–1 through N–4 present the impacts on resource use of disposition operations, including plutonium polishing, at the four candidate disposition sites.

Table N–1. Potential Impacts on Resource Use at Hanford From Operation of Disposition Facilities With Plutonium Polishing

Resource	Disposition Alternative 2	Polishing Increment	Alternative 2 With Polishing
Facility employment	1,014	85	1099
Electrical consumption (MWh/yr)	63,700	5,520	69,220
Water usage (million l/yr)	132	1.4	133
Developed land (ha)	15	0.09	15

Table N–2. Potential Impacts on Resource Use at INEEL From Operation of Disposition Facilities With Plutonium Polishing

Resource	Disposition Alternative 7A	Polishing Increment	Alternative 7A With Polishing
Facility employment	750	85	835
Electrical consumption (MWh/yr)	27,000	5,520	32,520
Water usage (million l/yr)	92	1.4	93
Developed land (ha)	13	0.09	13

Table N–3. Potential Impacts on Resource Use at Pantex From Operation of Disposition Facilities With Plutonium Polishing

Resource	Disposition Alternative 9A	Polishing Increment	Alternative 9A With Polishing
Facility employment	750	85	835
Electrical consumption (MWh/yr)	28,000	5,520	33,520
Water usage (million l/yr)	91	1.4	92
Developed land (ha)	16	0.09	16

Table N–4. Potential Impacts on Resource Use at SRS From Operation of Disposition Facilities With Plutonium Polishing

Resource	Disposition Alternative 3	Polishing Increment	Alternative 3 With Polishing
Facility employment	1,022	85	1,107
Electrical consumption (MWh/yr)	36,500	5,520	42,020
Water usage (million l/yr)	138	1.4	139
Developed land (ha)	31	0.09	31

N.4.2.2 Human Health Risk

As indicated in Tables N–5 through N–8, the additional processing steps required to implement the plutonium-polishing capability would not discernibly increase the dose or latent cancer fatality risk to members of the public, nor appreciably increase the dose or number of potential fatal cancers within the site workforce. The values in these tables are calculated for a 15-year period, including construction, startup, and facility operation.

Table N–5. Potential Impacts on Radiation Exposures at Hanford From Disposition Facilities With Plutonium Polishing

	Population Within 80 km		Badged Facility Workforce	
Impact	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Alternative 2	7.0×10^{1}	4×10^{-2}	5.6×10^{3}	2.2
Polishing	1.25×10^{-3}	6.3×10^{-7}	3.0×10^{2}	1.2×10^{-1}
Alternative 2 with polishing	7.0×10^{1}	4×10^{-2}	5.9×10^{3}	2.3

[a] Based on projected population of 387,800 in 2010.

Table N–6. Potential Impacts on Radiation Exposures at INEEL From Disposition Facilities With Plutonium Polishing

Impact	Population Within 80 km		Badged Facility Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Alternative 7A	2.2×10^{1}	1.1×10^{-2}	3.4×10^{3}	1.4
Polishing	1.35×10^{-3}	6.3×10^{-7}	3.1×10^{2}	1.2×10^{-1}
Alternative 7A with polishing	2.2×10^{1}	1.1×10^{-2}	3.8×10^{3}	1.5

[a] Based on projected population of 182,800 in 2010.

Table N–7. Potential Impacts on Radiation Exposures at Pantex From Disposition Facilities With Plutonium Polishing

Impact	Population Within 80 km		Badged Facility Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Alternative 9A	5.9	2.9×10^{-3}	3.7×10^{3}	1.5
Polishing	1.25×10^{-3}	6.3×10^{-7}	3.0×10^{2}	1.2×10^{-1}
Alternative 9A with polishing	5.9	2.9×10^{-3}	4.0×10^{3}	1.6

[a] Based on projected population of 299,000 in 2010.

Table N–8. Potential Impacts on Radiation Exposures at SRS From Disposition Facilities With Plutonium Polishing

Impact	Population Within 80 km		Badged Facility Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Alternative 3	1.6×10^{1}	8×10^{-3}	5.6×10^{3}	2.3
Polishing	1.25×10^{-3}	6.3×10^{-7}	3.2×10^{2}	1.3×10^{-1}
Alternative 3 with polishing	1.6×10^{1}	8×10^{-3}	6.0×10^{3}	2.4

[a] Based on projected population of 387,800 in 2010.

Doses to involved workers from normal operations are provided in Table N–9. These workers are defined as those directly associated with process activities. The annual average dose to plutonium-polishing module workers would be 500 mrem, and the latent cancer fatality risk from 10 years of operation would be 2×10^{-3}, regardless of whether the module were added to either the pit conversion or MOX facility.

Table N–9. Potential Radiological Impacts on Involved Workers From Operation of Plutonium-Polishing Module

Impact	Estimate
Number of badged workers	60
Total dose (person-rem/yr)	30
10-year latent fatal cancers	0.12
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

N.4.2.3 Waste Management

Potential impacts of the additional waste that would be generated by the plutonium-polishing module at the candidate sites are presented in Tables N–10 through N–13. As indicated in these tables, waste could be a fairly large percentage of the total waste generated by the disposition facilities. With the exception of the storage of transuranic (TRU) waste at Pantex, however, it would be within the waste management capabilities of the sites. As discussed in Section 4.17 of the SPD EIS, TRU waste is not currently stored at Pantex, so TRU waste storage space would be provided in the pit conversion and MOX facilities. Although the addition of plutonium polishing would increase the TRU waste requiring storage by 210 m^3 (275 yd^3), additional TRU waste storage would be needed at Pantex under Alternative 9A with or without the plutonium-polishing module.

Table N–10. Potential Impacts on Waste Management at Hanford From Operation of Disposition Facilities With Plutonium Polishing (m^3)

Waste Type	Disposition Alternative 2[a]	Polishing Increment	Alternative 2 with Polishing	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	1,700	210	1,900	1,130,000	16,800	168,500[c]
LLW	2,200	600	2,800	2,000,000	24,000	1,970,000
Mixed LLW	44	10	54	2,400,000	24,500	14,200
Hazardous	414	17	431	NA	NA	NA
Nonhazardous						
Liquid	943,000	14,000	957,000	5,300,000	NA	5,300,000
Solid	30,100	290	30,400	NA	NA	NA

[a] Includes waste generated during lead assembly fabrication and postirradiation examination.
[b] Total 15-year capacity derived from Table 3–5.
[c] Current disposal capacity at the Waste Isolation Pilot Plant.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic.

Table N–11. Potential Impacts on Waste Management at INEEL From Operation of Disposition Facilities With Plutonium Polishing (m^3)

Waste Type	Disposition Alternative 7A[a]	Polishing Increment	Alternative 7A with Polishing	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	783	210	1,000	723,000	158,800	168,500[c]
LLW	1,800	600	2,400	1,370,000	112,500	565,500
Mixed LLW	35	10	45	1,760,000	114,500	NA
Hazardous	112	17	130	744,150	NA	NA
Nonhazardous						
Liquid	713,900	14,000	728,000	48,000,000	NA	48,000,000
Solid	27,400	290	27,700	NA	NA	NA

[a] Includes waste generated during lead assembly fabrication and postirradiation examination.
[b] Total 15-year capacity derived from Table 3–17.
[c] Current disposal capacity at the Waste Isolation Pilot Plant.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic.

Table N–12. Potential Impacts on Waste Management at Pantex From Operation of Disposition Facilities With Plutonium Polishing (m^3)

Waste Type	Disposition Alternative 9A	Polishing Increment	Alternative 9A with Polishing	Site Capacity[a] Treatment	Storage	Disposal
TRU	640	210	850	NA	NA	168,500[b]
LLW	940	600	1,540	17,700	2,400	500,000[c]
Mixed LLW	30	10	40	16,300	1,000	NA
Hazardous	213	17	230	21,800	NA	NA
Nonhazardous						
Liquid	554,900	13,800	569,000	14,200,000	NA	14,204,010
Solid	22,300	290	22,600	NA	NA	NA

[a] Total 15-year capacity derived from Table 3–29.
[b] Current disposal capacity at the Waste Isolation Pilot Plant.
[c] Current disposal capacity at the Nevada Test Site.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic.

Table N–13. Potential Impacts on Waste Management at SRS From Operation of Disposition Facilities With Plutonium Polishing (m^3)

Waste Type	Disposition Alternative 3[a]	Polishing Increment	Alternative 3 with Polishing	Site Capacity[b] Treatment	Storage	Disposal
TRU	1,900	210	2,100	60,000	34,400	168,500[c]
LLW	3,700	600	4,300	459,000	NA	1,605,500
Mixed LLW	44	10	54	543,000	14,300	45,600
Hazardous	548	17	565	80,000	3,200	45,600
Nonhazardous						
Liquid	855,400	13,800	869,000	15,450,000	NA	15,450,000
Solid	35,000	290	35,300	NA	NA	NA

[a] Includes waste generated during lead assembly fabrication.
[b] Total 15-year capacity derived from Table 3–41.
[c] Current disposal capacity at the Waste Isolation Pilot Plant.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic.

N.4.2.4 Air Quality

Tables N–14 through N–17 demonstrate that only oxides of nitrogen and hydrocarbon emissions (solvent extraction only) would result from the additional processing steps required to implement the plutonium-polishing capability. As shown in these tables, however, none of the emissions from the disposition facilities at any of the candidate sites, even with the additional nitrogen dioxide and hydrocarbon contributions, would amount to even 1 percent of the regulatory standard or guideline.

Table N–14. Potential Impacts on Air Pollutant Emissions at Hanford From Operation of Disposition Facilities With Plutonium Polishing

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] ($\mu g/m^3$)	Disposition Alternative 2 Increment ($\mu g/m^3$)	Polishing Increment ($\mu g/m^3$)	Alternative 2 with Polishing ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants						
Carbon monoxide	8 hours	10,000	0.53	NA	0.53	0.0053
	1 hour	40,000	3.29	NA	3.29	0.0082
Nitrogen dioxide	Annual	100	0.046	0.0392	0.0499	0.050
PM_{10}	Annual	50	0.0025	NA	0.0025	0.005
	24 hours	150	0.0278	NA	0.0278	0.019
Sulfur dioxide	Annual	50	0.00222	NA	0.00222	0.0044
	24 hours	260	0.0247	NA	0.0247	0.0095
	3 hours	1,300	0.168	NA	0.168	0.013
	1 hour	700	0.504	NA	0.504	0.072
Other regulated pollutants						
Total suspended particulates	Annual	60	0.0025	NA	0.0025	0.0042
	24 hours	150	0.0278	NA	0.0278	0.019
Hazardous and other toxic compounds						
n-Paraffin hydrocarbon[b]	24 hours	6.7	NA	0.000325	0.000325	0.0048
Ethylene glycol	24 hours	420	0.0406	NA	0.0406	0.0097

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Solvent extraction process only.
Key: NA, not applicable.

Table N–15. Potential Impacts on Air Pollutant Emissions at INEEL From Operation of Disposition Facilities With Plutonium Polishing

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] ($\mu g/m^3$)	Disposition Alternative 7A Increment ($\mu g/m^3$)	Polishing Increment ($\mu g/m^3$)	Alternative 7A with Polishing ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants						
Carbon monoxide	8 hours	10,000	0.703	NA	0.703	0.0070
	1 hour	40,000	2.82	NA	2.82	0.0071
Nitrogen dioxide	Annual	100	0.141	0.0947	0.15	0.15
PM_{10}	Annual	50	0.00798	NA	0.000798	0.0016
	24 hours	150	0.0854	NA	0.0854	0.057
Sulfur dioxide	Annual	80	0.305	NA	0.305	0.38
	24 hours	365	3.05	NA	3.05	0.84
	3 hours	1,300	16.4	NA	16.4	1.3
Hazardous and other toxic compounds						
n-Paraffin hydrocarbon[b]	24 hours	100	NA	0.00157	0.00157	0.0016
Ethylene glycol	24 hours	6,350	0.197	NA	0.0197	0.0031

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Solvent extraction process only.
Key: NA, not applicable.

Table N–16. Potential Impacts on Air Pollutant Emissions at Pantex From Operation of Disposition Facilities With Plutonium Polishing

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] ($\mu g/m^3$)	Disposition Alternative 9A Increment ($\mu g/m^3$)	Polishing Increment ($\mu g/m^3$)	Alternative 9A with Polishing ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants						
Carbon monoxide	8 hours	10,000	0.687	NA	0.687	0.0068
	1 hour	40,000	3.79	NA	3.79	0.0095
Nitrogen dioxide	Annual	100	0.0725	0.015	0.0875	0.088
PM_{10}	Annual	50	0.00514	NA	0.00514	0.010
	24 hours	150	0.056	NA	0.056	0.037
Sulfur dioxide	Annual	80	0.00264	NA	0.00264	0.0033
	24 hours	365	0.0314	NA	0.0314	0.0086
	3 hours	1,300	0.137	NA	0.137	0.011
	30 minutes	1,048	0.55	NA	0.55	0.053
Other regulated pollutants						
Total suspended particulates	3 hours	200	0.237	NA	0.237	0.12
	1 hour	400	0.783	NA	0.783	0.20
Hazardous and other toxic compounds						
n-Paraffin hydrocarbon[b]	24 hours	2	NA	0.00174	0.00174	0.087
	1 hour	20	NA	0.0424	0.0424	0.21
Ethylene glycol	24 hours	26	0.217	NA	0.217	0.83
	1 hour	260	5.3		5.3	2.0

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Solvent extraction process only.
Key: NA, not applicable.

Table N–17. Potential Impacts on Air Pollutant Emissions at SRS From Operation of Disposition Facilities With Plutonium Polishing

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] ($\mu g/m^3$)	Disposition Alternative 3 Increment ($\mu g/m^3$)	Polishing Increment ($\mu g/m^3$)	Alternative 3 with Polishing ($\mu g/m^3$)	Percent of Standard or Guideline
Criteria pollutants						
Carbon monoxide	8 hours	10,000	0.339	NA	0.339	0.0034
	1 hour	40,000	1.28	NA	1.28	0.0032
Nitrogen dioxide	Annual	100	0.0409	0.00178	0.0427	0.043
PM_{10}	Annual	50	0.00261	NA	0.00261	0.0052
	24 hours	150	0.0424	NA	0.0424	0.028
Sulfur dioxide	Annual	80	0.0779	NA	0.0779	0.097
	24 hours	365	1.07	NA	1.07	0.29
	3 hours	1,300	2.81	NA	2.81	0.22
Other regulated pollutants						
Total suspended particulates	Annual	75	0.00261	NA	0.00261	0.0035
Hazardous and other toxic compounds						
n-Paraffin	24 hours	(c)	NA	0.000468	0.000468	(c)
hydrocarbon[b]	1 hour	20	NA	0.0424	0.0424	0.21
Ethylene glycol	24 hours	650	0.0585	NA	0.0585	0.009

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Solvent extraction process only.
[c] There is no South Carolina acceptable ambient level.
Key: NA, not applicable.

N.4.2.5 Facility Accidents

A set of bounding accidents were identified for liquid phase operations of the plutonium-polishing process. Accidents involving dry powder handling were analyzed and determined to be bounded by similar accidents associated with the pit conversion and MOX facilities without polishing. Table N–18 summarizes the set of bounding design basis and beyond-design-basis accidents for the plutonium-polishing module.

For the bounding beyond-design-basis accidents, consequences were developed for the noninvolved worker, the maximally exposed member of the public, and the public within 80 km (50 mi). The design-basis-accident with the greatest consequences is criticality. The beyond-design-basis accident with the greatest consequences is the beyond-design-basis earthquake. Impacts from criticality and beyond-design-basis earthquake are summarized in Table N–19 for each of the candidate sites. The beyond-design-basis earthquake impacts are for the plutonium-polishing module only, and increase the postulated impacts from the pit conversion and MOX facilities by 15 and 6.8 percent, respectively.

Table N–18. Summary of Bounding Accidents for the Plutonium-Polishing Module

Postulated Accident	Material at Risk (Plutonium [g])	ARF/RF	Frequency	Material Released (Plutonium [g]) [a]
Spill (with release outside facility)	5,000 (in concentrated acid)	$2\times10^{-4}/0.5$	Extremely unlikely	5×10^{-6}
Fire in glovebox[b]	40 (in organic solvent)	$1\times10^{-2}/1.0$	Unlikely	4×10^{-6}
Uncontrolled reaction/explosion:				
Thermal excursion in ion exchange column[c]	1,000 (resin) 246 (solution)	9×10^{-3} 6×10^{-3}	Unlikely	2.4×10^{-5} (d)
Nitric acid reactant events	2.75 (in dilute acid)	$2\times10^{-3}/1.0$	Extremely unlikely	5.5×10^{-8}
Criticality (1×10^{19} fissions)[e]	4,200 (in dilute acid)	1.3×10^{-4} (f)	Extremely unlikely	5.3×10^{-6} (g)
Beyond-design-basis earthquake	24,000 (in dilute acid)	$2\times10^{-5}/1.0$ $1\times10^{-4}/1.0$ 1.9×10^{-4} (h)	Extremely unlikely to beyond extremely unlikely	6.0

[a] Including an LPF of 1×10^{-5} on particulates for all design basis accidents.
[b] Solvent extraction process only.
[c] Ion exchange process only.
[d] Assuming a DR of 0.1 for anion exchange column resin.
[e] For consistency, the criticality source term has been modified from that reported in *Environmental Data Report for Generic Site Add-On Facility for Plutonium Polishing* (ORNL 1998), a is based on the criticality in plutonium dioxide powder postulated in the body of the SPD EIS, adjusted to reflect the release potential of fission products from solution.
[f] Based on 0.05 percent converted to an aerosol and 25 percent evaporated.
[g] Plus fission product gases.
[h] Half of the material has an ARF/RF value of $2\times10^{-5}/1.0$, the other half, a value of $1\times10^{-4}/1.0$. Resuspension is 1.9×10^{-4}.

Key: ARF, airborne release fraction; DR, damage ratio; LPF, leak path factor; RF, respirable fraction.

Table N–19. Accident Impacts of the Plutonium-Polishing Module

Accident	Frequency	Impacts on Noninvolved Worker: Dose (rem)[a]	Impacts on Noninvolved Worker: Probability of Cancer Fatality[b]	Impacts at Site Boundary: Dose (rem)[a]	Impacts at Site Boundary: Probability of Cancer Fatality[b]	Impacts on Population Within 80 km: Dose (person-rem)[a]	Impacts on Population Within 80 km: Latent Cancer Fatalities[c]
Hanford:							
Criticality at FMEF[d]	Extremely unlikely	1.5×10^{-1}	6.0×10^{-5}	1.9×10^{-2}	9.5×10^{-6}	3.8×10^{1}	1.9×10^{-2}
Criticality at MOX facility (new construction)	Extremely unlikely	6.1×10^{-1}	2.4×10^{-4}	3.5×10^{-2}	1.8×10^{-5}	5.5×10^{1}	2.8×10^{-2}
Beyond-design-basis earthquake[c]	Extremely unlikely to beyond extremely unlikely	3.8×10^{1}	1.5×10^{-2}	1.4	7.0×10^{-4}	3.5×10^{3}	1.8
INEEL:							
Criticality at pit conversion facility	Extremely unlikely	1.2×10^{-1}	4.8×10^{-5}	9.1×10^{-3}	4.6×10^{-6}	8.4×10^{-1}	4.2×10^{-4}
Criticality at MOX facility	Extremely unlikely	7.5×10^{-1}	3.0×10^{-4}	1.6×10^{-2}	8.0×10^{-6}	1.0	5.0×10^{-4}
Beyond-design-basis earthquake[c]	Extremely unlikely to beyond extremely unlikely	4.0×10^{1}	1.6×10^{-2}	1.0	5.0×10^{-4}	1.3×10^{2}	6.5×10^{-2}
Pantex:							
Criticality at pit conversion facility	Extremely unlikely	7.6×10^{-2}	3.0×10^{-5}	2.9×10^{-2}	1.4×10^{-5}	1.0×10^{1}	5.0×10^{-3}
Criticality at MOX facility	Extremely unlikely	2.4×10^{-1}	9.6×10^{-5}	4.7×10^{-2}	2.4×10^{-5}	1.1×10^{1}	5.5×10^{-3}
Beyond-design-basis earthquake[c]	Extremely unlikely to beyond extremely unlikely	9.8	3.9×10^{-3}	1.5	7.5×10^{-4}	4.6×10^{2}	2.3×10^{-1}
SRS:							
Criticality at pit conversion facility	Extremely unlikely	8.7×10^{-2}	3.5×10^{-5}	9.4×10^{-3}	4.7×10^{-6}	1.4×10^{1}	7.0×10^{-3}
Criticality at MOX facility	Extremely unlikely	3.0×10^{-1}	1.2×10^{-4}	1.6×10^{-2}	8.0×10^{-6}	1.6×10^{1}	8.0×10^{-3}
Beyond-design-basis earthquake[c]	Extremely unlikely to beyond extremely unlikely	1.4×10^{1}	5.6×10^{-3}	5.5×10^{-1}	2.8×10^{-4}	1.3×10^{3}	6.5×10^{-1}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual. Criticality doses also have a component from shine.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single onsite worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

[d] Impacts of a criticality accident occurring in FMEF would be the same whether the plutonium-polishing module were added to the pit conversion or MOX facility.

[e] Impacts of the design basis earthquake would be the same whether the plutonium-polishing module were added to the pit conversion or MOX facility.

Based on the frequency analysis documented in Appendix K of the SPD EIS, aircraft crash scenarios have been evaluated for the proposed disposition facilities at Pantex. The crash of an aircraft into the plutonium-polishing module was examined as a potential bounding beyond-design-basis accident.

The analysis of aircraft crash assumes that a plutonium inventory of 12 kg (26 lb) in a concentrated acid solution and 12 kg (26 lb) in a dilute acid solution is impacted by aircraft debris or building rubble. The bounding airborne release fractions and respirable fractions for free-fall spill of the concentrated solution are 2×10^{-5} and 1.0, respectively, and for the dilute solution, 2×10^{-4} and 0.5 (DOE 1994). These values have been used historically to model the collapse of building rubble onto plutonium solutions. It can be argued, however, that the energetics of the aircraft crash exceed the scope of these values, so that higher values must be used. For perspective, the bounding values for high-pressure release (>0.35 MPa_g) such as might result from the crushing and rupturing of a process vessel directly hit by aircraft debris, are 20 times greater than those for a free-fall spill. While it is unrealistic to assume that all process inventory would be impacted in this manner, it is conceivable that this type of phenomenology might play a part in the release. It is therefore assumed that half the inventory is subject to free-fall spill, and half to high-pressure release, for combined airborne release fraction/respirable fraction (ARF×RF) values of 2×10^{-4} and 1×10^{-3} for the concentrated and dilute solutions, respectively. This results in a plutonium source term of 14 g (0.5 oz).

For analysis purposes, it is also assumed that a jet fuel fire ensues, releasing additional plutonium into the air. DOE-HDBK-3010-94 presents two bounding estimates; a combined ARF×RF of 3×10^{-5} for heating without boiling, and 2×10^{-3} for boiling. It is highly unlikely that a fire would be of sufficient magnitude to involve the entire inventory in a boiling release. Moreover, the larger the fire, the greater the lofting of the resultant plume, tending to lower the doses for the noninvolved worker, the maximally exposed member of the public, and population within 80 km (50 mi). Consequently, the geometric mean value of 2×10^{-4} has been selected, along with the assumption of a nonlofted plume. This results in an additional plutonium release of 4.8 g, for a total of 19 g. This scenario results in less plutonium being released than would be released by an aircraft crash into the power storage areas of the pit conversion or MOX facilities, or from a beyond-design-basis earthquake at either of these facilities. Because the potential impacts of an aircraft crash are bounded by these other scenarios, this accident was not analyzed further.

No major consequences for the maximally exposed involved workers would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions, on the other hand, could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality were to occur, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the criticality. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident.

N.5 REFERENCES

DOE (U.S. Department of Energy), 1994, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, vols. I and II, DOE-HDBK-3010-94, Washington, DC, November.

ORNL (Oak Ridge National Laboratory), 1998, *Environmental Data Report for Generic Site Add-On Facility for Plutonium Polishing*, ORNL/MD/TR-139, Oak Ridge, TN.

ATTACHMENT 1. PLUTONIUM-POLISHING DATA TABLES

1.1 Construction

Table 1–1. Average Annual Resource Requirements for Construction of Plutonium-Polishing Module

Resource	Requirement
Electricity	
Annual consumption (MWh)	890
Peak hourly demand (MW)	< 0.35
Fuel (l)	50,160
Water (l)	
Annual consumption	2,200,000
Peak daily demand	8,600
Concrete (m^3)	750
Steel (t)	300

Table 1–2. Estimated Waste Generation From Construction of Plutonium-Polishing Module

Waste Type	Estimated Additional Waste Generation
Hazardous	
Liquid (l)	2,940
Solid (m^3)	12
Nonhazardous	
Liquid (l)	3,260,000
Solid (m^3)	93,600

Table 1–3. Air Emissions From Construction of Plutonium-Polishing Module

Pollutant	Emissions (t/yr)
Carbon monoxide	2.7
Nitrogen dioxide	4.3
PM_{10}	2.7
Sulfur dioxide	0.29
Volatile organic compounds	0.62
Total suspended particulates	6.3
Hazardous and other toxic compounds (e.g., lead, benzene, hexane)	< 1

Table 1–4. Estimated Air Pollutant Concentrations From Construction of Plutonium-Polishing Module

Pollutant	Averaging Period[a]	Concentration ($\mu g/m^3$)
Carbon monoxide	8 hours	0.53
	1 hour	3.3
Nitrogen dioxide	Annual	0.07
PM_{10}	Annual	0.049
	24 hours	1.3
Sulfur dioxide	Annual	0.0046
	24 hours	0.055
	3 hours	0.24
	30 minutes	0.98
Total suspended particulates	3 hours	10.1
	1 hour	41
Hazardous and other toxic compounds (e.g., lead benzene, hexane)[b]	24 hours	0.002
	1 hour	0.0036

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Various toxic air pollutants may be emitted during construction. Figures here represent analysis for benzene.

1.2 Operations

Table 1–5. Average Annual Resource Requirements for Operation of Plutonium-Polishing Module

Process Chemical	Requirement
Nitric oxide (gas) (m^3/yr)[a]	850
Solvent (tri-butyl phosphate in n-Paraffin hydrocarbon) (l/yr)[b]	15
Hydrofluoric acid (l/yr)	90
Formic acid (l/yr)	81,140
Hydroxylamine nitrate (kg/yr)	656
Aluminum nitrate nanohydrate (kg/yr)	1,238
Oxalic acid dihydrate (kg/yr)	6,970
Reillex HPQ resin (wet basis) (kg/yr)[c]	163

[a] Makeup for nitric acid in processes.
[b] Solvent extraction process only.
[c] Ion exchange process only.

Table 1–6. Potential Radiological Impacts on the Public of Operation of Plutonium-Polishing Module

Impact	Estimate
Population within 80 km	
Dose (person-rem/yr)	1.2×10^{-4}
10-year latent fatal cancers	6.3×10^{-7}
Maximally exposed individual	
Annual dose (mrem)	5.3×10^{-5}
10-year latent fatal cancer risk	2.7×10^{-10}
Average exposed individual within 80 km	
Annual dose (mrem)	4.2×10^{-7}
10-year latent fatal cancer risk	2.1×10^{-12}

Table 1–7. Radiological Emissions From Operation of Plutonium-Polishing Module

Stream	Plutonium Release	Average Release Height
Air	1.65×10^{-8} g/yr (2μCi/yr)	Base facility stack height
Water	Not Applicable	Not Applicable

Table 1–8. Potential Waste Generation From Operation of Plutonium-Polishing Module

Waste Type	Estimate
TRU (m^3/yr)	21
LLW (m^3/yr)	60
Mixed LLW (m^3/yr)	1.0
Hazardous	
Liquid (l/yr)	740
Solid (m^3/yr)	1.0
Nonhazardous	
Liquid (l/yr)	1,380
Solid (m^3/yr)	290

Key: LLW, low-level waste; TRU, transuranic.

Table 1–9. Estimated Air Emissions (t) From Operation of Plutonium-Polishing Module

Pollutant	Annual Emissions
Nitrogen dioxide	0.86
Hazardous air pollutants (n-Paraffin hydrocarbon)[a]	<0.01

[a] Solvent extraction process only.