DOE/EIS-0283-S2
July 2012


Savannah River Site – South Carolina


Sequoyah Nuclear Plant – Tennessee

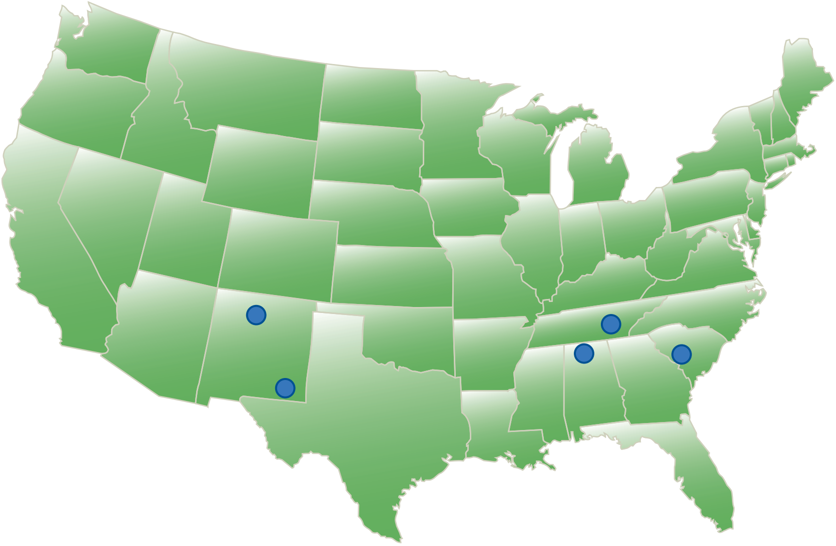

Browns Ferry Nuclear Plant – Alabama

Waste Isolation Pilot Plant – New Mexico


Los Alamos National Laboratory – New Mexico

Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement

Volume 1
(Chapters 1 through 10)



National Nuclear Security Administration
U.S. Department of Energy
Office of Fissile Materials Disposition
and
Office of Environmental Management
Washington, DC

AVAILABILITY OF THE DRAFT SURPLUS PLUTONIUM DISPOSITION SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

(SPD Supplemental EIS)

To submit comments on this *SPD Supplemental EIS*, or to request a copy, please contact:

Sachiko McAlhany, NEPA Document Manager
SPD Supplemental EIS
U.S. Department of Energy
P.O. Box 2324
Germantown, MD 20874-2324
Telephone: 1-877-344-0513
Email: spdsupplementaleis@saic.com

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Locations: South Carolina, New Mexico, Alabama, and Tennessee

For further information or for copies of this Draft SPD Supplemental EIS, *contact:*

Sachiko McAlhany, NEPA Document Manager
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Germantown, MD 20874-2324
Telephone: 1-877-344-0513
E-mail: spdsupplementaleis@saic.com

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

Carol M. Borgstrom, Director
Office of NEPA Policy and Compliance
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0103
Telephone: 202-586-4600, or leave a message at 1-800-472-2756

This document is available on the *SPD Supplemental EIS* website (http://nnsa.energy.gov/nepa/spdsupplementaleis), the DOE NEPA website (http://energy.gov/nepa/nepa-documents), and the Savannah River Operations Office website (http://www.srs.gov/general/pubs/envbul/nepa1.htm) for viewing and downloading.

Abstract: On March 28, 2007, DOE published a Notice of Intent (NOI) in the *Federal Register* (72 FR 14543) to prepare the *SPD Supplemental EIS* to evaluate the potential environmental impacts at the Savannah River Site (SRS) in South Carolina of disposition pathways for surplus weapons-usable plutonium (referred to as "surplus plutonium") originally planned for immobilization. The proposed actions and alternatives included construction and operation of a new vitrification capability in K-Area, processing in H-Canyon/HB-Line and the Defense Waste Processing Facility (DWPF), and fabricating mixed oxide (MOX) fuel in the MOX Fuel Fabrication Facility (MFFF) currently under construction in F-Area. Before the *Draft SPD Supplemental EIS* was issued, DOE decided to modify the scope of this *SPD Supplemental EIS* and evaluate additional alternatives. Therefore, on July 19, 2010 and again on January 12, 2012, DOE issued amended NOIs (75 FR 41850 and 77 FR 1920) announcing its intent to modify the scope of this *SPD Supplemental EIS* and to conduct additional public scoping.

The public scoping periods extended from March 28, 2007, through May 29, 2007; July 19, 2010 through September 17, 2010; and January 12, 2012 through March 12, 2012. Scoping meetings were conducted on April 17, 2007, in Aiken, South Carolina; April 19, 2007, in Columbia, South Carolina; August 3, 2010, in Tanner, Alabama; August 5, 2010, in Chattanooga, Tennessee; August 17, 2010, in North Augusta, South Carolina; August 24, 2010, in Carlsbad, New Mexico; August 26, 2010, in Santa Fe, New Mexico; and February 2, 2012, in Pojoaque, New Mexico. A summary of the comments received during the public scoping periods is provided in Chapter 1 of this *SPD Supplemental EIS* and available on the project website at http://nnsa.energy.gov/nepa/spdsupplementaleis.

DOE has revised the scope of this *SPD Supplemental EIS* to refine the quantity and types of surplus plutonium, evaluate additional alternatives (including additional pit disassembly and conversion options), no longer

consider in detail one of the alternatives identified in the 2007 NOI (ceramic can-in-canister immobilization), and revise DOE's preferred alternative. In this *SPD Supplemental EIS*, DOE describes the environmental impacts of alternatives for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which DOE has not made a disposition decision, including 7.1 metric tons (7.8 tons) of plutonium from pits that were declared excess to national defense needs after publication of the 2007 NOI, and 6.0 metric tons (6.6 tons) of surplus non-pit plutonium. The analyses also encompass potential use of MOX fuel in reactors at the Sequoyah and Browns Ferry Nuclear Plants of the Tennessee Valley Authority (TVA).

In this *SPD Supplemental EIS*, DOE evaluates the No Action Alternative and four action alternatives for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium: (1) Immobilization to DWPF Alternative – glass can-in-canister immobilization of both surplus non-pit and disassembled and converted pit plutonium and subsequent filling of the canister with high-level radioactive waste (HLW) at DWPF at SRS; (2) MOX Fuel Alternative – fabrication of the disassembled and converted pit plutonium and much of the non-pit plutonium into MOX fuel at MFFF, for use in domestic commercial nuclear power reactors to generate electricity, and disposition of the surplus non-pit plutonium that is not suitable for MFFF as transuranic waste at the existing Waste Isolation Pilot Plant (WIPP), a deep geologic repository in southeastern New Mexico; (3) H-Canyon/HB-Line to DWPF Alternative – processing the surplus non-pit plutonium in the existing H-Canyon/HB-Line at SRS with subsequent disposal as HLW (i.e., vitrification in the existing DWPF), and fabrication of the pit plutonium into MOX fuel at MFFF; and (4) WIPP Alternative – processing the surplus non-pit plutonium in the existing H-Canyon/HB-Line for disposal as transuranic waste at WIPP, and fabrication of the pit plutonium into MOX fuel at MFFF. Under all alternatives, DOE would also disposition as MOX fuel, 34 metric tons (37.5 tons) of surplus plutonium in accordance with previous decisions. The 34 metric tons (37.5 tons) of plutonium would be fabricated into MOX fuel at MFFF, for use at domestic commercial nuclear power reactors. Within each action alternative, DOE also evaluates options for pit disassembly and conversion to, among other things, disassemble nuclear weapons pits and convert the plutonium metal to an oxide form for disposition. Under three of the options, DOE would not build a stand-alone Pit Disassembly and Conversion Facility in F-Area at SRS, which DOE had previously decided to construct (65 FR 1608).

Preferred Alternative: The MOX Fuel Alternative is DOE's Preferred Alternative for surplus plutonium disposition. DOE's preferred option for pit disassembly and the conversion of surplus plutonium metal, regardless of its origins, to feed for MFFF is to use some combination of facilities at Technical Area 55 at Los Alamos National Laboratory and K-Area, H-Canyon/HB-Line, and MFFF at SRS, rather than to construct a new stand-alone facility. This would likely require the installation of additional equipment and other modifications to some of these facilities. DOE's preferred alternative for disposition of surplus plutonium that is not suitable for MOX fuel fabrication is disposal at WIPP. The TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.

Public Involvement: Comments on this *Draft SPD Supplemental EIS* should be submitted within 60 days of the publication of the U.S. Environmental Protection Agency's Notice of Availability in the *Federal Register* to ensure consideration in preparation of the *Final SPD Supplemental EIS*. DOE will consider comments received after the 60-day comment period to the extent practicable. Written comments may be submitted to Sachiko McAlhany via postal mail to the address provided above, via email to spdsupplementaleis@saic.com, or by toll-free fax to 1-877-865-0277. Public hearings on this *Draft SPD Supplemental EIS* will be held during the comment period. The dates, times, and locations of these hearings will be published in a DOE *Federal Register* notice and will also be announced by other means, including the project website, newspaper advertisements, and notification to persons on the mailing list. Information on this *SPD Supplemental EIS* can be found on the project website at http://nnsa.energy.gov/nepa/spdsupplementaleis.

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ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

AADT	annual average daily traffic
ACS	American Community Survey
ALARA	as low as reasonably achievable
ARIES	Advanced Recovery and Integrated Extraction System
ATSDR	Agency for Toxic Substances and Disease Registry
BFN	Browns Ferry Nuclear Plant
BJWSA	Beaufort-Jasper Water and Sewer Authority
BLM	U.S. Bureau of Land Management
BLS	U.S. Bureau of Labor Statistics
BMP	best management practice
CCC	criticality control container
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CMR	chemistry and metallurgy research
CMRR	Chemistry and Metallurgy Research Building Replacement
CMRR-NF	Chemistry and Metallurgy Research Building Replacement Nuclear Facility
CSWTF	Central Sanitary Wastewater Treatment Facility
DARHT	Dual-Axis Radiographic Hydrodynamic Test
dBA	decibels A-weighted
DBA	design-basis accident
D&D	decontamination and decommissioning
DD&D	decontamination, decommissioning, and demolition
DHS	U.S. Department of Homeland Security
DMO	direct metal oxidation
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DSA	Documented Safety Analysis
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FFTF	Fast Flux Test Facility
FR	*Federal Register*
FY	fiscal year
GTCC	Greater-Than-Class C
GWSB	Glass Waste Storage Building
Hanford	Hanford Site
HEPA	high-efficiency particulate air

HEU	highly enriched uranium
HLW	high-level radioactive waste
HUFP	Hanford Unirradiated Fuel Package
IPCC	Intergovernmental Panel on Climate Change
ISLOCA	interfacing systems loss-of-coolant accident
ISO	International Organization for Standardization
KIS	K-Area Interim Surveillance capability
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security
LANSCE	Los Alamos Neutron Science Center
LCF	latent cancer fatality
LEED	Leadership in Energy and Environmental Design
LEU	low-enriched uranium
LLW	low-level radioactive waste
LOCA	loss-of-coolant accident
LOS	level of service
MDA	material disposal areas
MEI	maximally exposed individual
MFFF	Mixed Oxide Fuel Fabrication Facility
MLLW	mixed low-level radioactive waste
MOX	mixed oxide
MSA	Material Storage Area
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
ODS	ozone-depleting substances
Pantex	Pantex Plant
PCB	polychlorinated biphenyl
PDC	Pit Disassembly and Conversion Project
PDCF	Pit Disassembly and Conversion Facility
PEIS	programmatic environmental impact statement
PF-4	Plutonium Facility
PGA	peak (horizontal) ground acceleration
PM_n	particulate matter less than or equal to n microns in aerodynamic diameter
PMDA	Plutonium Management and Disposition Agreement
POC	pipe overpack container

ppm	parts per million
PSD	prevention of significant deterioration
RCRA	Resource Conservation and Recovery Act
RLUOB	Radiological Laboratory/Utility/Office Building
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROI	region of influence
S&P	Stabilization and Packaging Capability
SCDHEC	South Carolina Department of Health and Environmental Control
SEIS	Supplemental Environmental Impact Statement
SERF	Sanitary Effluent Reclamation Facility
SHPO	State Historic Preservation Office
SPD	surplus plutonium disposition
SQN	Sequoyah Nuclear Plant
SRARP	Savannah River Archaeological Research Program
SRS	Savannah River Site
STA	Secure Transportation Asset
SWPPP	Storm Water Pollution Prevention Plan
SWEIS	site-wide environmental impact statement
SWWS	Sanitary Wastewater Systems
TA	technical area
TRU	transuranic waste
TRUPACT-II	Transuranic Package Transporter Model 2
TVA	Tennessee Valley Authority
U.S.C.	United States Code
USGS	U.S. Geological Survey
VRM	Visual Resource Management
WIPP	Waste Isolation Pilot Plant
WSB	Waste Solidification Building
Y-12	Y-12 National Security Complex
ZPPR	Zero Power Physics Reactor
°C	degrees Celsius
°F	degrees Fahrenheit

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1[a]	Parts/million	Parts/million	1[a]	Milligrams/liter
Micrograms/liter	1[a]	Parts/billion	Parts/billion	1[a]	Micrograms/liter
Micrograms/cubic meter	1[a]	Parts/trillion	Parts/trillion	1[a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,018.5	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Radiation					
Sieverts	100	Rem	Rem	0.01	Sieverts
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.7854	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons

ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

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}
deca-	D	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}

CHAPTER 1

INTRODUCTION AND PURPOSE AND NEED

1.0 INTRODUCTION AND PURPOSE AND NEED

Chapter 1 of this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* (DOE/EIS-0283-S2) describes the purpose and need for agency action, introduces the proposed action and alternatives, and summarizes the scoping process for this document. This chapter also describes the amounts of surplus plutonium addressed and the decisions that could be made following completion of this *SPD Supplemental EIS*.

1.1 Introduction

In keeping with U.S. nonproliferation policies and commitments[1] to reduce the availability of material that is readily usable in nuclear weapons, the U.S. Department of Energy (DOE), including the semiautonomous National Nuclear Security Administration (NNSA), is engaged in a program to disposition U.S. surplus weapons-usable plutonium (referred to in this supplemental environmental impact statement as "surplus plutonium"). Surplus plutonium includes pit[2] and non-pit[3] plutonium that is no longer needed for U.S. national security or programmatic purposes. DOE has previously analyzed and made decisions on disposition paths for most of the plutonium the United States has declared surplus (see Section 1.5).

Weapons-usable plutonium is plutonium in forms that can be readily converted for use in nuclear weapons. Weapons-grade, fuel-grade, and power-reactor-grade plutonium are all weapons-usable plutonium.

Surplus plutonium has no identified programmatic use and does not fall into one of the categories of national security reserves.

On March 28, 2007, DOE published a Notice of Intent (NOI) in the *Federal Register* (72 FR 14543) to prepare this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)*[4] to evaluate the potential environmental impacts at the Savannah River Site (SRS) of alternative disposition pathways for surplus plutonium originally planned for immobilization in the Record of Decision (ROD) (65 FR 1608) for the *Surplus Plutonium Disposition Environmental Impact Statement (SPD EIS)* (DOE 1999b). The proposed actions and alternatives included construction and operation of a new vitrification capability in K-Area, processing in H-Canyon/HB-Line and the Defense Waste Processing Facility (DWPF), and fabricating mixed oxide (MOX) fuel in the MOX Fuel Fabrication Facility (MFFF) currently under construction in F-Area at SRS.

Then on July 19, 2010, DOE issued an amended NOI (75 FR 41850) announcing its intent to modify the scope of this *SPD Supplemental EIS* and to conduct additional public scoping. Under the revised scope, DOE would refine the quantity and types of surplus plutonium, evaluate additional alternatives, and no longer consider in detail one of the alternatives identified in the 2007 NOI (i.e., ceramic can-in-canister immobilization). In addition, DOE had identified in the 2007 NOI a glass can-in-canister immobilization approach as its Preferred Alternative for the non-pit plutonium then under consideration; the

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[1] *On September 1, 2000, the Agreement Between the Government of the United States and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation (referred to as "the PMDA") (USA and Russia 2000) was signed. The PMDA (and its 2010 Protocol) calls for each country to dispose of at least 34 metric tons (37 tons) of excess weapons grade plutonium by fabrication into MOX fuel and irradiation in reactors in each country.*

[2] *The plutonium was made by the United States in nuclear reactors for use in nuclear weapons. A pit is the central core of a primary assembly in a nuclear weapon and is typically composed of plutonium-239 metal, enriched uranium, or both, and other materials.*

[3] *Non-pit plutonium may exist in metal or oxide form, and may be combined with other materials that were used in the process of manufacturing plutonium for use in nuclear weapons or related research and development activities. Most surplus non-pit plutonium is currently stored at the Savannah River Site.*

[4] *In the NOI (72 FR 14543), the title was given as the "Supplemental Environmental Impact Statement for Surplus Plutonium Disposition at the Savannah River Site."*

2010 amended NOI explained that DOE would evaluate a glass can-in-canister immobilization alternative in this *SPD Supplemental EIS*, but that DOE did not have a preferred alternative.

On January 12, 2012, DOE issued a second amended NOI (77 FR 1920) announcing its intent to further modify the scope of this *SPD Supplemental EIS* to evaluate additional options for pit disassembly and conversion of plutonium metal to oxide, including potential use of the Plutonium Facility (PF-4) at the Los Alamos National Laboratory (LANL), and to conduct additional public scoping. In addition, DOE identified the MOX Fuel Alternative as DOE's Preferred Alternative.

This *SPD Supplemental EIS* updates the previous DOE National Environmental Policy Act (NEPA) analyses (described in Appendix A, Section A.1) to consider options for pit disassembly and conversion of plutonium metal to oxide. It also analyzes the use of fuel fabricated from surplus plutonium in Tennessee Valley Authority (TVA) reactors and other domestic commercial nuclear power reactors[5] to generate electricity. This *SPD Supplemental EIS* also evaluates alternatives for the disposition of 13.1 metric tons (14.2 tons) of surplus plutonium for which DOE has not yet made a disposition decision.

1.2 Purpose of and Need for Agency Action

DOE's purpose and need for action remains, as stated in the *SPD EIS* (DOE 1999b:1-3), to reduce the threat of nuclear weapons proliferation worldwide by conducting disposition of surplus plutonium in the United States in an environmentally sound manner, ensuring that it can never again be readily used in nuclear weapons.

TVA is a cooperating agency on this *SPD Supplemental EIS* because it is considering the use of MOX fuel, produced as part of DOE's Surplus Plutonium Disposition Program, in its nuclear power reactors. TVA provides electrical power to the people of the Tennessee Valley region, including almost all of Tennessee and parts of Alabama, Mississippi, Kentucky, Virginia, North Carolina, and Georgia. TVA's Sequoyah and Browns Ferry Nuclear Plants, located near Soddy-Daisy, Tennessee and Athens, Alabama, respectively, currently are, and will continue to be, major assets among TVA's energy generation resources in meeting the demand for power in the region. Consistent with DOE's purpose and need, TVA's purpose for considering use of MOX fuel derived from DOE's Surplus Plutonium Disposition Program is the possible procurement of MOX fuel for use in these reactors.

Cooperating Agency

A cooperating agency participates in the preparation of an environmental impact statement because of its jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) (40 CFR 1501.6, 1508.5).

1.3 Proposed Action

DOE proposes to disposition an additional 13.1 metric tons (14.4 tons) of surplus plutonium for which it has not previously made a disposition decision; to provide the appropriate capability to disassemble surplus pits and convert surplus plutonium to a form suitable for disposition; and to provide for the use of MOX fuel in TVA and other domestic commercial nuclear power reactors.

Figure 1–1 shows the major Surplus Plutonium Disposition Program activities. Facilities at E-, F-, H-, K-, and S-Areas at SRS in South Carolina; at Technical Area 55 (TA-55) at LANL in New Mexico; at the Waste Isolation Pilot Plant (WIPP) in New Mexico; and at the Browns Ferry and Sequoyah Nuclear Plants and other domestic commercial nuclear power reactors that could irradiate MOX fuel. **Figures 1–2 and 1–3** show the locations of SRS and LANL and the applicable operations areas at these sites. **Figures 1–4, 1–5, and 1–6** show the locations of WIPP, the Browns Ferry Nuclear Plant, and the Sequoyah Nuclear Plant, respectively.

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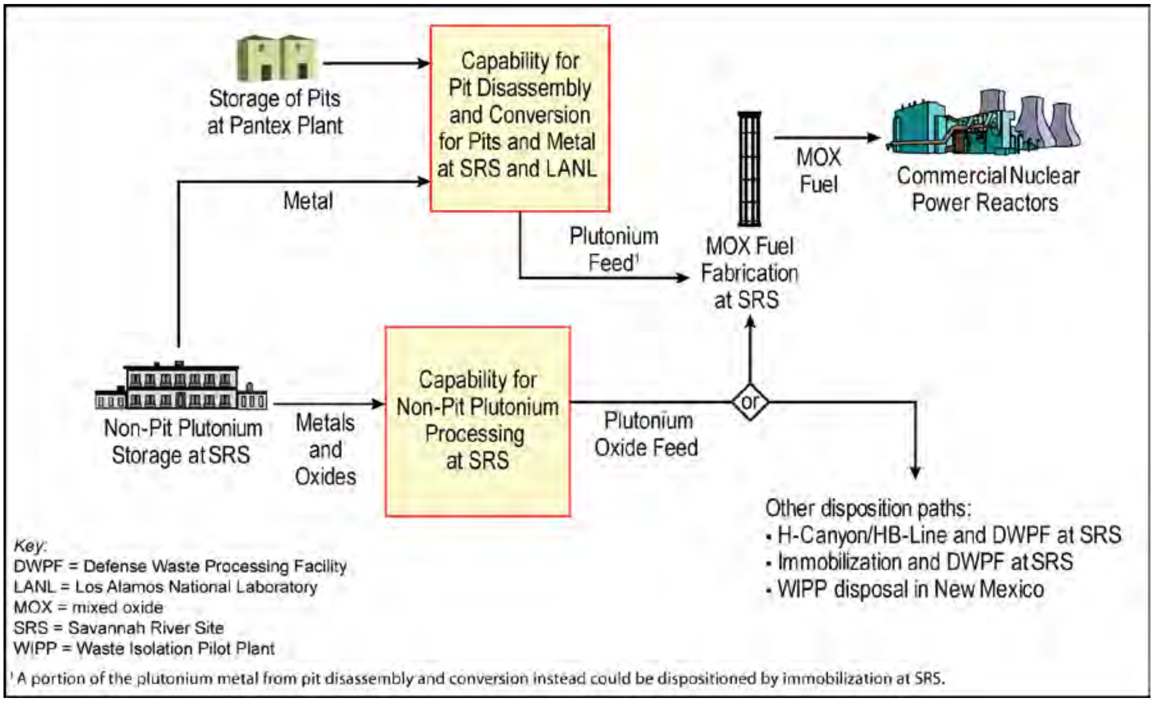
[5] *Other domestic commercial nuclear power reactors are evaluated in this* SPD Supplemental EIS *by way of analyzing a "generic reactor" reflecting characteristics of such reactors.*



Key:
DWPF = Defense Waste Processing Facility
LANL = Los Alamos National Laboratory
MOX = mixed oxide
SRS = Savannah River Site
WIPP = Waste Isolation Pilot Plant

[1] A portion of the plutonium metal from pit disassembly and conversion instead could be dispositioned by immobilization at SRS.

Figure 1–1 Surplus Plutonium Disposition Program Activities

1.4 Alternatives Evaluated

In addition to a No Action Alternative, in this *SPD Supplemental EIS* DOE evaluates four action alternatives. The alternatives are based on four options for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which DOE has not yet selected a disposition pathway, and include from one to four applicable options for pit disassembly and conversion.[6] The alternatives are briefly described below (Chapter 2, Section 2.3, describes the alternatives in more detail):

(1) *No Action Alternative* – continued storage of 7.1 metric tons (7.8 tons) of pit plutonium at the Pantex Plant (Pantex), and 6 metric tons (6.6 tons) of non-pit plutonium at SRS

(2) *Immobilization to DWPF Alternative* – glass can-in-canister immobilization for both surplus non-pit and disassembled and converted pit plutonium and subsequent filling of the canister with high-level radioactive waste (HLW) at DWPF

(3) *MOX Fuel Alternative* – fabrication of the disassembled and converted pit plutonium and much of the non-pit plutonium into MOX fuel at MFFF for use in domestic commercial nuclear power reactors to generate electricity and disposition of the surplus non-pit plutonium that is not suitable for MFFF as transuranic (TRU) waste at WIPP, a deep geologic repository in southeastern New Mexico

(4) *H-Canyon/HB-Line to DWPF Alternative* – processing the surplus non-pit plutonium in the existing H-Canyon/HB-Line at SRS and subsequent disposal with HLW (i.e., vitrification in the existing DWPF), and fabrication of the pit plutonium into MOX fuel at MFFF

(5) *WIPP Alternative* – disposal of the surplus non-pit plutonium as TRU waste at WIPP and fabrication of the pit plutonium into MOX fuel at MFFF

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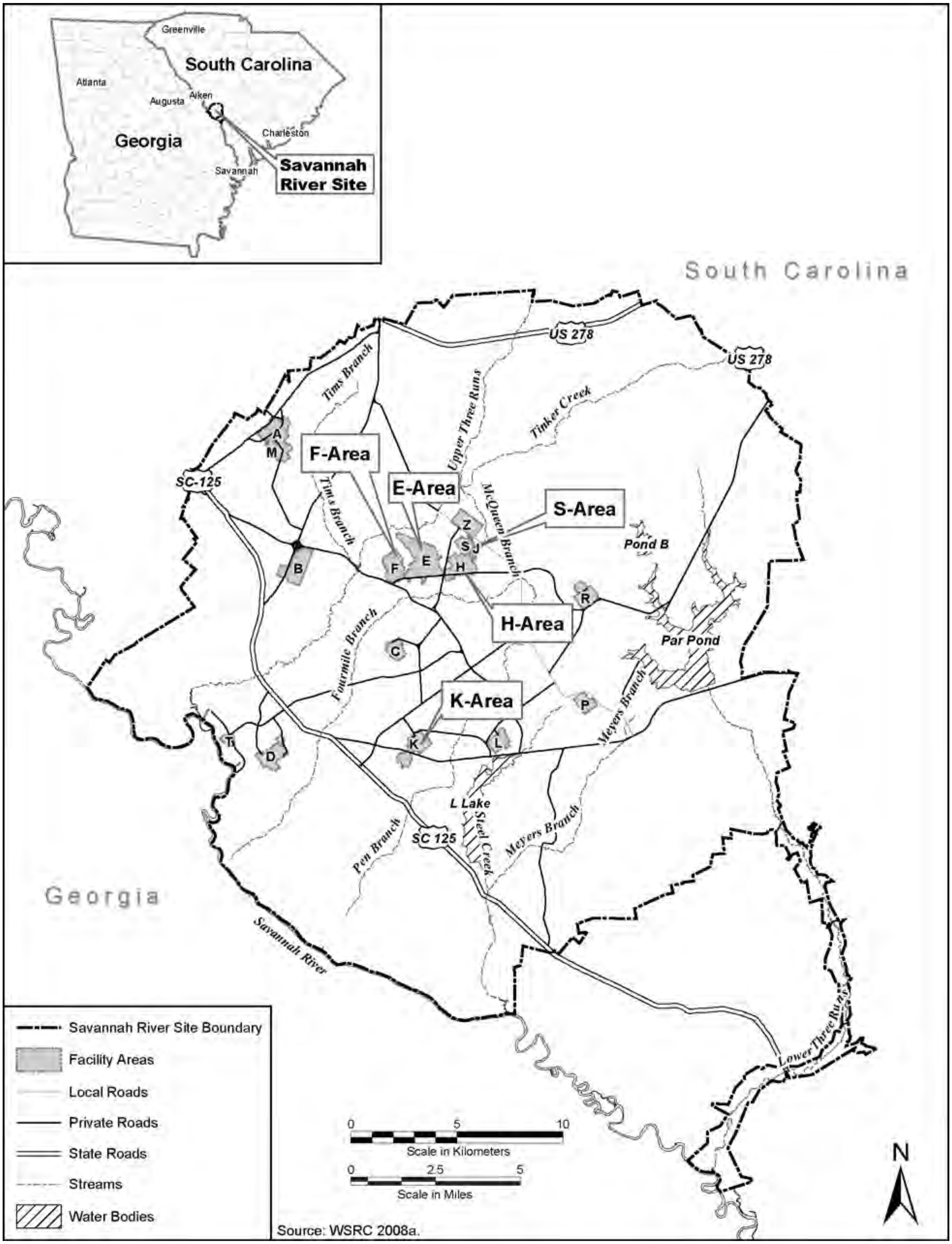
[6] *In the 2000 ROD (65 FR 1608) for the* SPD EIS, *DOE decided to construct and operate a Pit Disassembly and Conversion Facility at SRS. However, as described in DOE's amended NOIs issued in 2010 (75 FR 41850) and 2012 (77 FR 1920). DOE is revisiting this decision.*



Source: WSRC 2008a.

Figure 1–2 Savannah River Site Location and Operations Areas

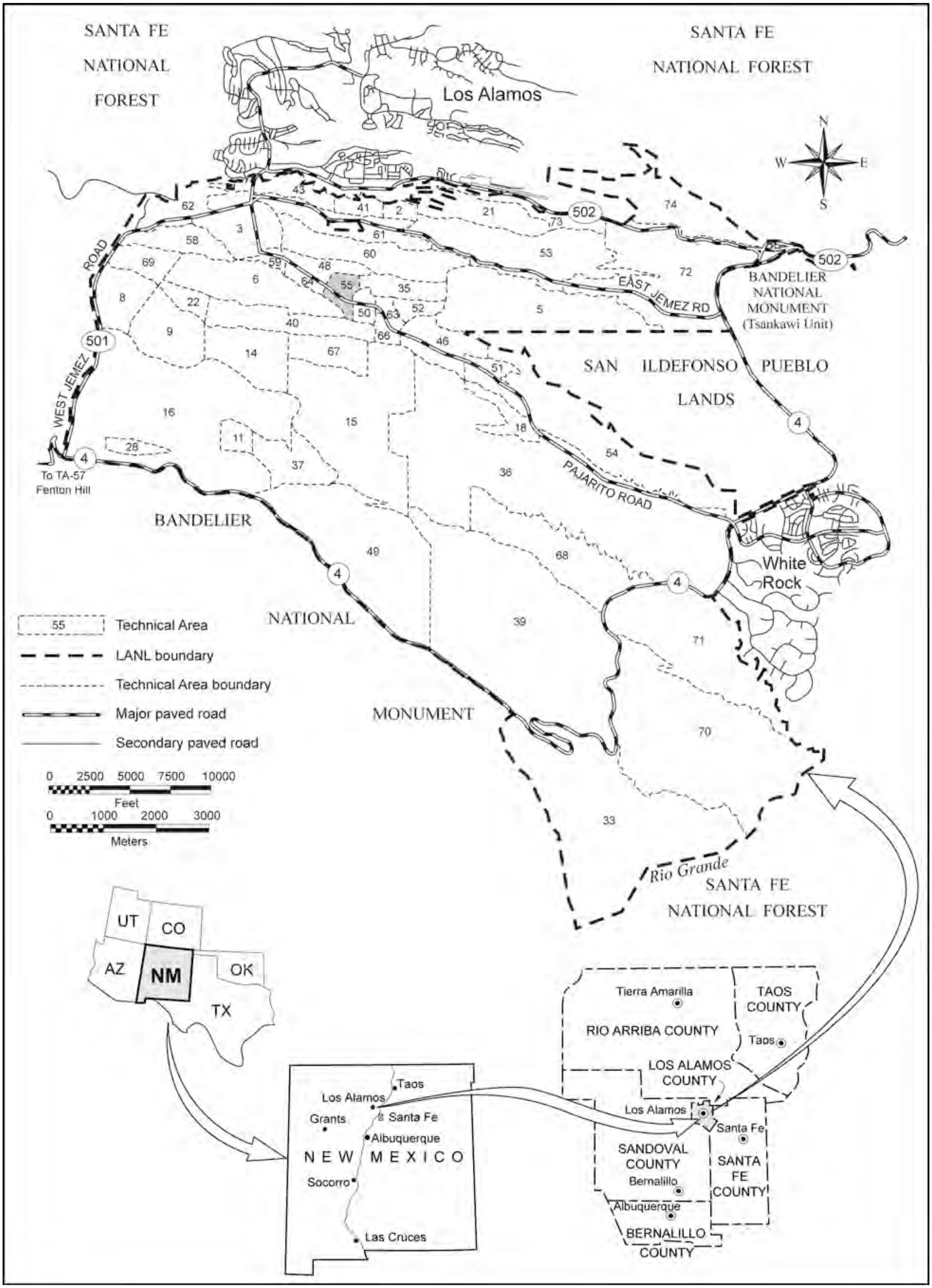


Figure 1–3 Los Alamos National Laboratory Location and Technical Areas

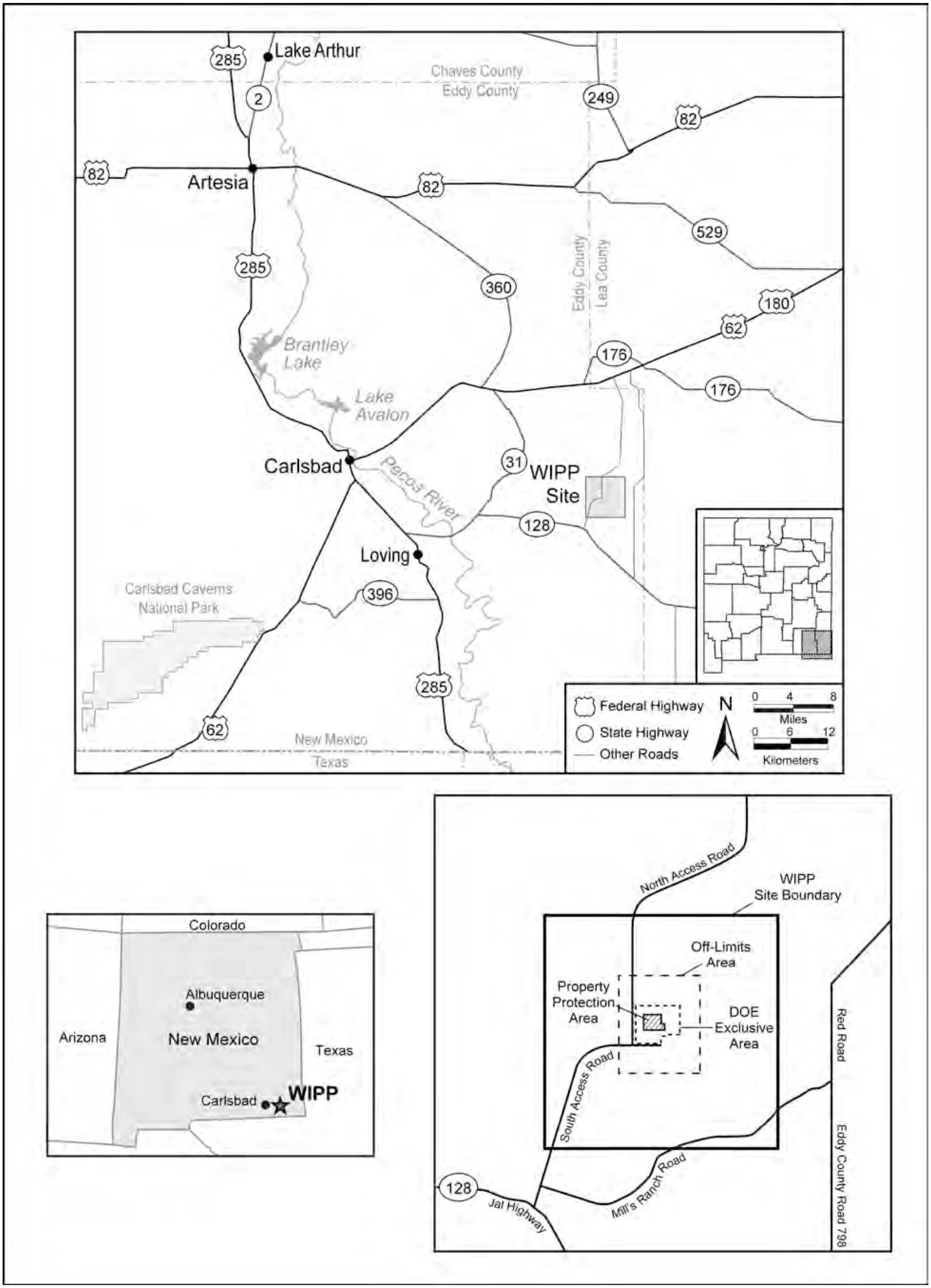


Figure 1–4 Waste Isolation Pilot Plant Location

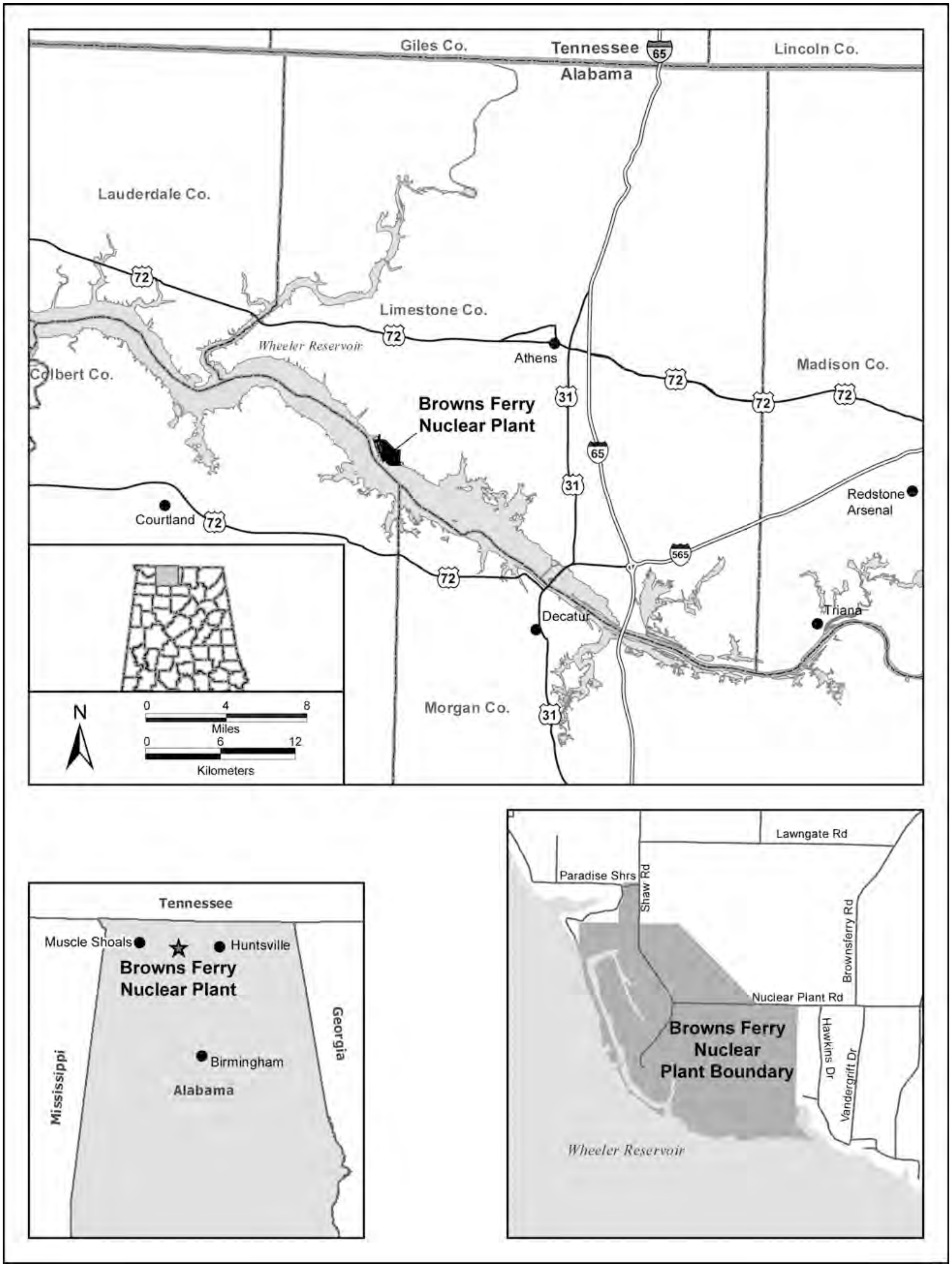


Figure 1–5 Browns Ferry Nuclear Plant Location

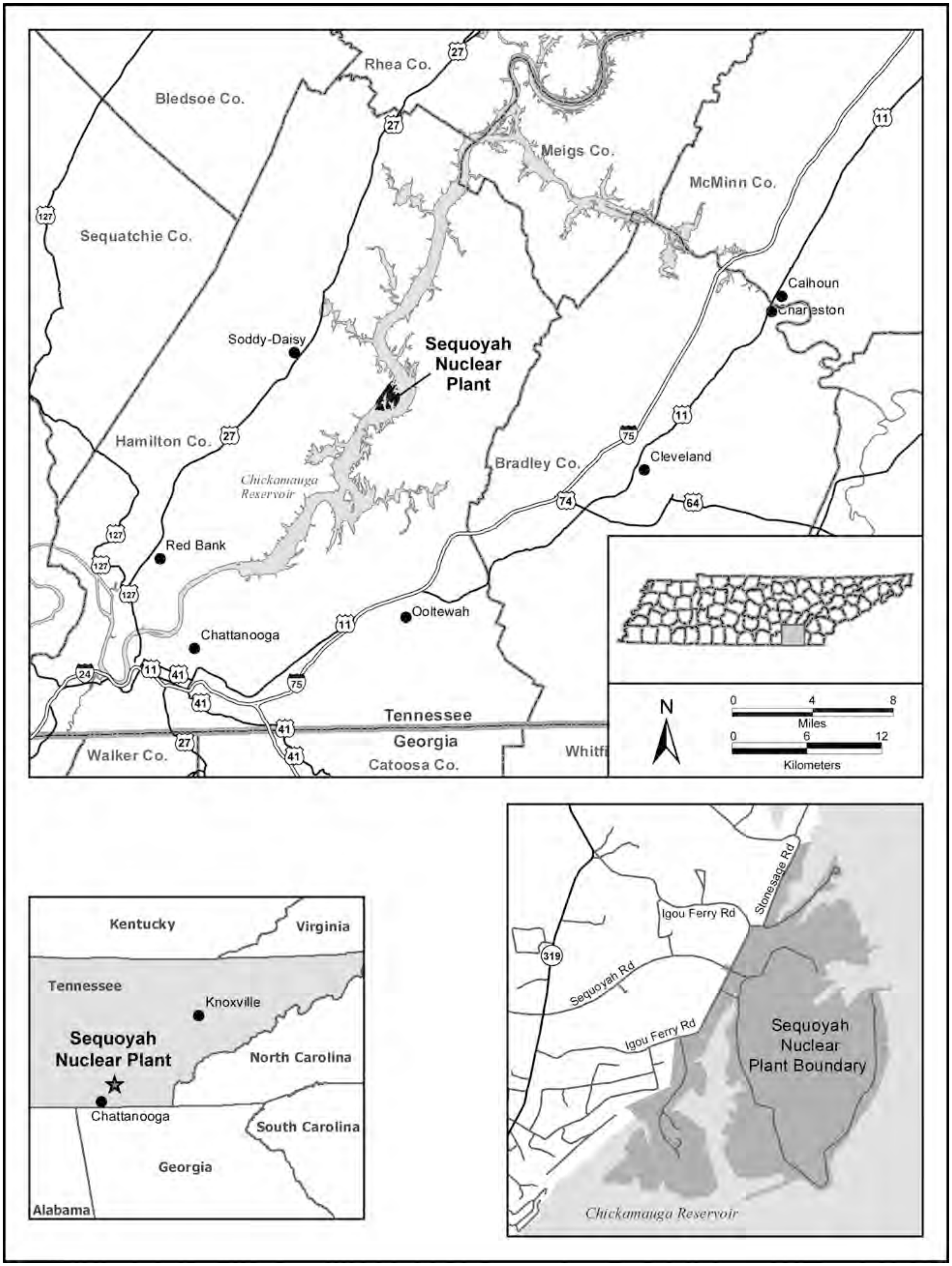


Figure 1–6 Sequoyah Nuclear Plant Location

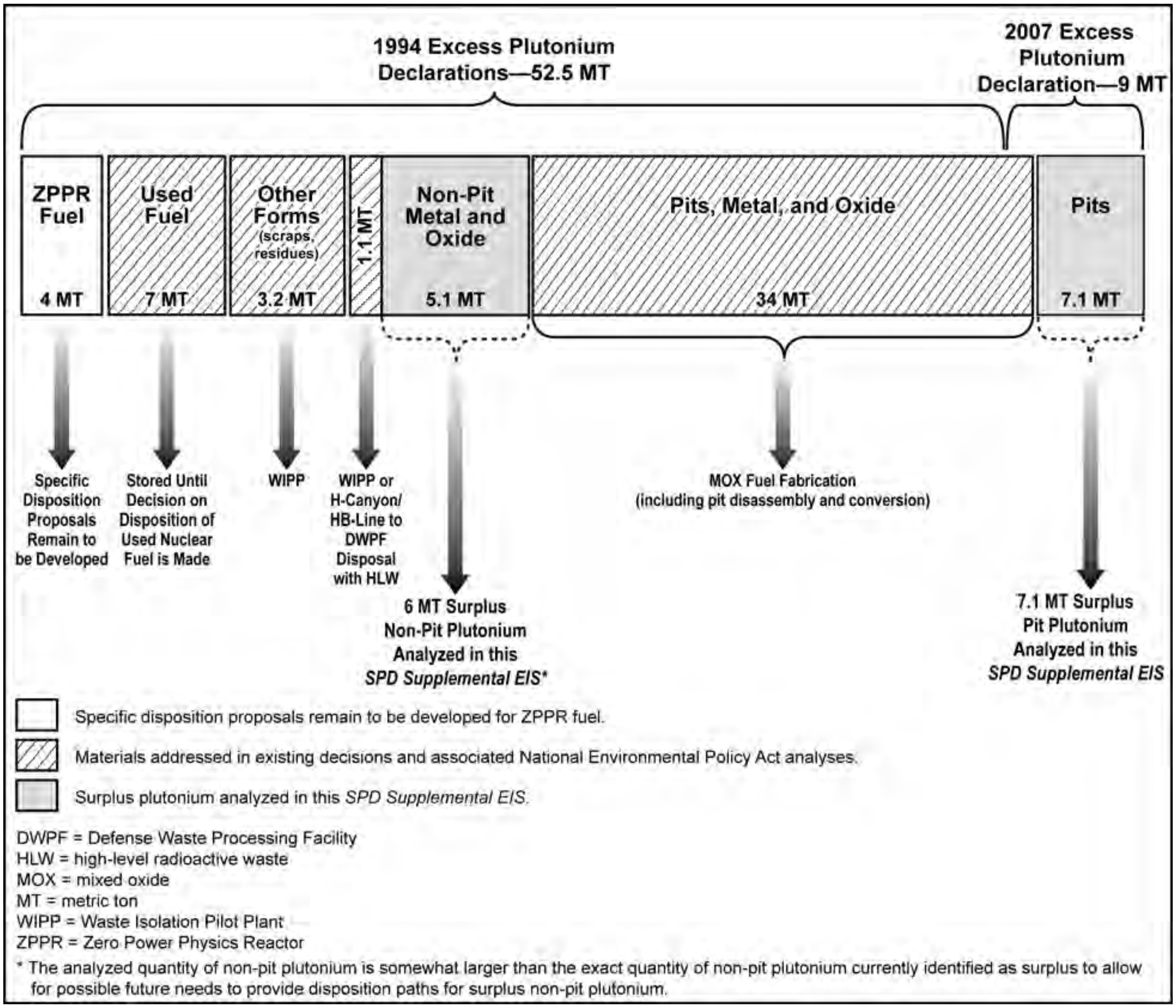
For brevity, the pit disassembly and conversion and plutonium disposition options are not described here, but are described in Chapter 2, Sections 2.1 and 2.2, respectively. Under all alternatives, DOE would also disposition as MOX fuel 34 metric tons (37.5 tons) of surplus plutonium in accordance with previous decisions. The 34 metric tons (37.5 tons) of plutonium would be fabricated into MOX fuel at MFFF, as described in Section 2.2.2, for use in domestic commercial nuclear power reactors.

1.5 Disposition Paths for Surplus Plutonium

To date, the United States has declared as excess to U.S. defense needs a total of 61.5 metric tons (67.8 tons) of plutonium. This quantity includes both pit and non-pit plutonium. Based on a series of NEPA reviews (described in Appendix A, Section A.1), DOE has determined disposition paths for most of this surplus plutonium.

1.5.1 Plutonium with Identified Disposition Paths

Figure 1–7 summarizes the various plutonium disposition paths decided to date for 45.3 metric tons (50.0 tons) of surplus plutonium.



☐ Specific disposition proposals remain to be developed for ZPPR fuel.
▨ Materials addressed in existing decisions and associated National Environmental Policy Act analyses.
■ Surplus plutonium analyzed in this *SPD Supplemental EIS*.

DWPF = Defense Waste Processing Facility
HLW = high-level radioactive waste
MOX = mixed oxide
MT = metric ton
WIPP = Waste Isolation Pilot Plant
ZPPR = Zero Power Physics Reactor

* The analyzed quantity of non-pit plutonium is somewhat larger than the exact quantity of non-pit plutonium currently identified as surplus to allow for possible future needs to provide disposition paths for surplus non-pit plutonium.

Figure 1–7 Disposition Paths for Surplus Plutonium

In the 2000 ROD (65 FR 1608) and 2003 amended ROD (68 FR 20134) for the *SPD EIS*, DOE decided to convert 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at an MFFF currently being constructed at SRS. DOE is not revisiting those decisions. However, DOE is revisiting its Pit Disassembly and Conversion Facility (PDCF) decision, and a total of 35 metric tons (38.6 tons) is analyzed for all pit disassembly and conversion options. Regardless of the disposition alternative selected, pit disassembly and conversion would be necessary for 35 metric tons (38.6 tons) of surplus plutonium.

Seven metric tons (7.7 tons) of surplus plutonium are contained in used reactor fuel (used fuel is also known as spent fuel) and are, therefore, already in a proliferation-resistant form. Following appropriate NEPA reviews as described in Appendix A, Section A.1, DOE has already disposed of 3.2 metric tons (3.5 tons) of surplus plutonium scrap and residues at WIPP as TRU waste. In 2008 and 2009, DOE completed interim action determinations concluding that 0.6 metric tons (0.7 tons) of surplus non-pit plutonium could be disposed of through H-Canyon/HB-Line and DWPF (DOE 2008g, 2009b); in 2011, DOE amended this determination to add WIPP as a disposal alternative for about 85 kilograms (187 pounds) of these 0.6 metric tons (0.7 tons) (DOE 2011c). Also in 2011, DOE decided to use H-Canyon/HB-Line to prepare 0.5 metric tons (0.6 tons) of surplus plutonium for disposal at WIPP (DOE 2011f). Thus, DOE has determined that a total of 1.1 metric tons (1.2 tons) of surplus plutonium could be dispositioned through H-Canyon/HB-Line to DWPF and WIPP.

1.5.2 Plutonium with No Identified Disposition Path

Figure 1–7 shows the surplus plutonium for which DOE has not made a disposition decision. Of this material, DOE previously set aside for programmatic use 4 metric tons (4.4 tons) of surplus plutonium in the form of Zero Power Physics Reactor fuel at its Idaho National Laboratory. The DOE program for which this material was set aside no longer has a programmatic use for the material. DOE is considering using a portion (about 0.4 metric tons [0.44 tons]) of the material for a different programmatic use. While the bulk of the Zero Power Physics Reactor fuel currently stored at the Idaho National Laboratory has been declared excess, specific disposition proposals remain to be developed.

Therefore, DOE currently proposes to make decisions regarding the disposition of 13.1 metric tons (14.4 tons) of surplus plutonium (i.e., 7.1 metric tons [7.8 tons] of pit plutonium[7] and 6 metric tons [6.6 tons] of non-pit plutonium[8]). The 6 metric tons (6.6 tons) of non-pit plutonium include a limited quantity of additional plutonium (0.9 metric tons [1.0 ton]), to allow for the possibility that DOE may, in the future, identify additional quantities of surplus plutonium that could be processed for disposition through the facilities and capabilities analyzed in this *SPD Supplemental EIS*. For example, future sources of additional surplus plutonium could include additional plutonium quantities recovered from foreign locations through NNSA's Global Threat Reduction Initiative[9] or future quantities of plutonium declared excess to U.S. defense needs.

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[7] *The 34 metric tons (37 tons) previously identified for MOX fuel fabrication included an allowance of 1.9 metric tons (2.1 tons) for future declarations. DOE later determined, as shown in Figure 1–7, that 1.9 metric tons (2.1 tons) from the 9 metric tons (9.9 tons) of pit plutonium in the 2007 declaration qualified for inclusion within the 34 metric tons (37 tons) identified for MOX fabrication, leaving 7.1 metric tons (7.8 tons) of pit plutonium to be dispositioned.*

[8] *The analyzed quantity of non-pit plutonium is somewhat larger than the exact quantity of non-pit plutonium currently identified as surplus (6 metric tons [6.6 tons] compared to 5.1 metric tons [5.6 tons]) to allow for possible future needs to provide disposition paths for surplus non-pit plutonium. This quantity also includes 0.7 metric tons (0.77 tons) of unirradiated Fast Flux Test Facility fuel.*

[9] *As analyzed in the Environmental Assessment for the U.S. Receipt and Storage of Gap Material Plutonium and Finding of No Significant Impact (DOE 2010b).*

1.6 Public Scoping

Since announcement of this *SPD Supplemental EIS*, DOE has provided three opportunities for the public to provide scoping comments (2007 [72 FR 14543]; 2010 [75 FR 41850]; and 2012 [77 FR 1920]). The public scoping periods extended from March 28, 2007, through May 29, 2007; July 19, 2010 through September 17, 2010; and January 12, 2012 through March 12, 2012. Scoping meetings were conducted on April 17, 2007, in Aiken, South Carolina; April 19, 2007, in Columbia, South Carolina; August 3, 2010, in Tanner, Alabama; August 5, 2010, in Chattanooga, Tennessee; August 17, 2010, in North Augusta, South Carolina; August 24, 2010, in Carlsbad, New Mexico; August 26, 2010, in Santa Fe, New Mexico; and February 2, 2012, in Pojoaque, New Mexico. This section summarizes issues raised and comments received during the public scoping periods. A more detailed summary of the comments received during the public scoping periods is available on the project website at http://nnsa.energy.gov/nepa/spdsupplementaleis.

Comment Summary: One commentor recounted the history of the plutonium declared surplus during the Clinton Administration and requested that DOE reconcile the quantities of plutonium by form and proposed disposition pathway.

Response: The quantities of plutonium that are analyzed in this *SPD Supplemental EIS* are described in Section 1.5. Figure 1–7 summarizes the disposition paths for surplus plutonium.

Comment Summary: A commentor asked about DOE's plan for additional plutonium disposition as the Nation's nuclear weapons stockpile is retired.

Response: As described in Section 1.5, the scope of this *SPD Supplemental EIS* is limited to 13.1 metric tons (14.4 tons) of additional surplus plutonium. Additional future declarations related to nuclear weapons stockpile retirement would be subject to appropriate NEPA review before a disposition path could be selected.

Comment Summary: Commentors were concerned about the composition of the surplus plutonium and where it is currently stored.

Response: DOE has information on the composition of all pit and non-pit plutonium. This information is sensitive and, therefore, has not been included in this *SPD Supplemental EIS*. As described in Chapter 2, Section 2.3.1, plutonium pits are safely stored at Pantex near Amarillo, Texas, and most surplus non-pit plutonium is in safe storage at the K-Area Complex at SRS; the remaining surplus non-pit plutonium is in the process of being moved to SRS, and in the interim, is safely stored at other DOE sites.

Comment Summary: Commentors were concerned that related environmental impact statements (EISs) need to be updated before this *SPD Supplemental EIS* is issued and a decision made.

Response: This *SPD Supplemental EIS* is being prepared in accordance with applicable Council on Environmental Quality and DOE NEPA regulations. This *SPD Supplemental EIS* addresses all of the relevant issues and analysis covered in the other documents and updates the analyses where necessary. The other related EISs and supplement analyses, and the decisions announced in the RODs for these documents, remain valid and, and in accordance with Council on Environmental Quality and DOE NEPA regulations, do not need to be updated before this *SPD Supplemental EIS* can be issued.

Comment Summary: Commentors variously supported or opposed the individual surplus plutonium disposition options constituting the proposed alternatives. Commentors asked DOE to reconsider previous decisions, including fabrication of 34 metric tons (37 tons) of surplus plutonium into MOX fuel; the Preferred Alternative (MOX Fuel Alternative); eliminating the ceramic immobilization disposition option; and eliminating the disassembly of pits at Pantex. Some commentors supported the immobilization option, including extending it to the entire surplus plutonium inventory. A commentor asked that alternative approaches to surplus plutonium disposition be considered, including quicker, less costly methods.

Response: Although DOE has announced a Preferred Alternative (see Chapter 2, Section 2.5), DOE has not made a decision with respect to the surplus plutonium analyzed in this *Draft SPD Supplemental EIS* and could select one of the other alternatives or a combination of alternatives. Chapter 2, Section 2.3, describes the alternatives evaluated in this *SPD Supplemental EIS*, and Section 2.4 describes the alternatives considered, but dismissed from detailed study. As summarized in Section 2.4, the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition PEIS)* (DOE 1996c) and the *SPD EIS* (DOE 1999b) considered numerous alternatives for surplus plutonium disposition, including immobilization of the entire surplus plutonium inventory and pit disassembly and conversion at Pantex. Immobilization of the entire surplus plutonium inventory was evaluated in the *SPD EIS* (DOE 1999b), and DOE selected the MOX approach for some of the material declared surplus for reasons set forth in the *SPD EIS* ROD (65 FR 1608). DOE is not revisiting the decisions announced in that ROD, or in the 2002 and 2003 amended RODs (67 FR 19432 and 68 FR 20134), other than the decision to construct and operate a stand-alone PDCF. Although DOE is reconsidering the decision to build PDCF at SRS and is looking at other options, including using PF-4 at LANL, DOE is not reconsidering its prior decision to not construct a pit disassembly and conversion capability at Pantex, an alternative considered in the *SPD EIS*.

Comment Summary: A comment was made that the proposed processing of some of the plutonium through H-Canyon as identified in the NOI should be considered a separate alternative.

Response: As described in Chapter 2, Section 2.3.4, a separate H-Canyon/HB-Line to DWPF Alternative is evaluated.

Comment Summary: Commentors requested that DOE explain why disposal at WIPP is a reasonable alternative. Some commentors expressed concerns about sending plutonium to WIPP.

Response: The direct disposal of 50 metric tons (55 tons) of surplus plutonium was eliminated from further analysis in the *Storage and Disposition PEIS* because it would exceed the capacity of WIPP when added to DOE's inventory of TRU waste (DOE 1996c:2-13). The disposal at WIPP of up to 6 metric tons (6.6 tons) of non-pit plutonium, which is approximately 12 percent of the amount considered in the *Storage and Disposition PEIS*, would not exceed WIPP's capacity and, therefore, was considered to be a reasonable alternative in this *SPD Supplemental EIS*. A description of WIPP's capacity and the process that would be used to dispose of surplus plutonium as TRU waste at WIPP is contained in Appendix B, Sections B.1.3 and B.3; the environmental impacts of shipping waste to WIPP are described in Appendix E.

Comment Summary: Commentors were concerned that plutonium disposal at WIPP is an affirmation that disposal of plutonium utilizing the Spent Fuel Standard, by which plutonium is placed in a material with a radiation barrier, is essentially dead.

Response: DOE believes that the alternatives, including the WIPP Alternative, analyzed in this *SPD Supplemental EIS* provide protection from theft, diversion, or future reuse in nuclear weapons akin to that afforded by the Spent Fuel Standard.

Comment Summary: Commentors requested that this *SPD Supplemental EIS* reanalyze the impacts of plutonium storage at the K-Area Complex.

Response: The impacts of long-term storage of plutonium at the K-Area Complex are presented in Appendix H of this *SPD Supplemental EIS*.

Comment Summary: Hardened storage should be analyzed for immobilized wastes to protect them from risks posed by natural or manmade disasters and terrorist attack.

Response: As described in Appendix B, Section B.1.4.1, canisters containing cans of immobilized surplus plutonium would be filled with HLW and stored in the Glass Waste Storage Buildings at SRS. These buildings have controls and engineered safeguards required by safety assessments that examine the potential for, and consequences of, accidents caused by natural phenomena and manmade events. The presence of immobilized plutonium in the canisters is not expected to appreciably change their performance in severe accidents and these wastes would not be considered an attractive target for terrorist attack. DOE considers risks associated with security and safety to determine whether or not a hardened structure is required. DOE does not believe that additional hardening of the Glass Waste Storage Buildings is needed to safely store immobilized waste containing surplus plutonium.

Comment Summary: Commentors expressed concern over the MOX fuel fabrication program, including the lack of interest in MOX fuel of commercial nuclear power plant operators; cost and schedule; and tying U.S. disposition activities to the Russian government’s nuclear activities.

Response: MOX fuel use in commercial reactors is a demonstrated technology that has been used worldwide for over 40 years. DOE continues to pursue potential domestic commercial nuclear power customers. MFFF will start up using existing surplus plutonium oxide supplies and will be built and operated as described in Appendix B, Section B.1.1.2, and Chapter 5, Section 5.3.2, of this *SPD Supplemental EIS*. The United States remains committed to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated As No Longer Required for Defense Purposes and Related Cooperation (referred to as the “PMDA”), under which both the United States and the Russian Federation have each agreed to dispose of at least 34 metric tons (37.5 tons) of excess weapons-grade plutonium in nuclear reactors to produce electricity. It is important that MFFF begin operations to demonstrate progress to the Russian government, meet U.S. legislative requirements, and reduce the quantity of surplus plutonium and the concomitant cost of secure storage.

Comment Summary: A number of comments were received on MOX fuel use. Commentors were concerned about public health and safety risks associated with MOX fuel processing; the suitability of reactors for using MOX fuel; and MOX fuel use in reactors that had previously been uranium-fueled. Commentors requested that DOE discuss the potential use of MFFF beyond the publicly stated mission of producing MOX fuel for light water reactors.

Response: MOX fuel use in commercial reactors is a demonstrated technology that has been used worldwide for over 40 years. The risks of preparing MOX fuel in MFFF are discussed in Appendix G, Section G.2. The risks of using MOX fuel in domestic commercial nuclear power reactors are discussed in Appendix I, Sections I.1.2 and I.2.2. As described in Appendix B, Section B.1.1.1.2, MOX fuel could be fabricated for commercial nuclear power reactors including boiling water reactors and pressurized water reactors. DOE has no plans to use MOX fuel in other than light water reactors.

Comment Summary: Commentors were concerned about the impact of adding a plutonium oxidation function to MFFF and that adding this function could delay startup of MFFF.

Response: Appendix B, Section B.1.1.2, describes the oxidation furnaces that could be added to MFFF. DOE anticipates that addition of the oxidation furnaces would not affect the startup date for MFFF; the impacts of installation and operation of the oxidation furnaces at MFFF are described in Appendix F.

Comment Summary: Commentors requested information on plutonium in MOX fuel, including how much plutonium would be in the fresh MOX fuel and how much plutonium would remain when the fuel is withdrawn from the reactors following irradiation.

Response: The footnote at the introduction to Chapter 2 provides a description of the amount of plutonium-239 in fresh MOX fuel and the reduction in plutonium-239 after irradiation in a nuclear power reactor. In addition, Appendix J, Section J.2.2, compares the radionuclide inventory in a full low-enriched uranium (LEU) core to that in a partial MOX fuel core.

Comment Summary: Commentors expressed concern about human health risks and increased risk of accidents using a partial MOX fuel nuclear reactor core instead of a full uranium fuel core. Commentors said that this *SPD Supplemental EIS* must analyze beyond-design-basis accidents, including accidents involving used fuel pools, and a “river tsunami accident” as a result of upstream dam failure at the TVA reactor sites. Commentors expressed concern that the accident at the Fukushima Daiichi Nuclear Power Station in Japan should be considered because the design of the reactors is similar to the design of the reactors at the Browns Ferry Nuclear Plant.

Response: Appendix I describes the potential impacts, including differences associated with the two types of nuclear reactor cores, and summarizes the results of the more detailed human health risk analysis presented in Appendix J. Appendix J, Section J.3.3, includes an analysis of beyond-design-basis accidents for the TVA reactors. Used fuel pool accidents are not typically evaluated in detail in reactor accident analysis because other accidents would have greater consequences. TVA has considered applicable natural phenomena, such as earthquakes, tornados, flooding, and dam failure, in Safety Analysis Reports prepared for each reactor (TVA 2009, 2010c). This *SPD Supplemental EIS* does not evaluate a dam failure “river tsunami accident,” as this was not determined to be a credible accident in TVA’s Safety Analysis Reports. Appendix J, Section J.3.3.3, describes the U.S. Nuclear Regulatory Commission (NRC) recommendations developed in response to the accident at the Fukushima Daiichi Nuclear Power Station in Japan and subsequent actions that TVA has taken to further reduce the likelihood and severity of accidents at its nuclear plants.

Comment Summary: Commentors requested that NRC’s role in licensing the use of MOX fuel in commercial nuclear power reactors be explained.

Response: NRC regulations related to operation of domestic commercial nuclear power reactors are described in Chapter 5, Section 5.3.3, of this *SPD Supplemental EIS*. Domestic commercial nuclear power reactors undergo a rigorous licensing process under “Domestic Licensing of Production and Utilization Facilities” (10 CFR Part 50) or “Licenses, Certifications, and Approvals for Nuclear Power Plants” (10 CFR Part 52), beginning before facility construction and continuing throughout operation. Amendment to each reactor’s operating license would be required prior to MOX fuel being brought to the reactor sites and loaded into the reactors. Public meetings are regularly held in conjunction with plant licensing, and opportunities would be available for public hearings before any license amendment is issued.

Comment Summary: Commentors expressed concern about the use of TVA’s Sequoyah Nuclear Plant for the MOX fuel and tritium production missions.

Response: The interagency agreement with NNSA for tritium production requires TVA to use up to three of its pressurized water reactor units for tritium production. TVA decides how to use its pressurized water reactor units to meet DOE’s needs. To date, TVA has been able to produce all tritium needed by NNSA in Watts Bar Unit 1. Steps are being taken to prepare Sequoyah Units 1 and 2 to be capable of tritium production, if needed. Currently, TVA does not anticipate the need to perform tritium producing burnable absorber rod irradiation at Sequoyah for at least several years, if ever. TVA would not produce tritium and irradiate MOX fuel during the same fuel cycle.

Comment Summary: Commentors requested that this *SPD Supplemental EIS* describe the impacts of used MOX fuel on used fuel management at a reactor. In addition, commentors asked that this *SPD Supplemental EIS* describe where the used MOX fuel and the can-in-canister assemblies containing immobilized plutonium would be disposed of and the thermal impacts of used MOX fuel on an interim storage facility or geologic repository.

Response: As described in Appendix I, Section I.1, each LEU and MOX fuel assembly would be discharged from the reactor with its own unique burn-up level and decay heat. The used fuel assemblies would be placed in the used fuel pool to reduce decay heat. When the decay heat reaches manageable levels, the used fuel assemblies would be moved to dry storage casks. By the time used fuel assemblies are ready for dry storage, the decay heat for the LEU and MOX fuel assemblies would be similar. DOE anticipates that MOX and LEU fuel assemblies would be managed similarly.

Comment Summary: Commentors expressed concern about lead assembly testing at the Catawba Nuclear Station and the need to conduct lead assembly testing in the TVA reactors. A commentor stated that NRC regulations require reactor testing to the burn-up level being sought for licensing. MOX lead assemblies were only tested for two cycles at the Catawba Nuclear Station.

Response: Significant worldwide experience with the use of MOX fuel, coupled with lead assembly testing programs, including the one at Duke Energy's Catawba Nuclear Station, indicates MOX fuel performance. MOX fuel lead assemblies were successfully tested in the Catawba Nuclear Station Unit 1 reactor. The four MOX fuel lead assemblies performed safely; no safety limits were exceeded. The need for future lead test assemblies based on the reactor's planned use of MOX fuel (burn-up levels) will be determined by NRC as part of the fuel qualification and licensing process.

Comment Summary: Concerns were raised about TVA, including the condition of reactors, public safety procedures, and TVA's ability to remain focused on its core mission.

Response: TVA's reactors are licensed by NRC to operate safely, and NRC would perform a comprehensive safety review before MOX fuel could be used. Ultimately, NRC would make any decisions related to future use of MOX fuel in TVA reactors as a result of this review process. TVA remains committed to its core mission and expects that MOX fuel could help fulfill this mission, as a safe and cost-effective fuel to generate electricity.

Comment Summary: Some commentors were concerned that DOE, rather than TVA, would make the decision to use MOX fuel at TVA's nuclear power reactors.

Response: The decision to use MOX fuel in the reactors at the Browns Ferry and/or Sequoyah Nuclear Plants would be made independently by TVA subject to license amendment by NRC.

Comment Summary: Commentors expressed concern about processing more plutonium through DWPF.

Response: As described in Appendix B, Section B.1.4.1, and analyzed in Appendix G, DOE has analyzed the potential environmental impacts of increasing the plutonium loading in DWPF canisters.

Comment Summary: Commentors were concerned that construction of a pit disassembly and conversion capability at SRS could result in another expensive, excess facility.

Response: As described in Section 1.4, DOE is revisiting its previous decision to construct a full-scale PDCF at SRS. See Chapter 2, Section 2.1, for a description of the pit disassembly and conversion options that DOE evaluates in this *SPD Supplemental EIS.*

Comment Summary: Commentors had numerous questions about the characteristics of existing facilities that would be used for plutonium disposition, including MFFF, H-Canyon/HB-Line, and DWPF at SRS; WIPP; and PF-4 at LANL.

Response: Appendix B describes the facilities that could be used for surplus plutonium disposition at SRS, LANL, and WIPP, including building and process line modifications and plutonium throughput. The environmental impacts and human health risks of construction and operation of these facilities are described in Appendices F (Impacts of Pit Disassembly and Conversion Options), G (Impacts of Plutonium Disposition Options), and H (Impacts of Principal Plutonium Support Facilities). The environmental impacts and human health risks of construction and operation of the alternatives are described in Chapter 4, including the potential impacts of accidents at DOE facilities in Section 4.1.2.2. Transportation impacts are described in Appendix E. Impacts from TRU waste disposal at WIPP are analyzed in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b) and briefly described in Appendix A, Section A.2.

Comment Summary: Some commentors expressed concerns or requested that additional information be included in this *SPD Supplemental EIS* about consequences of potential accidents, security of nuclear materials, routine and accidental releases of radionuclides, worker safety, waste processing, synergistic effects of operating multiple facilities at SRS (i.e., cumulative impacts), dose calculation methods, transportation, the fate of waste vitrified at DWPF, and disposition of equipment after the surplus plutonium disposition activities are completed.

Response: Chapter 4 and supporting appendices of this *SPD Supplemental EIS* include analyses and discussions of these issues.

Comment Summary: Commentors were concerned about the risks of sabotage, theft, and terrorist attack on plutonium disposition facilities and transportation vehicles.

Response: The consequences of intentional destructive acts are described in Chapter 4, Section 4.1.2.5. This analysis is supported by a classified appendix to this *SPD Supplemental EIS* that is not available to the public.

Comment Summary: Commentors requested information on the environmental impacts and risks of expanded pit disassembly and conversion at PF-4 at LANL, including seismic and wildfire risks.

Response: Appendix F includes analyses of the environmental impacts and human health risks of expanded pit disassembly and conversion in PF-4, including the effects of handling larger quantities of plutonium in metal and oxide form. Appendix D, Section D.1.5.2.11, provides more-detailed information on accidents at PF-4, including consideration of natural phenomena hazards such as earthquakes, volcanoes, and wildfires. Section D.2.9.2 describes the completed and planned seismic upgrades to PF-4. To be conservative, the accident analyses in this *SPD Supplemental EIS* consider the current state of PF-4 without future seismic upgrades.

Comment Summary: A number of comments were received on the transportation of surplus plutonium, including risk of accidents, risk of transporting plutonium oxide powder, energy requirements, climate change impacts, and cumulative impacts.

Response: Chapter 4 addresses the issues raised. All shipments on public roads that contain plutonium pits or metal, or plutonium oxide powder would utilize NNSA's Secure Transportation Asset. All shipments would be in compliance with applicable U.S. Department of Transportation, NRC, and DOE requirements. Transportation impacts are described in Chapter 4, Section 4.1.5, and Appendix E. Cumulative transportation impacts and climate change impacts, including consideration of fuel used for transportation, are described in Chapter 4, Section 4.5. Notification of pending shipments would be given to state and Federal agencies in accordance with existing regulations and agreements. For security reasons, notice would not be given to the public.

Comment Summary: A commentor suggested an alternative transportation route to WIPP.

Response: DOE is evaluating representative transportation routes for TRU waste to WIPP in this *SPD Supplemental EIS*, and will not be selecting specific shipping routes.

Comment Summary: Commentors expressed concern that surplus plutonium disposition activities may interfere with cleanup and remediation activities and other projects at the DOE sites.

Response: The alternatives analyzed in this *SPD Supplemental EIS* take into account the availability of facilities and their closure schedules. Information relevant to these issues is presented in the description of the alternatives in Chapter 2, Section 2.3. DOE expects there would be minimal disruption of cleanup and remediation activities at DOE sites.

Comment Summary: Commentors had concerns about environmental justice issues related to American Indian tribes near LANL. Commentors requested that community meetings be held in each pueblo and connecting river community within a 100-mile (161-kilometer) radius from LANL to honor the government-to-government consultation process. A commentor asked that DOE include American Indian tribal perspectives in this *SPD Supplemental EIS*.

Response: Chapter 3, Section 3.2.11, describes minority and low-income populations near LANL. Chapter 4, Section 4.1.6, analyzes environmental justice impacts of the alternatives for surplus plutonium disposition at LANL, including consideration of a tribal exposure or special pathways scenario and has concluded that American Indians living near LANL are not exposed to elevated risks compared to nonminority populations living in the same area, and that the risks associated with the activities proposed to be done at LANL are small. In support of its public outreach effort, DOE conducted three public scoping meetings in Carlsbad, Pojoaque (on the Pojoaque Reservation), and Santa Fe, New Mexico. DOE has a significant tribal outreach program with the tribes surrounding LANL and routinely meets with interested tribal governments to discuss issues of mutual concern. In support of this *SPD Supplemental EIS*, DOE will continue to hold discussions with American Indian groups and tribal governments to brief them on the scope of this *SPD Supplemental EIS*.

Comment Summary: Commentors requested specific details about monitoring and emergency response plans.

Response: Some of the details requested, such as what radionuclides or other elements could be released from normal operations and DOE facility accidents, are included in the radiological analyses in Chapter 4, Section 4.1.2, and Appendices C and D of this *SPD Supplemental EIS*. Information about SRS, LANL, and TVA emergency response plans appears in Chapter 3, Sections 3.1.6.5, 3.2.6.5, 3.3.1.2, and 3.3.2.2. Other information about monitoring may be found in other documents, such as the SRS, LANL, and WIPP annual environmental reports (accessible at http://www.srs.gov/ general/pubs/ERsum/ index.html, http://www.lanl.gov/environment/all/esr.shtml, and http://www.wipp.energy.gov/Documents_ Environmental.htm, respectively).

Comment Summary: Commentors were interested in the background and structure of DOE and its ability to execute whichever alternative is selected in the ROD.

Response: On August 4, 1977, President Carter signed the Department of Energy Organization Act, creating DOE from the Federal Energy Administration and the Energy Research and Development Administration. DOE's mission is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. NNSA was established by Congress in 2000 as a separately organized, semiautonomous agency within DOE, responsible for the management and security of the Nation's nuclear weapons, nuclear nonproliferation, and naval reactor programs. DOE/NNSA has been working toward disposition of surplus plutonium for many years. As described in Appendix A, Section A.1, accomplishments to date include disposal of plutonium as TRU waste at WIPP; consolidation of surplus non-pit plutonium at SRS; and the ongoing construction of MFFF and the Waste Solidification Building. Surplus plutonium disposition activities are subject to the availability of funds appropriated by Congress.

Comment Summary: DOE received a number of comments on the public outreach effort. Commentors expressed dissatisfaction with notification for the public scoping meetings, numbers of scoping meeting, time allocated to comment, and scoping materials. A commentor requested that meetings be planned in collaboration with interested parties.

Response: DOE provided notice of public scoping meetings near potentially affected sites using a variety of media, including the *Federal Register*, the project website, press announcements, advertisements in local newspapers, and bulk mailings to persons on the project mailing list. DOE believes that the format of the scoping meetings and length of the public scoping period were adequate. DOE also believes that there was an appropriate number of scoping meetings, which were held in eight locations across the country. Commentors were also provided the opportunity to submit comments via mail, fax and email. Opportunities are available for individuals to be placed on the mailing list in order to receive updates and announcements related to this *SPD Supplemental EIS*. DOE has considered public comments in preparing the materials to be disseminated during the public hearings on this *Draft SPD Supplemental EIS*.

Comment Summary: A commentor requested that public hearings on this *Draft SPD Supplemental EIS* be held in Albuquerque and Santa Fe, New Mexico.

Response: DOE considered the request for meetings in Albuquerque and Santa Fe, New Mexico when planning for public hearings on this *Draft SPD Supplemental EIS*.

Comment Summary: Commentors expressed concern that the proposed use of MOX fuel is inconsistent with U.S. nonproliferation policy.

Response: The proposed use of MOX fuel is consistent with U.S. nonproliferation policy and international nonproliferation agreements. Use of MOX fuel would ensure that surplus plutonium is rendered into a used fuel form not readily usable for nuclear weapons.

A number of other issues raised by commentors are outside the scope of this *SPD Supplemental EIS*, including plutonium recycling, plutonium production, a nuclear-free world, war and nuclear weapons, mining sites that are contaminated and unsafe, the number of contractors with foreign roots involved in surplus plutonium disposition activities, concern that the surplus plutonium disposition program could be manipulated by special interests, the impacts of AREVA's operations in Europe, financial arrangements with utilities to use MOX fuel, TVA's interest in building new plants and its involvement in energy conservation and renewable energy, existing conditions at nuclear power reactors that are not a part of the proposed action, establishing a disposition path for the research reactor fuel in storage at SRS by processing through H-Canyon, compensation for local communities for extending plutonium storage at SRS, funding the complete cleanup of SRS, the presence of radioactive chemicals in the Rio Grande and Albuquerque drinking water, conduct of public meetings on the *CMRR-NF SEIS* (DOE 2011g), how the fate of waste vitrified at Hanford affects the proposed immobilization activities, support for other energy sources, emissions from coal-fired power plants, fluoride in toothpaste, and an invention to produce electricity.

1.7 Scope of this Surplus Plutonium Disposition Supplemental Environmental Impact Statement

In this *SPD Supplemental EIS*, DOE considers four action alternatives for the disposition of 13.1 metric tons (14.4 tons) of surplus plutonium and four options for pit disassembly and conversion of 34.6 metric tons (38.1 tons) (rounded to 35 metric tons [38.5 tons] in this *SPD Supplemental EIS*).[10] The alternatives involve DOE facilities at LANL, SRS, and WIPP. DOE also analyzes the potential environmental impacts of using MOX fuel in TVA's Browns Ferry and Sequoyah Nuclear Plants, as well as in one or more generic reactors. **Figure 1–8** shows the locations of major facilities that could be affected by activities analyzed in this *SPD Supplemental EIS*.[11]

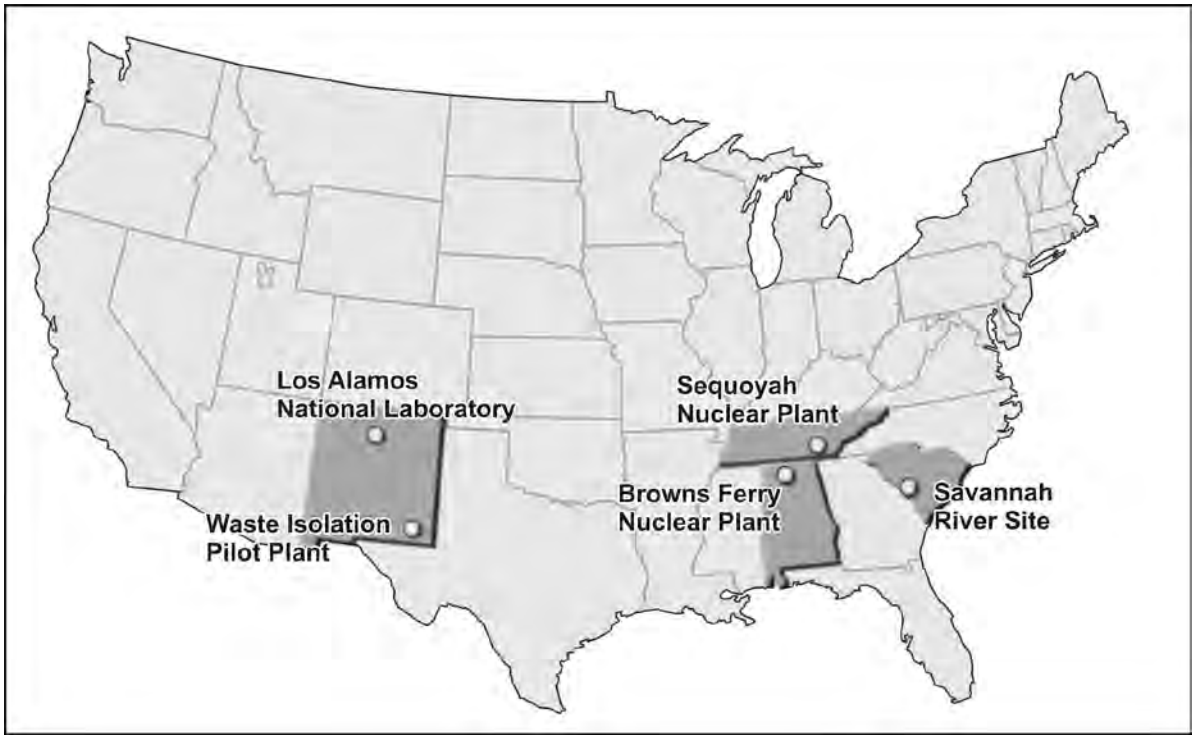

Figure 1–8 Locations of Major Facilities Evaluated in this *SPD Supplemental EIS*

Potential impacts from transporting surplus plutonium to WIPP are addressed in Chapter 4, Section 4.1.5, and Appendix E. The impacts from TRU waste disposed at WIPP are analyzed in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b) and briefly described in Appendix A, Section A.2.

The 7.1 metric tons (7.7 tons) of surplus pit plutonium addressed in this *SPD Supplemental EIS* are currently stored at Pantex near Amarillo, Texas. The continued storage of these pits is analyzed in the *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996b:3-1), which is incorporated by reference in this *SPD Supplemental EIS*. Potential impacts from transporting pits from Pantex to SRS and LANL are

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[10] *As described earlier, in two RODs for the* SPD EIS *(65 FR 1608 and 68 FR 20134), DOE decided to fabricate 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at an MFFF being constructed at SRS. DOE is not revisiting those decisions. However, because DOE is revisiting its decision to construct and operate a PDCF at SRS, the pit disassembly and conversion options analyzed in this* SPD Supplemental EIS *will apply to the 27.5 metric tons (30.3 tons) of plutonium metal that DOE has decided to fabricate into MOX fuel, as well as the 7.1 metric tons (7.7 tons) of pit plutonium for which disposition is under consideration in this* SPD Supplemental EIS.

[11] *Because reactors that may use MOX fuel could be located anywhere in the United States, they are not shown on Figure 1–8.*

addressed in Chapter 4, Section 4.1.5, and Appendix E. The impacts from continued storage of pits at Pantex are briefly described in Appendix A, Section A.2.

This supplement to the *SPD EIS* incorporates Appendix F, "Impact Assessment Methodology," of the *SPD EIS* (DOE 1999b) by reference. Rather than repeat the details of this appendix, Chapter 4 of this *SPD Supplemental EIS* refers to Appendix F and describes only variations from the impact assessment methodology outlined in the *SPD EIS*.

1.8 Decisions to be Supported by this Surplus Plutonium Disposition Supplemental Environmental Impact Statement

DOE may issue a ROD announcing its decision no sooner than 30 days after publication in the *Federal Register* of the U.S. Environmental Protection Agency's Notice of Availability for the Final *SPD Supplemental EIS*. DOE could decide, based on programmatic, engineering, facility safety, cost, and schedule information, and on the environmental impact analysis in this *SPD Supplemental EIS*, which pit disassembly and conversion option to implement and which option to implement for disposition of the additional 13.1 metric tons (14.4 tons) of surplus plutonium.

As stated in the 2010 amended NOI (75 FR 41850) and reaffirmed in the 2012 amended NOI (77 FR 1920), DOE and TVA are evaluating use of MOX fuel in up to five TVA reactors at the Sequoyah and Browns Ferry Nuclear Plants. TVA would determine whether to pursue irradiation of MOX fuel in TVA reactors and which reactors to use for this purpose.

CHAPTER 2

ALTERNATIVES FOR DISPOSITION OF SURPLUS PLUTONIUM

2. ALTERNATIVES FOR DISPOSITION OF SURPLUS PLUTONIUM

Chapter 2 of this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* describes the actions proposed by the U.S. Department of Energy for the disposition of surplus plutonium. Section 2.1 describes the options for pit disassembly and conversion. Section 2.2 describes the disposition options. Section 2.3 describes the alternatives analyzed in this *SPD Supplemental EIS*, consisting of the No Action Alternative and four action alternatives. Section 2.4 describes alternatives considered, but dismissed from detailed study and Section 2.5 describes the Preferred Alternative. The chapter concludes with a summary comparison of environmental impacts (Section 2.6). Appendix B provides a more detailed description of the facilities and operations addressed in the alternatives.

This chapter describes the alternatives the U.S. Department of Energy (DOE) has identified to disposition 13.1 metric tons (14.4 tons) of surplus plutonium—7.1 metric tons (7.8 tons) of pit plutonium and 6 metric tons (6.6 tons) of non-pit plutonium. The alternatives addressed in this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement* (*SPD Supplemental EIS)* are made up of a combination of pit disassembly and conversion options and plutonium disposition options[1] as summarized below and explained in more detail in Sections 2.1, 2.2, and 2.3.

Pit Disassembly and Conversion Options. Currently, surplus pit plutonium is not in a form suitable for disposition. Plutonium pits that must be disassembled or plutonium metal derived from pits must be converted to plutonium oxide before they can be dispositioned. In its Record of Decision (ROD) for the *Surplus Disposition Final Environmental Impact Statement (SPD EIS)* (65 *Federal Register* [FR] 1608), DOE made a decision to construct, operate, and eventually decommission a stand-alone Pit Disassembly and Conversion Facility (PDCF) at the Savannah River Site (SRS). DOE is reconsidering that decision and analyzing other pit disassembly and conversion options that would use existing facilities and a workforce experienced in these operations. As part of that reconsideration, DOE commissioned a study that examined, among other things, use of existing plutonium processing infrastructure at Los Alamos National Laboratory (LANL) and H-Canyon/HB-Line at SRS, and the delivery of plutonium metal in addition to plutonium oxide to the Mixed Oxide Fuel Fabrication Facility (MFFF) accompanied by installation of oxidation furnaces at MFFF (MPR 2011).

Based on the results of the study, DOE developed a range of pit disassembly and conversion options for analysis in this *SPD Supplemental EIS*: (1) a stand-alone PDCF at F-Area at SRS; (2) a Pit Disassembly and Conversion Project (PDC) at K-Area at SRS; (3) a pit disassembly and conversion capability in the Plutonium Facility (PF-4) in Technical Area 55 (TA-55) at LANL and metal oxidation in MFFF at SRS; and (4) a pit disassembly and conversion capability in PF-4 at LANL with the potential for pit disassembly in K-Area, conversion in H-Canyon/HB-Line, and metal oxidation in MFFF at SRS. Pit disassembly and conversion options are described in Section 2.1, and the impacts of each option are described in Appendix F of this *SPD Supplemental EIS*.

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[1] *In the 2012 Amended Notice of Intent (77 FR 1920), DOE described the four pit disassembly and conversion variants and the four plutonium disposition variants as "alternatives." This* SPD Supplemental EIS *considers these variants to be options under comprehensive surplus plutonium disposition alternatives.*

In the *SPD EIS* ROD (65 FR 1608) and amended ROD in 2003 (68 FR 20134), DOE decided to convert 34 metric tons (37.5 tons) of surplus plutonium into mixed oxide (MOX) fuel at MFFF, which is currently being constructed at SRS. DOE is not revisiting that decision. However, DOE is revisiting its PDCF decision, and a total of 35 metric tons (38.6 tons) is analyzed for all pit disassembly and conversion options. Regardless of the disposition alternative selected, pit disassembly and conversion would be necessary for 35 metric tons (38.6 tons) of surplus plutonium.

Plutonium Disposition Options. DOE evaluates the impacts of four options for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium: (1) immobilization and vitrification at the Defense Waste Processing Facility (DWPF) at SRS; (2) MOX fuel fabrication and use in domestic commercial nuclear power reactors;[2] (3) processing at H-Canyon/HB-Line and vitrification at DWPF; and (4) preparation at H-Canyon/HB-Line for disposal as transuranic (TRU) waste at the existing Waste Isolation Pilot Plant (WIPP), a deep geologic repository in southeastern New Mexico. Plutonium disposition options are described in Section 2.2, and the impacts of each option are described in Appendix G of this *SPD Supplemental EIS*.

Alternatives. DOE evaluates the impacts of four action alternatives, which are combinations of the pit disassembly and conversion options and disposition options, and a No Action Alternative. **Table 2–1** summarizes the pit disassembly and conversion and disposition pathways for the 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium. Each disposition option could be combined with different pit disassembly and conversion options (see **Table 2–2**). Each alternative also reflects the MOX disposition path previously designated for 34 metric tons (37.5 tons) of surplus plutonium (65 FR 1608 and 68 FR 20134), because that surplus plutonium is impacted by any decisions made on a pit disassembly and conversion option (also reflected in Table 2–2). The action alternatives are: (1) Immobilization to DWPF Alternative – glass can-in-canister immobilization for both surplus non-pit and disassembled and converted pit plutonium and subsequent filling of the canister with high-level radioactive waste (HLW) at DWPF; (2) MOX Fuel Alternative – fabrication of the disassembled and converted pit plutonium and much of the non-pit plutonium into MOX fuel at MFFF for use in domestic commercial nuclear power reactors to generate electricity and disposition of the surplus plutonium that is not suitable for MFFF as TRU waste at WIPP; (3) H-Canyon/HB-Line to DWPF Alternative – processing the surplus non-pit plutonium in H-Canyon/HB-Line and subsequent vitrification with HLW (in DWPF) and fabrication of the pit plutonium into MOX fuel at MFFF; and (4) WIPP Alternative – processing the surplus non-pit plutonium in H-Canyon/HB-Line for disposal as TRU waste at WIPP and fabrication of the pit plutonium into MOX fuel at MFFF. The alternatives are described in Section 2.3 and the impacts of each alternative are described in Chapter 4 of this *SPD Supplemental EIS*.

Preferred Alternative

The MOX Fuel Alternative is the U.S. Department of Energy's (DOE's) Preferred Alternative for surplus plutonium disposition. DOE's preferred option for pit disassembly and the conversion of surplus plutonium metal, regardless of its origins, to feed for the Mixed Oxide Fuel Fabrication Facility (MFFF) is to use some combination of facilities at Technical Area 55 at LANL and K-Area, H-Canyon/HB-Line, and MFFF at the Savannah River Site, rather than to construct a new stand-alone facility. This would likely require the installation of additional equipment and other modifications to some of these facilities. DOE's preferred option for disposition of surplus plutonium that is not suitable for mixed oxide (MOX) fuel fabrication is disposal at the Waste Isolation Pilot Plant.

The Tennessee Valley Authority (TVA) does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.

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[2] *The disposition of surplus plutonium (plutonium-239) can be accomplished by creating MOX assemblies that use plutonium-239 instead of uranium-235 as the fissile isotope. For example, if a fuel assembly is loaded with 4 percent plutonium-239 before it goes into the core, it would reasonably come out after two cycles of irradiation with about 1.6 percent plutonium-239 (a 60 percent reduction) and a buildup of fission products that make the material unattractive for nuclear weapons use. A non-MOX fuel assembly that starts with low-enriched uranium eventually accumulates about 1 percent plutonium and a significant fission product inventory, making the irradiated fuel unattractive for nuclear weapons use.*

Table 2–1 Pit Disassembly and Conversion and Plutonium Disposition Pathways

Plutonium Type		***Description***	***Pit Disassembly and Conversion***					***Plutonium Disposition***			
			PDCF at F-Area	***PDC at K-Area***	***H-Canyon/ HB-Line***	***Oxidation in MFFF***	***PF-4 at LANL***	***Immobilization***	***MFFF*** [a]	***H-Canyon/ HB-Line***	***WIPP*** [b]
Pits (7.1 metric tons)		Plutonium metal	X	X	X [c]	X	X	X	X		
Non-Pit (6 metric tons)	Metal and oxide (~4 metric tons)	Low levels of impurities						X	X	X	X
	Metal and oxide (~2 metric tons) [d]	Higher levels of impurities						X		X	X

LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; WIPP = Waste Isolation Pilot Plant.

[a] Only surplus plutonium that would meet the MFFF feed specification would be dispositioned as MOX fuel.

[b] Only surplus plutonium meeting the WIPP waste acceptance criteria would be disposed of at WIPP.

[c] Pits would be disassembled at PF-4 at LANL or at K-Area and plutonium would be converted to plutonium oxide at H-Canyon/HB-Line.

[d] Includes approximately 0.7 metric tons of unirradiated Fast Flux Test Facility fuel.

Note: To convert metric tons to tons, multiply by 1.1023.

Table 2–2 Relationship Between Plutonium Disposition Alternatives and Options [a]

	Options		
Alternatives	***Pit Disassembly and Conversion*** [b]	***Plutonium Disposition*** [c]	***MOX Fuel Use in Domestic Commercial Nuclear Power Reactors***
No Action [d]	PDCF at F-Area at SRS	MOX Fuel (34 metric tons)	Generic Reactors
Immobilization to DWPF [e]	PDCF at F-Area at SRS PF-4 at LANL and MFFF at SRS PF-4 at LANL, and HC/HBL [f] and MFFF at SRS	MOX Fuel (34 metric tons), Immobilization and DWPF (13.1 metric tons)	TVA Reactors Generic Reactors
MOX Fuel	PDCF at F-Area at SRS PDC at K-Area at SRS PF-4 at LANL and MFFF at SRS PF-4 at LANL, and HC/HBL [g] and MFFF at SRS	MOX Fuel (45.1 metric tons), WIPP Disposal (2 metric tons)	TVA Reactors Generic Reactors
H-Canyon/HB-Line to DWPF	PDCF at F-Area at SRS PDC at K-Area at SRS PF-4 at LANL and MFFF at SRS PF-4 at LANL, and HC/HBL [g] and MFFF at SRS	MOX Fuel (41.1 metric tons), H-Canyon/HB-Line and DWPF (6 metric tons)	TVA Reactors Generic Reactors
WIPP	PDCF at F-Area at SRS PDC at K-Area at SRS PF-4 at LANL and MFFF at SRS PF-4 at LANL, and HC/HBL [g] and MFFF at SRS	MOX Fuel (41.1 metric tons), WIPP Disposal (6 metric tons)	TVA Reactors Generic Reactors

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; LANL= Los Alamos National Laboratory; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; TVA = Tennessee Valley Authority; WIPP = Waste Isolation Pilot Plant.

[a] Principal support facilities (see Appendix H) are evaluated under all alternatives.

[b] All pit disassembly and conversion options include the production of 2 metric tons of plutonium oxide at PF-4 at LANL as documented in previous NEPA documentation and Records of Decision.

[c] All alternatives include the disposition of 34 metric tons of surplus plutonium via MOX fuel fabrication.

[d] 7.1 metric tons of pit plutonium and 6 metric tons of non-pit plutonium (13.1 metric tons total) remain in storage.

[e] PDC and immobilization are mutually exclusive because there is insufficient space at K-Area to construct and operate both capabilities.

[f] Pit disassembly could occur at PF-4 at LANL and pits disassembled at PF-4 could be sent to SRS for conversion at HC/HBL.

[g] Pit disassembly could occur at PF-4 at LANL or K-Area at SRS and conversion at HC/HBL.

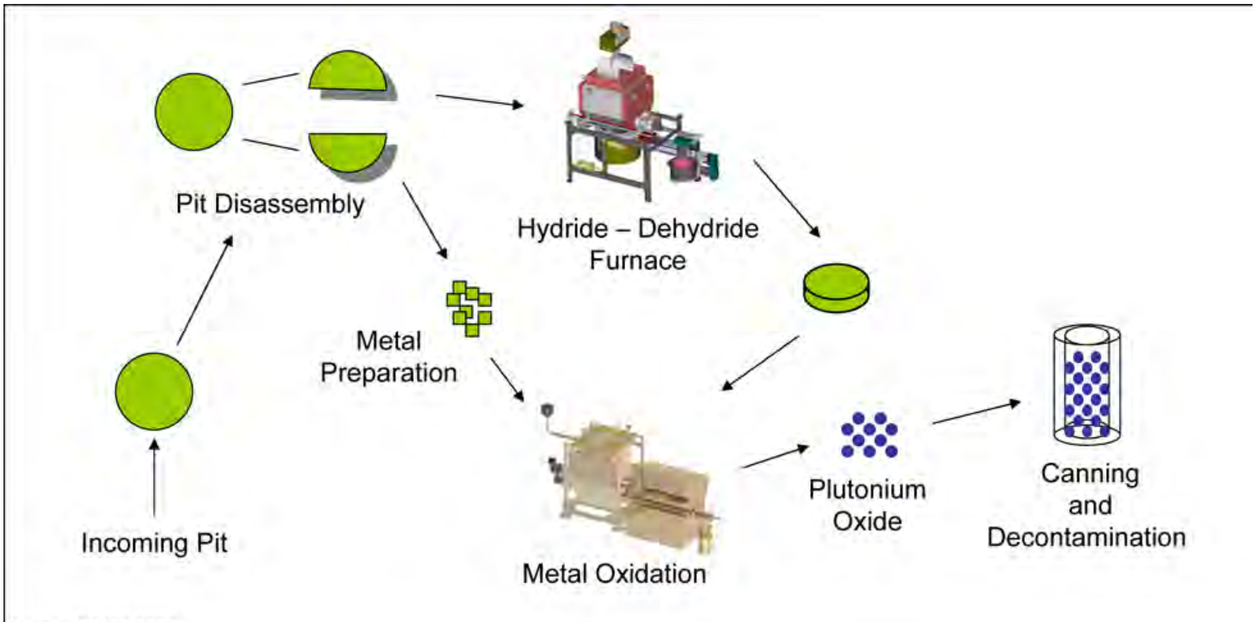
Note: To convert metric tons to tons, multiply by 1.1023.

Each pathway has minimum technical acceptance criteria for plutonium, which could preclude some volume of plutonium from being considered for disposition via that pathway. For instance, only plutonium that meets the MFFF feed specification could be dispositioned through the MOX fuel fabrication process. DOE estimates that, after processing, up to approximately 4 metric tons (4.4 tons) of the 6 metric tons (6.6 tons) of non-pit plutonium would meet the feed specification for MOX fuel fabrication, while approximately 2 metric tons (2.2 tons) would not meet the feed specification. Thus, the analysis for the MOX Fuel Alternative includes preparation of 2 metric tons (2.2 tons) for disposal at WIPP.

In this *SPD Supplemental EIS*, DOE also analyzes the potential environmental impacts of using MOX fuel in up to five reactors owned by Tennessee Valley Authority (TVA) and one or more domestic commercial nuclear power reactors.

2.1 Pit Disassembly and Conversion Options

This section describes four options for converting plutonium pits and plutonium metal to a form suitable for use with the disposition options (**Figure 2–1**). Pit disassembly and conversion capabilities could be located at SRS and LANL. Pits would be transported by the DOE/National Nuclear Security Administration (NNSA) Secure Transportation Asset operated by NNSA's Office of Secure Transportation from the Pantex Plant (Pantex), near Amarillo, Texas, to K-Area storage at SRS and/or PF-4 at LANL, depending on where the capability was ultimately located, and where they would be stored until ready for processing.



Source: NNSA 2008.

Figure 2–1 Pit Disassembly and Conversion by Oxidation

Under all of the pit disassembly and conversion options, in accordance with previous National Environmental Policy Act (NEPA) decisions (65 FR 1608; 73 FR 55833), 2 metric tons (2.2 tons) of plutonium would be disassembled and converted to plutonium oxide at PF-4 at LANL and shipped to SRS for fabrication into MOX fuel at MFFF. The Advanced Recovery and Integrated Extraction System (ARIES) line at PF-4 at LANL has been operational since 1998 and production operations are now under way to provide 2 metric tons (2.2 tons) of plutonium oxide feed for MFFF by 2018 (DOE 1998, 2008f; LANL 2012a).

2.1.1 PDCF at F-Area at SRS (PDCF)

Under this option, DOE would construct and operate a stand-alone PDCF in F-Area, as described in the *SPD EIS*, to convert plutonium pits and non-pit metal to an oxide form suitable for feed to MFFF or for immobilization.[3] PDCF would be a new facility constructed in F-Area near MFFF. Pits would be mechanically disassembled. As part of the metal preparation process, plutonium would be mechanically or chemically separated from other materials. The plutonium metal that was bonded with highly enriched uranium (HEU) or other material would be size-reduced and separated from these materials via a hydride/dehydride process. The hydride/dehydride process converts plutonium metal to plutonium hydride, which can be easily removed from other materials. The plutonium hydride can then be converted back to plutonium metal or to plutonium oxide (DOE 1999b:2-32). All mechanically or chemically separated plutonium metal would be converted to plutonium oxide via an oxidation process. The plutonium oxide would be sealed in DOE-STD-3013 cans[4] for transfer to MFFF and subsequent disposition.

2.1.2 PDC at K-Area at SRS (PDC)

Under this option, PDCF would not be constructed, and an equivalent capability, PDC, would be constructed at K-Area. PDC would be constructed largely within an existing building, with some support facilities outside the building but within K-Area. Pit disassembly and conversion would take place as described in Section 2.1.1.

2.1.3 PF-4 at LANL and MFFF at SRS (PF-4 and MFFF)

Under this option, a new stand-alone pit disassembly and conversion capability (i.e., PDCF or PDC) would not be constructed at SRS. DOE would use PF-4 at LANL for pit disassembly and conversion. The existing ARIES capability in PF-4 would be supplemented with equipment to process additional material. Pits would be disassembled and some plutonium would be converted to plutonium oxide and shipped to SRS. In addition, some of the plutonium could be shipped as metal to SRS, where it would be converted to plutonium oxide for use as feed for MOX fuel. Plutonium oxidation furnaces and associated systems and equipment would be installed in MFFF to convert the metal received from LANL to oxide suitable for subsequent fabrication into MOX fuel.[5]

2.1.4 PF-4 at LANL, and H-Canyon/HB-Line and MFFF at SRS (PF-4, H-Canyon/HB-Line, and MFFF)

Under this option, pit disassembly and conversion capabilities would be located at both LANL and SRS. Pit disassembly and conversion would take place in PF-4 at LANL as described in Section 2.1.3, and plutonium metal and plutonium oxide would be shipped to SRS as feed for either H-Canyon/HB-Line or MFFF. Oxidation furnaces and associated systems and equipment would be installed in MFFF to convert the metal received from LANL to oxide suitable for subsequent processing into MOX fuel. Pit disassembly at SRS could also take place within a glovebox in K-Area, where pits would be disassembled, resized, packaged, and transported to H-Canyon/HB-Line for preparation for ultimate disposition or to MFFF for metal oxidation and use as feed for MOX fuel. At H-Canyon, pit metal would be dissolved in existing dissolvers and sent to HB-Line for conversion to plutonium oxide for ultimate disposition.

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[3] *Only the 7.1 metric tons (7.8 tons) of pit plutonium under consideration in this* SPD Supplemental EIS *are included in the 13.1 metric tons (14.4 tons) of plutonium being considered for immobilization, given DOE's prior decision to fabricate 34 metric tons (37.5 tons) of plutonium into MOX fuel.*

[4] *Containers that meet the specifications in DOE-STD-3013, S*tabilization, Packaging, and Storage of Plutonium-Bearing Materials, *DOE-STD-3013-2102 (DOE 2012a).*

[5] *MFFF must be operated pursuant to a license from the U.S. Nuclear Regulatory Commission (NRC) to possess and use special nuclear material, and DOE's contractor has applied for the applicable license. If a plutonium oxidation capability at MFFF were selected by DOE in its ROD for this* SPD Supplemental EIS*, amendment to NRC license may be required.*

2.2 Plutonium Disposition Options

This section describes the four disposition options for the 13.1 metric tons (14.4 tons) of surplus plutonium analyzed in this *SPD Supplemental EIS*.

2.2.1 Immobilization and DWPF

Under this option, plutonium would be immobilized using a can-in-canister immobilization capability to be constructed at K-Area. Non-pit plutonium would be brought to the immobilization capability from K-Area storage, while pit plutonium in oxide form would be brought to the immobilization capability from PDCF or H-Canyon/HB-Line at SRS, or PF-4 at LANL. Clean oxides not requiring conversion would be stored pending immobilization. Metals and alloys would be converted to oxide in one of two oxidation furnaces housed within gloveboxes. The cladding from the Fast Flux Test Facility (FFTF) fuel from the Hanford Site would be removed, and the fuel pellets sorted according to fissile material content. Pellets containing plutonium or enriched uranium would be ground to an acceptable particle size for proper mixing. Plutonium oxide feed would be prepared to produce individual batches with the desired composition, and then milled to reduce the size of the oxide powder to achieve faster and more-uniform distribution during the subsequent melting process. The milled oxide would be blended with borosilicate glass frit (i.e., small glass particles) containing neutron absorbers (e.g., gadolinium, boron, hafnium). The mixture would be melted in a platinum/rhodium melter vessel and drained into stainless steel cans. The cans would be loaded into canisters and transferred to DWPF to be filled with an HLW[6]/glass mixture (DOE 1999b, 2007c; SRS 2007a, 2007b, 2007c). Filled canisters would be transported to one of the Glass Waste Storage Buildings (GWSBs), pending offsite storage or disposal. Because the cans of immobilized plutonium would displace an equivalent volume of vitrified HLW, approximately 95 additional HLW canisters would be processed at DWPF, if 13.1 metric tons (14.4 tons) of plutonium were immobilized using this approach, and stored at the GWSBs. The immobilization capability and PDC (Section 2.1.2) are mutually exclusive because there is insufficient space at K-Area to construct and operate both capabilities.

2.2.2 MOX Fuel

Under this option, plutonium would be fabricated into MOX fuel at MFFF, which is currently under construction at F-Area (DOE 2003c). Plutonium oxide from pit disassembly and conversion and also from processing some of the non-pit plutonium could serve as feed for MFFF. DOE estimates that, after processing, up to approximately 4 metric tons (4.4 tons) of the 6 metric tons (6.6 tons) of non-pit plutonium would meet the feed specification for MOX fuel fabrication. This non-pit plutonium would be processed at H-Canyon/HB-Line. As described under the pit disassembly and conversion options in Section 2.1, plutonium would be shipped from PDCF, PDC, or H-Canyon/HB-Line at SRS, or PF-4 at LANL. Some of the plutonium from PF-4 could be shipped as plutonium metal and converted to plutonium oxide at MFFF or H-Canyon/HB-Line.

The MOX fuel would be used in domestic commercial nuclear power reactors as previously decided by DOE in the *SPD EIS* ROD (65 FR 1608).[7] Appendix I, Section I.1, of this *SPD Supplemental EIS* includes an impact analysis of using MOX fuel in up to five reactors at TVA's Browns Ferry and Sequoyah Nuclear Plants. To support future DOE decisions involving domestic utilities that may be

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[6] *HLW is used to surround the plutonium to meet the Spent Fuel Standard and thereby provide a proliferation barrier. Under the Spent Fuel Standard, the surplus weapons-usable plutonium would be made as inaccessible and unattractive for weapons use as the much larger and growing quantity of plutonium that exists in used nuclear fuel (also known as spent nuclear fuel) from commercial nuclear power reactors.*

[7] *The* SPD EIS *ROD (65 FR 1608) identified Duke Energy's McGuire and Catawba Nuclear Plants, along with Virginia Power's North Anna Nuclear Plant, as reactors that would use MOX fuel. In April 2000, Virginia Power made a business decision to withdraw from the MOX fuel program. The subcontract with Duke Energy expired and DOE's contractor (Shaw AREVA MOX Services, LLC) currently does not have a subcontract in place with a utility to use this fuel. DOE intends to have a fuel sales subcontract in place with one or more utilities prior to producing MOX fuel assemblies.*

interested in using MOX fuel in one or more of their reactors, a generic reactor impact analysis has been included in Section I.2. Before MOX fuel could be used in any reactor in the United States, the utility operating the reactor would be required to obtain a license amendment from the U.S. Nuclear Regulatory Commission (NRC) in accordance with Title 10 of the *Code of Federal Regulations* (CFR), Parts 50 or 52 (10 CFR Parts 50 or 52).

When the MOX fuel completes its time within the reactor core, it would be withdrawn from the reactor in accordance with the plant's standard refueling procedures and placed in the plant's used fuel pool for cooling among other used fuel (also known as spent fuel). MOX used fuel has a slightly greater heat content than low-enriched uranium (LEU) used fuel, but this would have no meaningful impacts on fuel pool operation. No major changes are expected in the plant's used fuel storage plans to accommodate the MOX used fuel.

2.2.3 H-Canyon/HB-Line and DWPF

Under this option, non-pit plutonium would be brought to H-Canyon/HB-Line from K-Area storage. Plutonium processing in H-Canyon/HB-Line would start with dissolution of the majority of the material that is in oxide form in HB-Line, and dissolution of most of the metals in H-Canyon. Unirradiated FFTF fuel would be repackaged into carbon steel containers suitable for dissolution in H-Canyon. The dissolved solutions would then be transferred to the separations process, during which any uranium present in the material would be recovered and ultimately sent to the Y-12 National Security Complex (Y-12) in Oak Ridge, Tennessee, for disposition. The plutonium solutions from H-Canyon/HB-Line would be transferred to the liquid radioactive waste tank farm where it would be combined with HLW pending vitrification at DWPF. Canister-filling operations in DWPF and storage in the GWSBs for these solutions would be similar to the operations described in Section 2.2.1.

2.2.4 WIPP Disposal

Under this option, non-pit plutonium would be processed through H-Canyon/HB-Line for WIPP disposal. DOE-STD-3013 containers would be shipped to HB-Line, where they would be cut open in an existing glovebox. Metals would be converted to oxide using an existing or new furnace. Oxide would be repackaged into suitable cans, mixed/blended with inert material, and loaded into pipe overpack containers (POCs). The inert material is added to reduce the plutonium content to less than 10 percent by weight and inhibit plutonium material recovery and could include dry mixtures of commercially available materials. The loaded POCs would be transferred to E-Area, where WIPP waste characterization activities would be performed: nondestructive assay, digital radiography, and headspace gas sampling. Once the POCs have successfully passed the characterization process and meet WIPP waste acceptance criteria, they would be shipped to WIPP in Transuranic Package Transporter Model 2 (TRUPACT-II) or HalfPACT shipping containers.

If the unirradiated FFTF fuel cannot be disposed of by direct disposal at WIPP, the FFTF fuel would be disassembled and packaged for disposal at WIPP. H-Canyon could be used to disassemble the unirradiated FFTF fuel bundles, remove the pellets from the fuel pins and package the pellets into suitable containers. HB-Line could prepare, mix/blend the fuel pellet material with inert material and package for shipment to WIPP. Some modifications to H-Canyon and HB-Line might be required.

2.3 Alternatives

This section describes the No Action Alternative and four action alternatives, which are combinations of the pit disassembly and conversion options and plutonium disposition options described above. Each alternative also reflects the MOX disposition path previously designated for 34 metric tons (37.5 tons) of surplus plutonium (65 FR 1608 and 68 FR 20134), because that surplus plutonium is affected by any decisions made regarding a pit disassembly and conversion option. In accordance with previous decisions

(65 FR 1608; 73 FR 55833), 2 metric tons (2.2 tons) of plutonium would be converted to plutonium oxide at the ARIES line at PF-4 at LANL and shipped to SRS for fabrication into MOX fuel at MFFF.

Appendix B provides a more detailed description of the facilities and operations addressed in the alternatives. Table B–2 lists the durations of the construction and operations periods for each facility under each alternative. Table B–3 provides the plutonium processing throughput for each facility.

2.3.1 No Action Alternative

In its 2000 ROD (65 FR 1608) and 2003 amended ROD (68 FR 20134) for the *SPD EIS*, DOE decided to fabricate 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel for use in domestic commercial nuclear power reactors and has begun to implement the decision. DOE is not revisiting that decision.

Since the issuance of the *SPD EIS*, there have been changes in the MOX fuel program. The 1999 *SPD EIS* addressed the potential environmental impacts of using MOX fuel in Duke Energy and Virginia Power nuclear reactors (Section 1.6, lines 233–243). Neither company is part of the MOX fuel program at this time, and the No Action Alternative for this *SPD Supplemental EIS* addresses the use of MOX fuel at generic reactor sites.

Under the No Action Alternative for this *SPD Supplemental EIS*, surplus plutonium would remain in storage at various DOE sites. 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 SRS, consistent with the 2002 amended ROD (67 FR 19432); the *Supplement Analysis, Storage of Surplus Plutonium Materials at the Savannah River Site* (DOE/EIS-0229-SA-4) (DOE 2007d); and an amended ROD issued in 2007 (72 FR 51807). The No Action Alternative for this *SPD Supplemental EIS* addresses continued storage of surplus plutonium at SRS.

Under the No Action Alternative, the 13.1 metric tons (14.4 tons) of surplus plutonium analyzed in this *SPD Supplemental EIS* would be managed through the approaches illustrated in **Figure 2–2**. Six metric tons (6.6 tons) of surplus non-pit plutonium would continue to be stored at K-Area at SRS, consistent with previous NEPA analyses and decisions (DOE 2002a; 67 FR 19432). The 7.1 metric tons (7.8 tons) of the 9 metric tons (9.9 tons) of pit plutonium declared excess in 2007 (see Chapter 1, Figure 1–3) would remain in storage at Pantex.[8] DOE would also disposition as MOX fuel only 34 metric tons (37.5 tons) of surplus plutonium in accordance with previous decisions. Pits would be disassembled and the disassembled pits and other plutonium metal would be converted to plutonium oxide at PDCF as described in Section 2.1.1. The 34 metric tons (37.5 tons) of plutonium would be fabricated into MOX fuel at MFFF, as described in Section 2.2.2, for use at commercial nuclear power reactors; under the No Action Alternative, TVA would not receive MOX fuel from DOE.

The No Action Alternative would not satisfy the purpose and need for agency action because no disposition pathway would be selected for 13.1 metric tons (14.4 tons) of surplus plutonium. Although this surplus plutonium would continue to be stored safely, disposition of this portion of the U.S. surplus plutonium inventory would not occur. In addition, the No Action Alternative would not be consistent with DOE's *Plan for Alternative Disposition of Defense Plutonium and Defense Plutonium Materials That Were Destined for the Cancelled Plutonium Immobilization Plant* (DOE 2007c) under Section 3155 of the National Defense Authorization Act of 2002 (Public Law 107-107). This plan documented DOE's approach for disposition and removal from South Carolina of surplus weapons-usable plutonium located at, or transferred to, SRS that had been previously destined for a cancelled immobilization facility.

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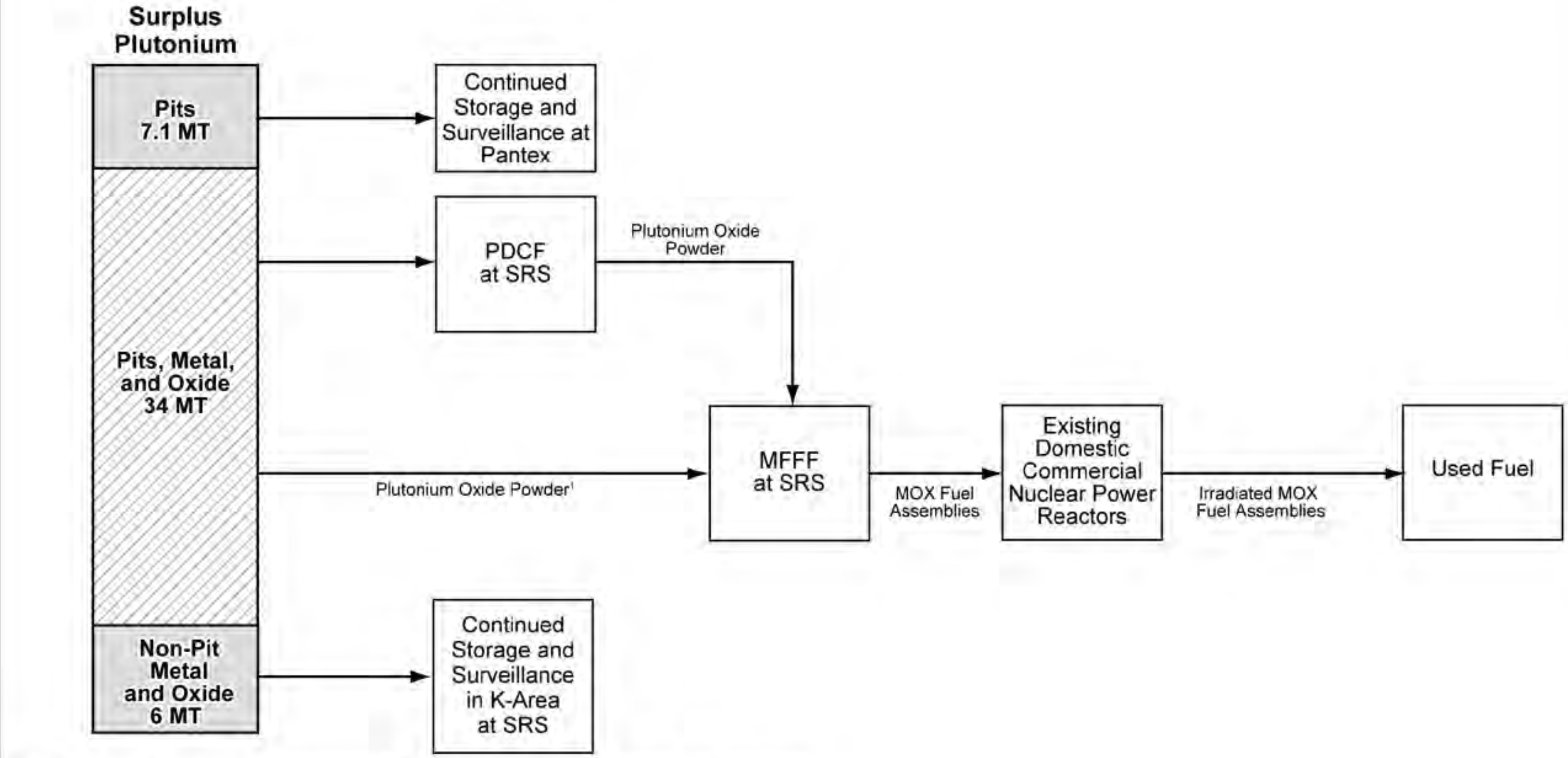
[8] *The remaining 1.9 metric tons (2.1 tons) of pit plutonium declared excess in 2007 is included in the 34 metric tons (37.5 tons) already designated for fabrication into MOX fuel at MFFF (see Chapter 1, Section 1.5).*



▨ Materials already covered by previous National Environmental Policy Act Records of Decision.

▒ Surplus materials analyzed in this SPD Supplemental EIS.

MFFF = Mixed Oxide Fuel Fabrication Facility
MOX = mixed oxide
MT = metric tons
PDCF = Pit Disassembly and Conversion Facility
SRS = Savannah River Site

[1] Includes plutonium oxide prepared at Los Alamos National Laboratory and H-Canyon/HB-Line at SRS.

Figure 2–2 No Action Alternative

2.3.2 Immobilization to DWPF Alternative

This alternative evaluates disposition of 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium by immobilization and vitrification with HLW while, as under the No Action Alternative, 34 metric tons (37.5 tons) of surplus plutonium would be dispositioned as MOX fuel. Under the Immobilization to DWPF Alternative, the surplus plutonium addressed in this *SPD Supplemental EIS* would be dispositioned through the approaches illustrated in **Figure 2–3**. The 7.1 metric tons (7.8 tons) of pit plutonium and 6 metric tons (6.6 tons) of non-pit plutonium would be immobilized as described in Section 2.2.1. The immobilization capability would operate for 10 years. The 34 metric tons (37.5 tons) addressed in previous decisions would be fabricated into MOX fuel and dispositioned as discussed in Section 2.2.2.

Plutonium immobilization would need to be completed by 2026 to avoid affecting the current DWPF schedule for HLW vitrification; the schedule is determined by compliance with applicable permits and consent orders (SRR 2010). Based on the proposed rates and schedule for treatment of HLW at DWPF, there would be insufficient HLW with the characteristics needed to enable vitrification of more than approximately 6 metric tons (6.6 tons) of surplus plutonium. Under these conditions, it is possible that the remaining approximately 7.1 metric tons (7.8 tons) of plutonium could not be immobilized and vitrified under this alternative, but would need to be dispositioned by another method.

As noted in Section 2.2.1, the immobilization capability and PDC at K-Area (Section 2.1.2) are mutually exclusive because there is insufficient space at K-Area to construct and operate both capabilities. Therefore, only three options for pit disassembly and conversion under the Immobilization to DWPF Alternative would be possible, PDCF, PF-4 and MFFF, or PF-4, H-Canyon/HB-Line and MFFF. These options are discussed in Section 2.1.

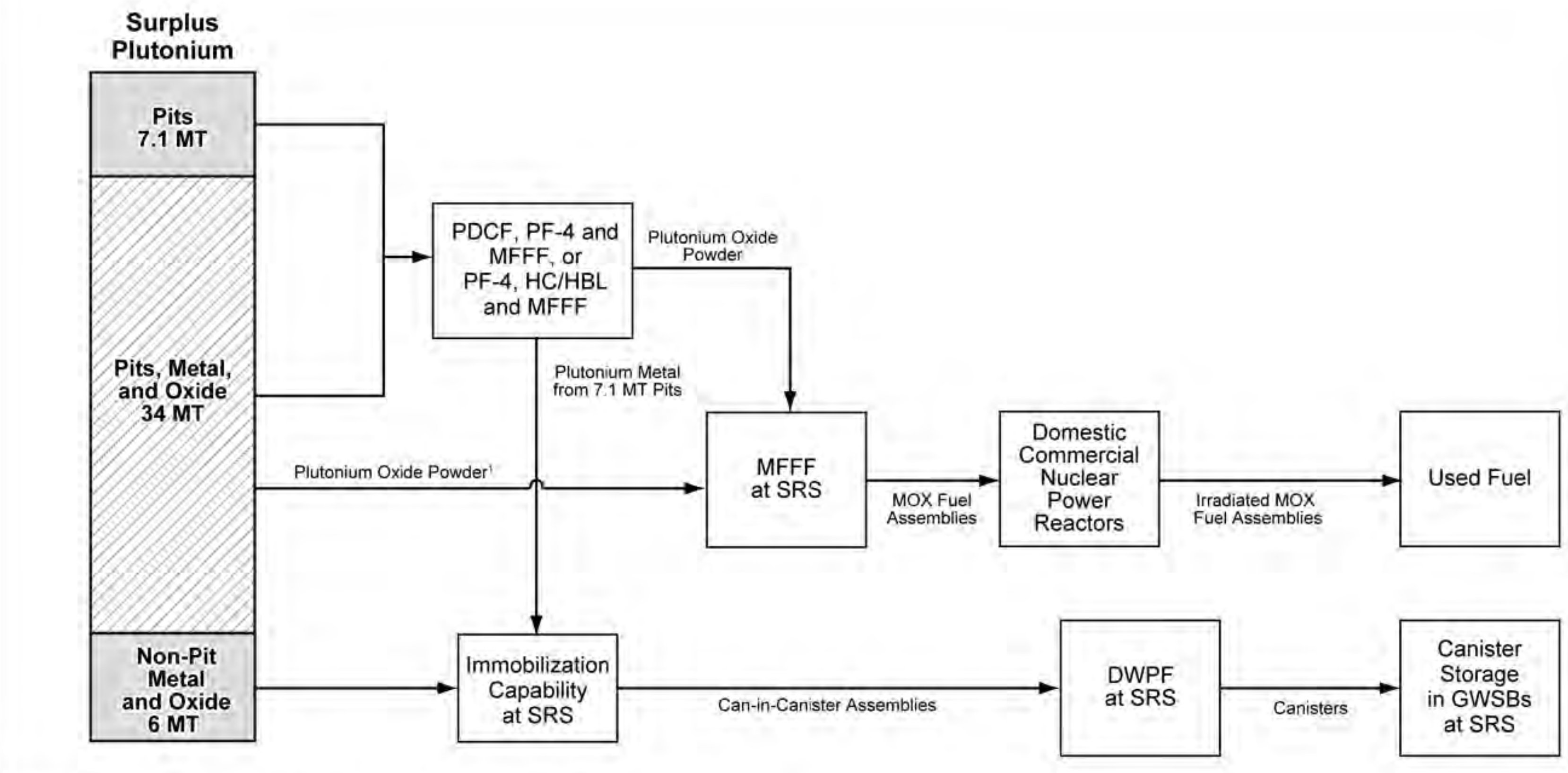
2.3.3 MOX Fuel Alternative

The MOX Fuel Alternative would maximize the disposition of surplus plutonium as MOX fuel. Under this alternative, surplus plutonium would be dispositioned using the approaches illustrated in **Figure 2–4**.

The 7.1 metric tons (7.8 tons) of surplus pit plutonium and 4 metric tons (4.4 tons) of surplus non-pit plutonium, along with the 34 metric tons (37.5 tons) of surplus plutonium addressed in previous decisions (a total of 45.1 metric tons [49.7 tons]), would be fabricated into MOX fuel at MFFF, as described in Section 2.2.2. Preparation of the 2 metric tons (2.2 tons) of non-pit plutonium that could not meet the criteria for MOX feed would be processed and packaged at H-Canyon/HB-Line for disposal as TRU waste at WIPP in accordance with the WIPP waste acceptance criteria, as described in Section 2.2.4. The four options for pit disassembly and conversion under the MOX Fuel Alternative are discussed in Section 2.1.

2.3.4 H-Canyon/HB-Line to DWPF Alternative

The H-Canyon/HB-Line to DWPF Alternative evaluates disposition of 6 metric tons (6.6 tons) of surplus non-pit plutonium through H-Canyon/HB-Line and disposition of 7.1 metric tons (7.8 tons) of surplus pit plutonium as MOX fuel using the approaches illustrated in **Figure 2–5**. The 6 metric tons (6.6 tons) of surplus non-pit plutonium would be processed in H-Canyon/HB-Line with subsequent vitrification with HLW at DWPF, as described in Section 2.2.3. Pit plutonium is not considered for dissolution and vitrification with HLW because there would be insufficient HLW with the characteristics needed to vitrify more than approximately 6 metric tons (6.6 tons) of surplus plutonium. The 7.1 metric tons (7.8 tons) of surplus pit plutonium, along with the 34 metric tons (37.5 tons) of surplus plutonium addressed in previous decisions (a total of 41.1 metric tons [45.3 tons]), would be fabricated into MOX fuel at MFFF with subsequent irradiation in domestic commercial nuclear power reactors, as described in Section 2.2.2. The four options for pit disassembly and conversion under this alternative would be the same as those under the MOX Fuel Alternative.



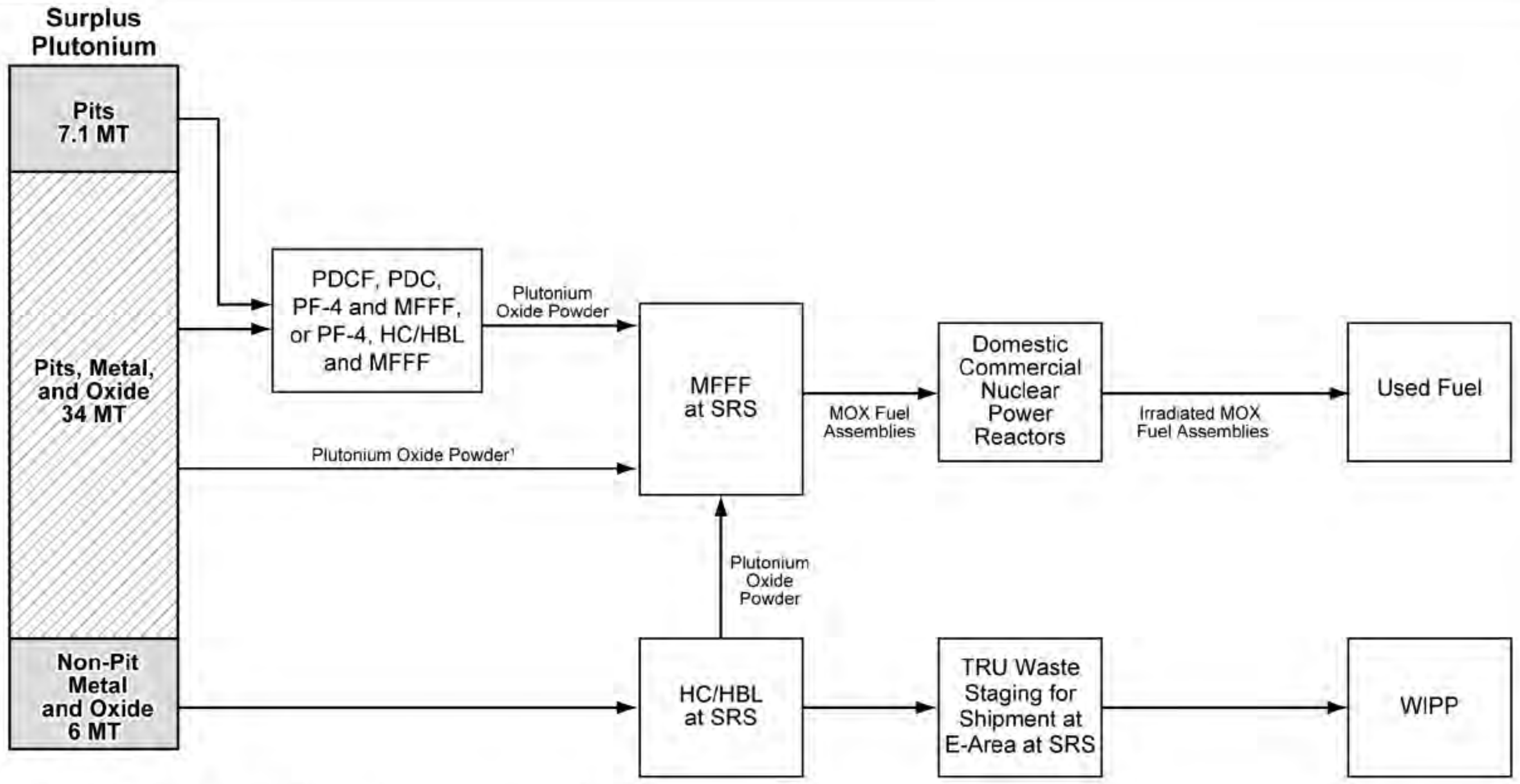
▨ Materials already covered by previous National Environmental Policy Act Records of Decision.

■ Surplus materials analyzed in this SPD Supplemental EIS.

DWPF = Defense Waste Processing Facility
GWSB = Glass Waste Storage Building
HC/HBL = H-Canyon/HB-Line
LANL = Los Alamos National Laboratory
MFFF = Mixed Oxide Fuel Fabrication Facility
MOX = mixed oxide
MT = metric tons
PDCF = Pit Disassembly and Conversion Facility
PF-4 = Plutonium Facility
SRS = Savannah River Site

[1] Includes plutonium oxide prepared at Los Alamos National Laboratory and H-Canyon/HB-Line at SRS.

Figure 2–3 Immobilization to DWPF Alternative



▨ Materials already covered by previous National Environmental Policy Act Records of Decision

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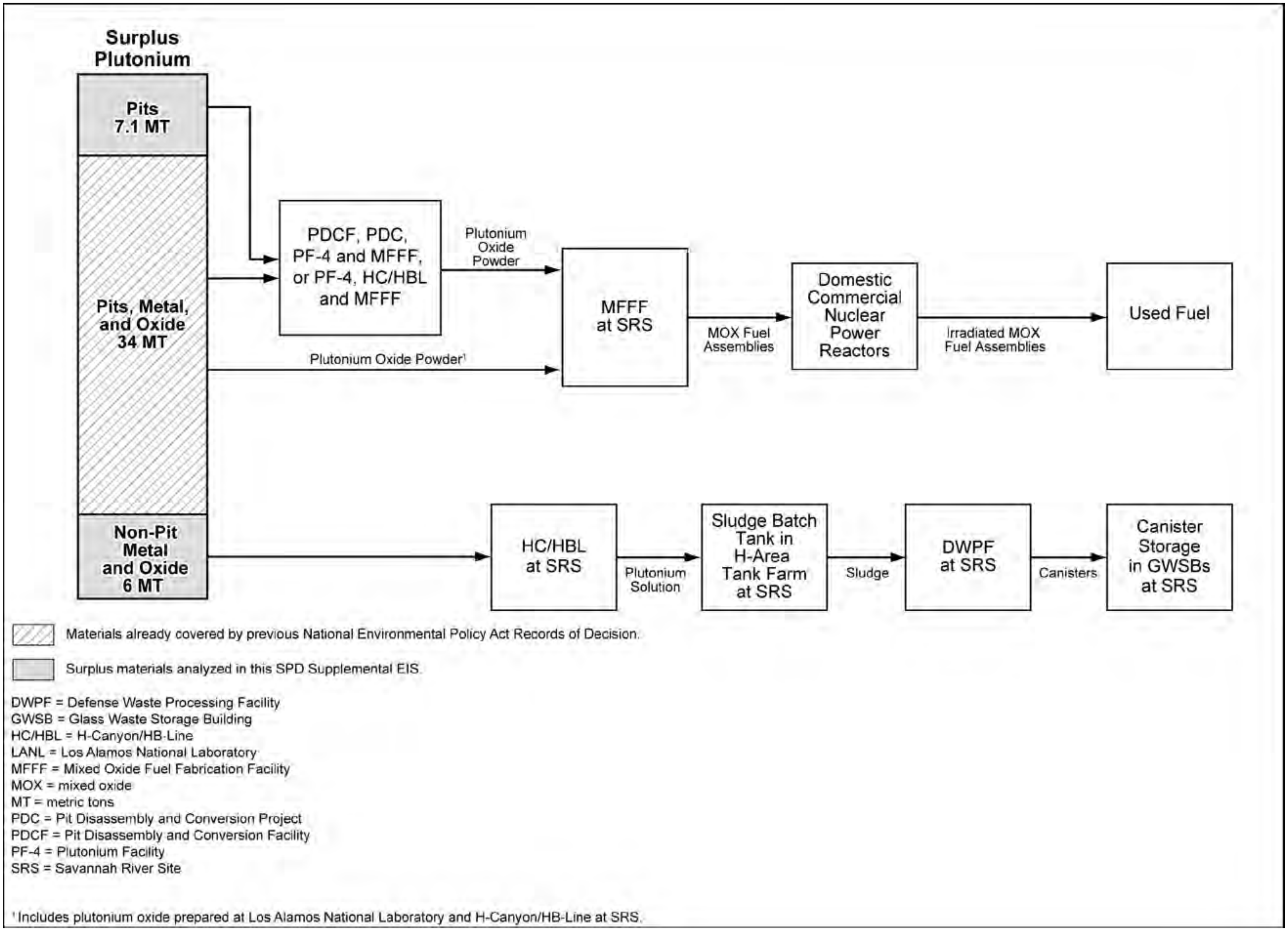
HC/HBL = H-Canyon/HB-Line
LANL = Los Alamos National Laboratory
MFFF = Mixed Oxide Fuel Fabrication Facility
MOX = mixed oxide
MT = metric tons
PDC = Pit Disassembly and Conversion Project
PDCF = Pit Disassembly and Conversion Facility
PF-4 = Plutonium Facility
SRS = Savannah River Site
TRU = transuranic
WIPP = Waste Isolation Pilot Plant

[1] Includes plutonium oxide prepared at Los Alamos National Laboratory and H-Canyon/HB-Line at SRS.

Figure 2–4 MOX Fuel Alternative



▨ Materials already covered by previous National Environmental Policy Act Records of Decision.

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DWPF = Defense Waste Processing Facility
GWSB = Glass Waste Storage Building
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PDC = Pit Disassembly and Conversion Project
PDCF = Pit Disassembly and Conversion Facility
PF-4 = Plutonium Facility
SRS = Savannah River Site

[1] Includes plutonium oxide prepared at Los Alamos National Laboratory and H-Canyon/HB-Line at SRS.

Figure 2–5 H-Canyon/HB-Line to DWPF Alternative

2.3.5 WIPP Alternative

The WIPP Alternative evaluates disposition of 6 metric tons (6.6 tons) surplus non-pit plutonium at WIPP and disposition of 7.1 metric tons (7.8 tons) of surplus pit plutonium as MOX fuel using the approaches illustrated in **Figure 2–6**. The 6 metric tons (6.6 tons) of surplus non-pit plutonium would be processed at H-Canyon/HB-Line such that they would meet the WIPP waste acceptance criteria and could be disposed of at WIPP as TRU waste, as described in Section 2.2.4. The 7.1 metric tons (7.8 tons) of surplus pit plutonium, along with the 34 metric tons (37.5 tons) of surplus plutonium addressed in previous decisions (a total of 41.1 metric tons [45.3 tons]), would be fabricated into MOX fuel at MFFF with subsequent irradiation in domestic commercial nuclear power reactors, as described in Section 2.2.2. The four options for pit disassembly and conversion under this alternative would be the same as those under the MOX Fuel Alternative.

2.4 Alternatives Considered but Dismissed from Detailed Study

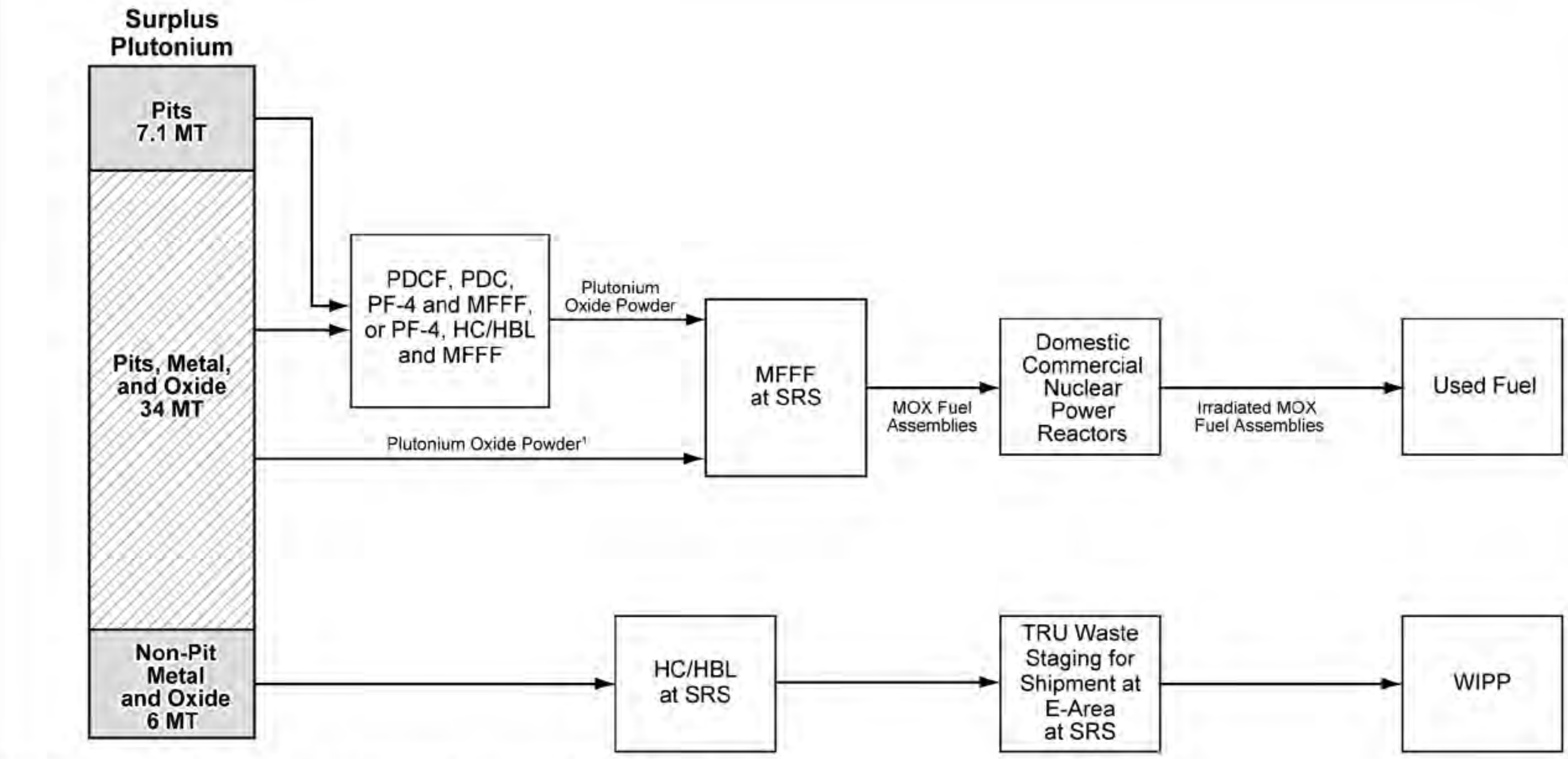
The *Storage and Disposition PEIS* (DOE 1996c) and the *SPD EIS* (DOE 1999b) considered numerous alternatives for surplus plutonium disposition, including disposal of the entire surplus plutonium inventory (which at the time was 50 metric tons [55 tons]) at WIPP, immobilization of the entire surplus plutonium inventory, and pit disassembly and conversion at Pantex.

The direct disposal of 50 metric tons (55 tons) of surplus plutonium was eliminated from further analysis in the *Storage and Disposition PEIS* because it would exceed the capacity of WIPP when added to DOE's inventory of TRU waste (DOE 1996c:2-13). The disposal at WIPP of up to 6 metric tons (6.6 tons) of non-pit plutonium, which is approximately 12 percent of the amount considered in the *Storage and Disposition PEIS*, would not exceed WIPP's capacity and, therefore, was considered to be a reasonable alternative in this *SPD Supplemental EIS*.

Immobilization of the entire surplus plutonium inventory was evaluated in the *SPD EIS* (DOE 1999b), and DOE selected the MOX approach for most of the material declared surplus for reasons set forth in the *SPD EIS* ROD (65 FR 1608). DOE is not revisiting the decisions made in that ROD, or in the 2002 and 2003 amended RODs (67 FR 19432 and 68 FR 20134), other than the decision to construct and operate a stand-alone PDCF.

Pit disassembly and conversion at Pantex was evaluated in the *SPD EIS* (DOE 1999b), and DOE selected PDCF at SRS for reasons set forth in the *SPD EIS* ROD (65 FR 1608). Although DOE is reconsidering the decision to build a PDCF at SRS and is looking at other options including using PF-4 at LANL, DOE is not reconsidering pit disassembly and conversion at Pantex for the reasons set forth in the *SPD EIS* ROD.

The following alternatives were considered for evaluation, but dismissed from detailed study in this *SPD Supplemental EIS*: (1) The ceramic can-in canister approach to immobilization; (2) disposal of the entire 13.1 metric tons (14.4 tons) of surplus plutonium using the MOX fuel approach; (3) disposal of the entire 13.1 metric tons (14.4 tons) of surplus plutonium using H-Canyon/HB-Line and DWPF, (4) disposal of the entire 13.1 metric tons (14.4 tons) of surplus plutonium at WIPP. These alternatives are described in the following sections.



▨ Materials already covered by previous National Environmental Policy Act Records of Decision.

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HC/HBL = H-Canyon/HB-Line
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MFFF = Mixed Oxide Fuel Fabrication Facility
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PDCF = Pit Disassembly and Conversion Facility
PF-4 = Plutonium Facility
SRS = Savannah River Site
TRU = transuranic
WIPP = Waste Isolation Pilot Plant

[1] Includes plutonium oxide prepared at Los Alamos National Laboratory and H-Canyon/HB-Line at SRS.

Figure 2–6 WIPP Alternative

2.4.1 Ceramic Can-in-Canister Approach

DOE considered the ceramic can-in-canister approach to immobilization for evaluation, but dismissed it from detailed study in this *SPD Supplemental EIS.* In the *SPD EIS*, DOE evaluated both ceramic and glass waste form approaches to can-in-canister immobilization, and discussed the potential environmental impacts associated with each (DOE 1999b). In Chapter 4, Section 4.29, of the *SPD EIS*, no substantial differences were identified between these two technology variants in terms of the expected environmental impacts on air quality, waste management, human health risk, facility accidents, facility resource requirements, intersite transportation, and environmental justice. Subsequently, in the *SPD EIS* ROD (65 FR 1608), DOE selected ceramic as the preferred can-in-canister immobilization waste form, and the surplus plutonium immobilization program proceeded based on a ceramic process. This decision was based in part on DOE's expectation that the ceramic can-in-canister approach could provide: (1) better performance in a geologic repository due to the ceramic form's projected higher durability under repository conditions and lower potential for long-term criticality, and (2) greater proliferation resistance than the glass can-in-canister approach because recovery of plutonium from the ceramic form would require a more chemically complex process than what had been developed up to that time (DOE 1999b:1-11).

In 2002, however, DOE made the decision to cancel the surplus plutonium immobilization program due to budgetary constraints (67 FR 19432). As a result of this action, work supporting further refinement of the ceramic technology for plutonium disposition was stopped. The United States has not focused policy direction on development of the ceramic process or waste form qualification since that time, and concomitantly, DOE infrastructure and expertise associated with this technology has not evolved or matured.

In contrast, DOE has maintained research, development, and production infrastructure capabilities for glass waste forms. In 2003, work began on qualifying the waste form for inclusion in the Yucca Mountain Geologic Repository license application pursuant to 10 CFR Part 63. Understanding of the glass approach has also benefited from parallel work to develop or qualify similar processes for other applications, including the immobilization of HLW.

Studies have shown that neither waste form has significant advantages over the other in terms of resistance to theft or diversion; resistance to retrieval, extraction, and reuse; technical viability; environment, safety, and health; cost effectiveness; or timeliness. The choice between ceramic and glass immobilized waste forms would also not significantly affect surplus plutonium disposition, or other nonproliferation missions (DOE 2008a:447-453). Therefore, for analysis purposes in this *SPD Supplemental EIS*, the glass can-in-canister approach is evaluated as the representative case for both technologies, and the ceramic can-in-canister technology variant is not evaluated.

2.4.2 Disposition of 13.1 Metric Tons (14.4 tons) of Surplus Plutonium using the MOX Fuel Approach

Under the MOX Fuel Alternative, DOE is considering disposition of the entire 7.1 metric tons (7.8 tons) of surplus plutonium pits and up to 4 metric tons (4.4 tons) of surplus non-pit plutonium using the MOX fuel approach. Approximately 2 metric tons (2.2 tons) of the surplus non-pit plutonium contains impure metals and oxides that do not meet the acceptance criteria for feed to MFFF, even after consideration of modifications that would allow for processing of additional alternate feedstock. The additional 2 metric tons (2.2 tons) of the surplus non-pit plutonium is not considered to be viable for processing at MFFF and, therefore, an alternative that considers the disposal of entire surplus plutonium inventory using the MOX fuel approach was not evaluated.

2.4.3 Disposition of 13.1 Metric Tons (14.4 tons) of Surplus Plutonium using H-Canyon/HB-Line and the DWPF

Under the H-Canyon/HB-Line to DWPF Alternative, DOE is considering disposition of the 6 metric tons (6.6 tons) of surplus non-pit plutonium using H-Canyon/HB-Line and vitrification at DWPF. Disposition of the 7.1 metric tons (7.8 tons) of surplus plutonium pits using H-Canyon/HB-Line is not being considered. Based on planned rates, loading and schedule for treatment of waste at DWPF, there would be insufficient HLW with the characteristics needed to vitrify more than approximately 6 metric tons (6.6 tons) of surplus plutonium. In addition, concerns about criticality would limit the loading in the waste storage tanks and would not support vitrification of 13.1 metric tons (14.4) tons of plutonium. Therefore, an alternative that evaluates the disposition of the entire 13.1 metric tons (14.4 tons) of surplus plutonium inventory using H-Canyon/HB-Line and DWPF was not evaluated.

2.4.4 Disposal of 13.1 Metric Tons (14.4 tons) of Surplus Plutonium at the Waste Isolation Pilot Plant

Under the WIPP Alternative, DOE is considering disposal of the 6 metric tons (6.6 tons) of surplus non-pit plutonium at WIPP. Disposal of the 7.1 metric tons (7.8 tons) of surplus plutonium pits at WIPP is not being considered. Based on the proposed rates and schedules for disposal of waste at WIPP, disposal of an additional 7.1 metric tons (7.8 tons) of plutonium pits would significantly increase the volume of TRU waste generated and exceed the remaining WIPP capacity. Therefore, an alternative that evaluates the disposal of the entire 13.1 metric tons (14.4 tons) of surplus plutonium inventory at WIPP was not evaluated.

2.5 Preferred Alternative

The MOX Fuel Alternative is DOE's Preferred Alternative for surplus plutonium disposition. DOE's preferred option for pit disassembly and the conversion of surplus plutonium metal, regardless of its origins, to feed for MFFF is to use some combination of facilities at TA-55 at LANL and K-Area, H-Canyon/HB-Line, and MFFF at SRS, rather than to construct a new stand-alone facility. This would likely require the installation of additional equipment and other modifications to some of these facilities. DOE's preferred option for disposition of surplus non-pit plutonium that is not suitable for MOX fuel fabrication is disposal at WIPP.

TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.

2.6 Summary of Environmental Consequences

This section summarizes the impact analyses for the alternatives evaluated in this *SPD Supplemental EIS*. Section 2.6.1 summarizes the potential consequences of each alternative by resource area at SRS and LANL, as well as potential domestic commercial nuclear power reactor sites. Section 2.6.2 is a summary of the cumulative impacts analysis that considers the consequences of the proposed alternatives in the context of other past, present, and reasonably foreseeable future actions.

2.6.1 Comparison of Potential Consequences of Alternatives

Table 2–3 summarizes the potential impacts of the alternatives evaluated in this *SPD Supplemental EIS* on activities at SRS and LANL. Impacts on key resource areas at these DOE sites (i.e., air quality, human health, socioeconomics, waste management, transportation, and environmental justice) are discussed in the following paragraphs. The remaining resource areas (i.e., land resources, geology and soils, water resources, noise, ecological resources, cultural resources, and infrastructure) are likely to experience minimal or no impacts regardless of the alternative being considered and, therefore, are analyzed in less detail.

Normal operation of reactors using a partial MOX fuel core is not expected to change substantively from operations using a full LEU fuel core. Construction related to a reactor's ability to use MOX fuel is expected to be minimal and would not substantively add to the environmental impacts currently associated with these plants. The environmental analysis performed in support of this *SPD Supplemental EIS* included both boiling water and pressurized water reactors. The impacts of operating these reactors using a partial MOX fuel core are not expected to change from the impacts currently being realized during normal operations of the reactors using full LEU fuel cores. The areas where some minor differences are noted are worker dose, reactor accidents, used fuel generation, and transportation. Given the small changes, if any, in the impacts associated with the use of a partial MOX fuel core, the results are discussed in the following paragraphs and are not included in Table 2–3.

Air Quality. Particulate matter from soil disturbance and criteria and toxic pollutants from construction equipment could be emitted during construction and modification activities under all alternatives. Alternatives with modifications to existing facilities at SRS and LANL would result in lower levels of criteria and toxic pollutants than alternatives that include construction of new facilities. Under all alternatives, air pollutant concentrations at site boundaries from construction activities would not exceed air quality standards. The site boundary concentrations from operation of the plutonium disposition facilities under each alternative also would not exceed ambient air quality standards at either site. Actual emissions from currently operating facilities are less than the permitted emission levels, and the proposed activities would result in site boundary concentrations at SRS and LANL that are lower than the ambient air quality standards. Generally, the incremental impacts from implementing these *SPD Supplemental EIS* alternatives would be minimal.

Greenhouse gases emitted by operations of the proposed surplus plutonium disposition facilities at SRS and LANL would add a relatively small increment to emissions of these gases in the United States and the world. Overall greenhouse gas emissions in the United States during 2009 totaled about 6.8 billion metric tons (7.5 billion tons) of carbon dioxide equivalent[9] (EPA 2012). By way of comparison, increases in annual operational emissions of greenhouse gases from the proposed surplus plutonium disposition facilities at SRS and LANL (up to 170,000 metric tons [190,000 tons]) would equal about 0.003 percent of the United States' total emissions in 2009. However, emissions from the proposed surplus plutonium disposition facilities at SRS and LANL would contribute incrementally to climate change impacts. At present, there is no methodology that would allow DOE to estimate the specific impacts this increment of climate change would produce in the vicinity of the facility or elsewhere.

Operations at the reactor sites would result in the release of a small amount of nonradioactive air pollutants to the atmosphere, mainly due to the requirement to periodically test diesel generators and the operation of auxiliary steam boilers. The estimated air pollutants resulting from operation of the reactors are not expected to increase due to the use of MOX fuel in these reactors.

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[9] *Carbon dioxide equivalents include emissions of carbon dioxide and other greenhouse gases multiplied by their global warming potential, a metric for comparing the potential climate impact of the emissions of different greenhouse gases.*

Human Health – Workers. Total construction worker doses (SRS and LANL combined) would range from 0 to 6.6 person-rem for any of the alternatives implementing the PDCF or PDC Option for pit disassembly and conversion and from 140 to 150 person-rem for any of the action alternatives that implement the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion. No latent cancer fatalities (LCFs)[10] would be expected as a result of these doses.

The annual collective worker dose during operations of all required capabilities at LANL and SRS under each alternative is estimated to range from approximately 310 person-rem under the H-Canyon/HB-Line to DWPF Alternative with the PF-4 and MFFF Option for pit disassembly and conversion to approximately 650 person-rem under the Immobilization to DWPF Alternative with the PF-4, H-Canyon/HB-Line and MFFF Option for pit disassembly and conversion. Based on exposures over the operating life of the plutonium disposition facilities required under each alternative, 2 LCFs (under the MOX Fuel and H-Canyon/HB-Line to DWPF Alternatives with the PDCF or PDC Option for pit disassembly and conversion) to 7 LCFs (under the Immobilization to DWPF Alternative with the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion) could occur among the facilities' radiation workers. Worker doses would be monitored and controlled to ensure that individual doses are less than 2,000 millirem per year and as low as reasonably achievable (ALARA) to limit the potential health effects of these worker doses.

Occupational doses to plant workers during periods of MOX fuel loading and irradiation are expected to be similar to those for LEU fuel. The only time any increase in dose is likely to occur would be during acceptance inspections at the reactor when the fuel assemblies are first delivered to the plant. Workers are required to inspect the fuel assemblies to ensure there are no apparent problems; however, TVA has indicated that any potential increases in worker dose would be prevented through the continued implementation of aggressive ALARA programs (TVA 2012). If needed, additional shielding and remote handling equipment would be used to prevent an increase in worker dose. After inspection, worker doses would be limited because the assemblies would be handled remotely as they are loaded into the reactor and subsequently removed from the reactor and transferred into the used fuel pool. Worker doses at the reactors would continue to meet 10 CFR Part 20 Federal regulatory dose limits as required by NRC, and steps would be taken at the reactor sites to limit any increase in doses to workers that could result from use of MOX fuel.

Human Health – Public. Construction of the required plutonium disposition capabilities under all alternatives at SRS or LANL is not expected to result in radiological exposures to the public.

The annual dose to the population[11] surrounding SRS from operation of the proposed plutonium disposition activities would range from 0.45 to 0.97 person-rem across the alternatives, resulting in no LCFs. The annual dose to the offsite maximally exposed individual (MEI)[12] from SRS operations of the proposed plutonium disposition activities would range from 0.0052 to 0.010 millirem across the alternatives, resulting in an annual risk of a latent fatal cancer ranging from 1 chance in 170 million to 1 chance in 320 million.

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[10] *For each individual or population group considered, an estimate of the potential LCFs is made using the risk estimator of 0.0006 latent fatal cancers per rem or person-rem (or 600 latent fatal cancers per 1 million rem or person-rem) (DOE 2003b).*

[11] *Populations for the area within an 80-kilometer (50-mile) radius around the DOE or reactor sites were projected to 2020 using 2010 and past decennial census data.*

[12] *The MEI is a hypothetical member of the public at a location of public access that would result in the highest exposure; for purposes of evaluation in this* SPD Supplemental EIS*, the offsite MEI is considered to be at the site boundary, or in the case of reactor accidents, at the exclusion area boundary.*

Based on exposures from normal operations over the life of the surplus plutonium disposition activities required under each alternative, no LCFs are expected from these surplus plutonium disposition activities among the general population surrounding SRS. Similarly, the MEI at SRS is not expected to develop a fatal cancer from exposures from normal operations over the life of the plutonium disposition activities required under each alternative. The risk to the MEI at SRS of developing a fatal cancer from these exposures over the operating life of the alternatives would be 1 chance in 10 million or less.

The annual dose to the population surrounding LANL from pit disassembly and conversion activities would range from 0.025 to 0.21 person-rem across the alternatives, resulting in no LCFs. The total annual dose to the MEI from LANL operations of the pit disassembly and conversion activities would range from 0.0097 to 0.081 millirem across the alternatives, with an annual risk of a latent fatal cancer ranging from 1 chance in 20 million to 1 chance in 170 million.

Based on exposures from normal operations over the life of the pit disassembly and conversion activities under all of the alternatives, no LCFs are expected from these surplus plutonium disposition activities among the general population surrounding LANL. Similarly, the MEI at LANL is not expected to develop a latent fatal cancer from exposures due to normal operations over the life of the plutonium disposition activities under any of the alternatives. The risk to the MEI at LANL of developing a latent fatal cancer from these exposures would be 1 chance in a million or less.

Based on information presented in this *SPD Supplemental EIS* and the *SPD EIS* (DOE 1999b), normal operation of reactors using partial MOX cores as opposed to LEU cores is not expected to result in any greater doses to the general population surrounding the reactor,[13] or the MEI. Doses from normal operation of the TVA reactors are very low and are not expected to result in any additional LCFs among the public.

Human Health – Accidents. The risks to the MEI and the general population from accidents at SRS and LANL are very small.

Under the No Action Alternative, the limiting design-basis accident[14] for the general population and MEI at SRS would be an overpressurization of a plutonium oxide storage can at PDCF under the PDCF Option for pit disassembly and conversion. This accident would result in no LCFs in the general population, should it occur. The dose to the MEI would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 3,300, should this accident occur. The dose to a noninvolved worker from the limiting design-basis operational accident (a K-Area interim storage vault fire) would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 330, should this accident occur.

Under the Immobilization to DWPF Alternative, the limiting design-basis operational accident at SRS would be an explosion in a metal oxidation furnace during immobilization activities. This accident would result in no LCFs in the general population, should it occur. The dose to the MEI would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 1,000, should this accident occur. The dose to a noninvolved worker would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 33, should this accident occur.

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[13] *Populations for the area within an 80-kilometer (50-mile) radius around the reactor sites were projected to 2020 using past decennial census data. By 2020, the MOX program should be firmly established and is expected to remain stable through the end of the program.*

[14] *As used here, the limiting design-basis accident means the individual facility accident analyzed in this* SPD Supplemental EIS *that would have the largest potential impact, with the exception of accidents involving earthquakes. Accidents involving earthquakes are assumed to affect multiple facilities and are addressed separately.*

Under the MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives, the limiting design-basis operational accident for the population at SRS would be a level-wide fire in HB-Line. This accident would result in no LCFs in the general population, should it occur. The limiting design-basis operational accident for the MEI would be overpressurization of a plutonium oxide storage can at PDCF; the resulting dose would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 3,300, should this accident occur. The dose to a noninvolved worker from the limiting design-basis operational accident (a K-Area interim storage vault fire and 3013 can rupture) would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 330, should this accident occur.

Under all alternatives, the limiting design-basis operational accident at LANL could be different for the general public and the MEI or noninvolved worker. For the public, it would be from an elevated release as a result of a fire in the PF-4 vault or a hydrogen deflagration from dissolution of plutonium metal. Neither of these accidents would result in LCFs in the general population, should either of them occur. For the MEI and the noninvolved worker, the limiting design-basis accident would be from the hydrogen deflagration. The dose to the MEI would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 14,000, should this accident occur. The dose to a noninvolved worker would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 500, should this accident occur.

Under all alternatives, the maximum design-basis, natural-phenomenon-initiated accident at SRS would be a design-basis earthquake with fire. This accident is considered unlikely to beyond extremely unlikely. Such an accident could affect multiple facilities supporting the disposition of surplus plutonium. Under all alternatives, this accident would result in no LCFs in the general population, should it occur. The MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives would have the largest impacts; should a design-basis earthquake with fire occur at SRS under any of these alternatives, the increased risk of a latent fatal cancer to the MEI would be about 1 chance in 2,500. Should this accident occur under the Immobilization to DWPF Alternative, with the PF-4 and MFFF Option for pit disassembly and conversion, it would result in the lowest risk to the MEI at SRS. The increased risk of a latent fatal cancer, should the accident occur, would be about 1 chance in 50,000. The risks of a latent cancer to the MEI at SRS under the other alternative and pit disassembly and conversion option combinations range from about 1 chance in 2,500 to 1 chance in 10,000. The dose to a noninvolved worker at SRS from this accident would increase that individual's probability of developing a fatal cancer by about 1 chance in 1,000 to 1 chance in 3,300 should this accident occur.

Under any of the action alternatives, the maximum design-basis, natural-phenomenon-initiated accident at LANL would be a design-basis earthquake with spill plus fire. This accident is considered extremely unlikely and would result in no LCFs in the general population, should it occur. Under the pit disassembly and conversion options involving processing 2 metric tons (2.2 tons) of plutonium at LANL (the PDCF and PDC Options for pit disassembly and conversion), the dose to the MEI at LANL from this accident, should it occur, would increase the probability of the MEI developing a latent fatal cancer by about 1 chance in 1,100. The dose to a noninvolved worker at LANL would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 17. For the PF-4 and MFFF and the PF-4, H-Canyon/HB-Line, and MFFF Options for pit disassembly and conversion, which involve a higher level of pit disassembly and conversion in PF-4, the dose from this accident, should it occur, would increase the probability of the MEI developing a latent fatal cancer by about 1 chance in 500. The dose to a noninvolved worker would increase that individual's probability of developing a latent fatal cancer by about 1 chance in 5, should this accident occur.

The maximum evaluated beyond-design-basis accident at SRS or LANL under all alternatives would be an earthquake that could result in severe damage to the facilities. This accident is considered extremely unlikely to beyond extremely unlikely. This accident would result in 3 to 16 LCFs among the general population surrounding SRS from radiation exposure and uptake of radionuclides, should it occur. A similar accident at LANL involving pit disassembly and conversion activities would result in 1 to 2 LCFs among the general population surrounding LANL from radiation exposure and uptake of radionuclides, should it occur. At the same time, however, numerous deaths associated with falling structural materials would be expected in the area surrounding SRS or LANL, should an earthquake severe enough to significantly damage highly engineered facilities such as those proposed to support surplus plutonium disposition activities occur at either site.

Based on the reactor accident evaluation performed for this *SPD Supplemental EIS*, the risk from potential design-basis accidents with either a full LEU or partial MOX fuel core would be similar for a member of the general public at the exclusion area boundary at the time of the accident or for the general population residing within 50 miles (80 kilometers) of the reactor (see Appendix I of this *SPD Supplemental EIS*). The maximum evaluated design-basis accident at TVA's Sequoyah and Browns Ferry Nuclear Plants would be a loss-of-coolant accident. This accident, should it occur, would result in no LCFs among the general population residing within 50 miles (80 kilometers) of the reactor site from radiation exposure and uptake of radionuclides.

The maximum evaluated beyond-design-basis accident at Browns Ferry would be an early containment failure accident. Taking into account the frequency of this accident, the average individual's probability of developing a fatal cancer would increase by about 1 chance in 3.3 billion, regardless of whether the plant was operating with a partial MOX fuel core or a full LEU fuel core. The maximum evaluated beyond-design-basis accident at Sequoyah would be a steam generator tube rupture accident. Taking into account the frequency of this accident, the average individual's probability of developing a fatal cancer would increase by about 1 chance in 330 million, regardless of whether the plant was operating with a partial MOX fuel core or a full LEU fuel core.

Socioeconomics. Peak construction direct employment at SRS would range from 252 under the Immobilization to DWPF Alternative with the PF-4 and MFFF Option for pit disassembly and conversion, to a maximum of 943 under the Immobilization to DWPF Alternative with the PDCF Option for pit disassembly and conversion. These construction efforts are expected to result in indirect employment in the area surrounding SRS ranging from 159 to 595 jobs. Peak construction direct employment at LANL would range from 0 to 46, with the higher value related to modification of pit disassembly and conversion activities in PF-4 to support a higher level of pit disassembly and conversion in PF-4. These construction efforts are expected to result in indirect employment in the area surrounding LANL ranging from 0 to 26 jobs. The total change in employment related to construction would represent less than 1 percent of the region of influence (ROI) labor force under all alternatives for both SRS and LANL.

Under all alternatives, the additional workers required for operations at SRS would help offset recent reductions in other activities at the site. Peak operations direct employment would range from 1,242 under the H-Canyon/HB-Line to DWPF Alternative with the PF-4 and MFFF Option for pit disassembly and conversion, to 2,111 under the Immobilization to DWPF Alternative with the PDCF Option for pit disassembly and conversion. These operations-related jobs are expected to result in indirect employment in the area surrounding SRS ranging from 1,430 to 2,511 jobs. The total change in employment related to operations would represent about 1.6 percent of the SRS ROI labor force under all alternatives. When considered in conjunction with planned reductions in the workforce at SRS, it is expected that the local housing market would be able to absorb any in-migration of workers resulting from implementation of any of the alternatives. Likewise, the flow of traffic on main transportation corridors to and from the site would remain largely unchanged.

LANL peak operations direct employment would range from 85 under all of the alternatives that include the PDCF or PDC Option for pit disassembly and conversion to 253 under all of the action alternatives that include increased pit disassembly and conversion activities at LANL (i.e., the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Option). These operations-related jobs are expected to result in indirect employment in the area surrounding LANL ranging from 86 to 256 jobs. The total change in employment related to operations would represent less than 1 percent of the LANL ROI labor force under all alternatives. It is expected that the local housing market would be able to absorb any in-migration of workers resulting from implementation of any of the alternatives. Likewise, the flow of traffic on main transportation corridors to and from the site would remain largely unchanged.

Nuclear power reactors would not need to employ additional workers to support MOX fuel use. This is consistent with information presented in the *SPD EIS*, which concluded that MOX fuel use would not result in increases in the worker population at the reactor sites (DOE 1999b).

Waste Management. Nonradiological waste would be the major type of waste generated during construction at SRS, although some TRU waste, low-level radioactive waste (LLW), and mixed low-level radioactive waste (MLLW) would be generated due to removal of contaminated equipment and structures. TRU waste, MLLW, and hazardous waste would be disposed of off site; LLW would be disposed of on site or off site; and nonhazardous solid and liquid wastes would be treated and disposed of on site. Sufficient SRS treatment, storage, and disposal capacity exists to manage the wastes generated during construction under all alternatives.

Small amounts of TRU waste, LLW, and MLLW would be generated at LANL during modification of PF-4 to support the proposed pit disassembly and conversion activities under all of the action alternatives. TRU waste would be shipped to WIPP for disposal, MLLW would be disposed of off site, and LLW would be disposed of on site or off site. Sufficient LANL treatment, storage, and disposal capacity exists to manage the wastes generated during construction under all alternatives.

The lowest amount of waste would be generated under the No Action Alternative; however, much of the plutonium would remain in storage under this alternative and would not be dispositioned. Under the WIPP Alternative, there would be more TRU waste, but less MLLW and LLW, generated compared to the other alternatives over the life of the alternatives. The greatest amounts of radioactive waste from construction and operations at both SRS and LANL would be generated under the following alternatives:

- TRU waste – up to 17,000 cubic meters (600,000 cubic feet) under the WIPP Alternative with pit disassembly and conversion accomplished under the PF-4, H-Canyon/HB-Line, and MFFF Option

- MLLW – up to 1,000 cubic meters (35,000 cubic feet) under the Immobilization to DWPF Alternative if all 13.1 metric tons [14.4 tons] of plutonium were immobilized and pit disassembly and conversion was accomplished under the PF-4, H-Canyon/HB-Line, and MFFF Option

- LLW – up to 50,000 cubic meters (1.8 million cubic feet) under the H-Canyon/HB-Line to DWPF Alternative with pit disassembly and conversion accomplished under the PDC Option

Sufficient waste treatment, storage, and disposal capacities currently exist at SRS and LANL to manage the waste generated under all of the alternatives. Additional HLW canisters would be generated under the Immobilization to DWPF and H-Canyon/HB-Line to DWPF Alternatives. These canisters would be stored on site at SRS until a final disposition path is identified.

All alternatives would also generate TRU waste. The total WIPP capacity for TRU waste disposal is currently set at 175,600 cubic meters (6.2 million cubic feet) by the WIPP Land Withdrawal Act, or 168,485 cubic meters (5.95 million cubic feet) of contact-handled TRU waste (DOE 2008k:16). Estimates in the *Annual Transuranic Waste Inventory Report – 2011* indicate that 148,800 cubic meters (5.25 million cubic feet) of contact-handled TRU waste would be disposed of at WIPP (DOE 2011k:Table C–1), approximately 19,700 cubic meters (696,000 cubic feet) less than the current contact-handled TRU waste capacity. TRU waste generation for the activities being considered under this *SPD Supplemental EIS* alternatives would represent 30 to 88 percent of this unsubscribed disposal capacity. Less TRU waste would be generated, representing a smaller percentage of the unsubscribed WIPP disposal capacity (down to 63 percent compared to 88 percent under the WIPP Alternative), if a decision is made to ship the FFTF portion of non-pit plutonium inventory as TRU waste directly to WIPP, and if criticality control containers[15] could be used for packaging of some materials rather than the assumed POCs.

Decisions about disposal of any significant quantities of TRU waste would be made within the context of the needs of the entire DOE complex. It should be also noted that surplus plutonium disposition activities would extend to 2036 for the No Action Alternative and 2038 for the action alternatives. It was assumed for analysis in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b) that TRU waste would be received at WIPP over about a 35-year period, through approximately 2033, but because the total quantity of TRU waste that may be disposed of at WIPP is statutorily established by the WIPP Land Withdrawal Act, the actual operating period for WIPP will depend on the volumes of TRU waste that are disposed of at WIPP by all DOE waste generators. Waste minimization across the DOE complex could extend the WIPP operating period. The potential impacts and resolution of these issues would be evaluated as additional information becomes available during the course of operations.

Reactors using MOX fuel are expected to continue to produce LLW, MLLW, hazardous waste, and nonhazardous waste as part of their normal operations. However, waste volumes are not expected to increase as a result of MOX fuel use. Some additional used nuclear fuel would likely be generated from use of a partial MOX core in an existing reactor. Based on the analyses done in this *SPD Supplemental EIS* and the *SPD EIS* (DOE 1999b), the amount of additional used nuclear fuel generated during the period MOX fuel would be used in a reactor is estimated to increase by approximately 2 to 16 percent compared to the reactor continuing to use only LEU fuel. It is expected that these small increases would be managed within the reactor's normal planning for used fuel storage.

Transportation. Construction activities at SRS would generate waste streams that would primarily be disposed of on site and would, therefore, have negligible transportation impacts. However, some MLLW would be generated at SRS during construction that would need to be shipped off site for treatment and disposal. The impacts associated with these shipments would be small and are included in the total estimated impacts shown in the operations discussion.

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[15] *A criticality control container is a proposed transportation package that would allow the transport of more plutonium material in a package (estimated at 380 plutonium fissile gram equivalents per container) than in a POC. A criticality control container would have components that would address possible criticality concerns that would be inherent in transporting a larger quantity of plutonium in a container.*

Similarly, construction activities at LANL would generate waste streams that would primarily be disposed of on site and would, therefore, have negligible transportation impacts. Some MLLW and TRU waste, however, would be generated at LANL during modification of PF-4. This MLLW and TRU waste would be shipped off site for treatment and/or disposal. The impacts associated with these shipments would be small and are included in the total estimated impacts shown in the operations discussion.

For operations under all alternatives, offsite shipments of radioactive wastes and materials would be required, including the following: MLLW, LLW, and TRU waste to treatment and disposal facilities; pit transport from Pantex to SRS or LANL; plutonium metal or oxide from LANL to SRS; highly enriched uranium from SRS or LANL to the Y-12 National Security Complex in Oak Ridge, Tennessee; pieces and parts from pit disassembly from SRS to LANL if pit disassembly is performed at SRS; depleted uranium hexafluoride from Piketon, Ohio, to a uranium conversion plant in Richland, Washington; and depleted uranium dioxide and depleted uranyl nitrate hexahydrate from Richland, Washington, to SRS. Under all alternatives, no LCFs are expected in the general public along the transportation routes due to incident-free transport of radioactive wastes and materials to and from SRS and LANL (i.e., no more than about 1 chance in 3 for the duration of any alternative), including shipment of unirradiated MOX fuel for use in TVA or generic commercial nuclear power reactors (assumed to be located in the northwestern United States to maximize potential transportation impacts). The risk to the transportation crew from these shipments would also be low. No LCFs are expected in the transportation crews due to incident-free transport of radioactive wastes and materials to and from SRS and LANL (i.e., no more than about 1 chance in 3 for the duration of any alternative).

There is the risk of up to 1 fatality due to a traffic accident. The risk of an LCF due to the release of the radioactive cargo in an accident under all alternatives would be much less than 1 (i.e., no more than about 1 chance in 10,000 for the duration of an alternative).

In addition to the offsite shipments of radioactive wastes and materials, all alternatives would include the shipment of hazardous wastes and construction materials. Under all of the alternatives, these shipments could result in three to four accidents over the life of the alternative. The risk of a fatality due to a traffic accident from these shipments would be less than 1 under all of the alternatives.

All alternatives would also include onsite transportation to and from the facilities involved in surplus plutonium disposition activities. Onsite transportation would not affect members of the public because roads between SRS and LANL processing areas are closed to the public. Onsite transportation is not expected to significantly increase the risk to onsite workers. Transportation activities currently conducted as part of site operations do not have a discernible impact on onsite workers.

Environmental Justice. As discussed in Section 4.1.6 of this *SPD Supplemental EIS*, the potential environmental impacts and risks associated with the proposed surplus plutonium disposition activities are essentially the same or lower for minority and low-income populations residing near SRS or LANL as they are for nonminority and non-low-income populations. Included in the analysis described in Section 4.1.6 is a discussion of the potential impacts on an American Indian who may live a more traditional lifestyle on lands near LANL. This analysis concluded that this person would not be subject to significantly increased risks due to the actions proposed in this *SPD Supplemental EIS*. Therefore, no disproportionately high and adverse impacts on minority or low-income populations residing near SRS or LANL would result from implementing any alternative.

Table 2–3 Summary of Environmental Consequences of Alternatives for Surplus Plutonium Disposition

Resource Area	*Alternative*				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Air Quality	***Construction***				
	- Particulate matter would be emitted from land-disturbing activities associated with construction of PDCF in F-Area at SRS. Pollutants would be emitted from diesel construction equipment, operation of a concrete batch plant, and vehicle emissions. - Concentrations at the site boundary would not exceed air quality standards.	- Impacts would be approximately the same as under the No Action Alternative. - Activities at LANL, if undertaken, would not exceed air quality standards.	- Impacts would be approximately the same as under the No Action Alternative from construction of PDCF or reduced impacts from construction of PDC or modification of existing facilities at SRS. - Activities at LANL would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Operations				
	Concentrations at the SRS and LANL site boundaries would not exceed air quality standards.	Same as under the No Action Alternative for SRS. Expanded activities at LANL, if undertaken, would not exceed air quality standards.	Approximately the same as under the Immobilization to DWPF Alternative.	Approximately the same as under the Immobilization to DWPF Alternative.	Approximately the same as under the Immobilization to DWPF Alternative.
Human Health – Normal Operations, Workers	***Construction***				
	No additional worker doses or risks are expected at SRS or LANL.	- Total worker dose at SRS – up to 11 person-rem - SRS total LCFs – 0 (up to 0.007) - Total worker dose at LANL – up to 140 person-rem - LANL total LCFs – 0 (up to 0.08)	- Total worker dose at SRS – up to 4.5 person-rem - SRS total LCFs – 0 (up to 0.003) - Total worker dose and LCFs at LANL would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	- Total worker dose at SRS – up to 5.7 person-rem - SRS total LCFs – 0 (up to 0.003) - Total worker dose and LCFs at LANL would be the same as under the Immobilization to DWPF Alternative.
	Operations				
	- Annual total worker dose at SRS – 300 person-rem - SRS annual LCFs – 0 (0.2) - SRS total LCFs – 3 - Annual total worker dose at LANL – 29 person-rem - LANL annual LCFs – 0 (0.02) - LANL total LCFs – 0 (0.1)	- Annual total worker dose at SRS – 430 to 620 person-rem - SRS annual LCFs – 0 (0.3 to 0.4) - SRS total LCFs – 3 to 4 - Annual total worker dose at LANL – 29 - 190 person-rem - LANL annual LCFs – 0 (0.02 to 0.1) - LANL total LCFs – 0 (0.1) to 3	- Annual total worker dose at SRS – 130 to 320 person-rem - SRS annual LCFs – 0 (0.08 to 0.2) - SRS total LCFs – 1 to 2 - Annual total worker dose at LANL would be the same as under the Immobilization to DWPF Alternative	- Annual total worker dose at SRS – 120 to 310 person-rem - SRS annual LCFs – 0 (0.07 to 0.2) - SRS total LCFs – 2 - Annual total worker dose at LANL would be the same as under the Immobilization to DWPF Alternative	- Annual total worker dose at SRS – 170 to 360 person-rem - SRS annual LCFs – 0 (0.1 to 0.2) - SRS total LCFs – 2 to 3 - Annual total worker dose at LANL would be the same as under the Immobilization to DWPF Alternative

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Human Health – Normal Operations, General Population	***Construction***				
	Construction of PDCF in F-Area at SRS would be in uncontaminated areas. No radiological exposure to the public would result.	- Same as under the No Action Alternative, except activities would include removal of contaminated equipment and structures during construction of the immobilization capability at K-Area and could include modification of H-Canyon/ HB-Line to support plutonium conversion. - Modification at PF-4 at LANL would be within the existing building. No radiological exposure to the public would result at SRS or LANL.	- Same as under the No Action Alternative, except activities could include removal of contaminated equipment and structures during construction of PDC at K-Area at SRS or modification of H-Canyon/ HB-Line to support plutonium conversion. - Modification of PF-4 at LANL would be the same as that under the Immobilization to DWPF Alternative. No radiological exposure to the public would result at SRS or LANL.	Same as under the MOX Fuel Alternative.	- Same as under the MOX Fuel Alternative, except would include modification of H-Canyon/HB-Line to support preparation of plutonium for WIPP disposal. - Modification of PF-4 at LANL would be the same as that under the Immobilization to DWPF Alternative. No radiological exposure to the public would result at SRS or LANL.
	Operations				
	Annual population dose (person-rem) - SRS – 0.54 - LANL – 0.025 Annual population LCFs - SRS – 0 (3×10^{-4}) - LANL – 0 (2×10^{-5}) Project total population LCFs - SRS – 0 (4×10^{-3}) - LANL – 0 (1×10^{-4}) Annual MEI dose (millirem) - SRS – 0.0066 - LANL – 0.0097 Annual MEI LCF risk - SRS – 4×10^{-9} - LANL – 6×10^{-9} Project total MEI LCF risk - SRS – 4×10^{-8} - LANL – 4×10^{-8} Risk to the public would be small.	Annual population dose (person-rem) - SRS – 0.45 to 0.71 - LANL – 0.025 to 0.21 Annual population LCFs - SRS – 0 (3×10^{-4} to 4×10^{-4}) - LANL – 0 (2×10^{-5} to 1×10^{-4}) Project total population LCFs - SRS – 0 (4×10^{-3} to 7×10^{-3}) - LANL – 0 (1×10^{-4} to 3×10^{-3}) Annual MEI dose (millirem) - SRS – 0.0052 to 0.0076 - LANL – 0.0097 to 0.081 Annual MEI LCF risk - SRS – 3×10^{-9} to 5×10^{-9} - LANL – 6×10^{-9} to 5×10^{-8} Project total MEI LCF risk - SRS – 5×10^{-8} to 8×10^{-8} - LANL – 4×10^{-8} to 1×10^{-6} Risk to the public would be small.	Annual population dose (person-rem) - SRS – 0.71 to 0.97 - LANL – 0.025 to 0.21 Annual population LCFs - SRS – 0 (4×10^{-4} to 6×10^{-4}) - LANL – 0 (2×10^{-5} to 1×10^{-4}) Project total population LCFs - SRS – 0 (6×10^{-3} to 9×10^{-3}) - LANL – 0 (1×10^{-4} to 3×10^{-3}) Annual MEI dose (millirem) – - SRS – 0.0077 to 0.010 - LANL – 0.0097 to 0.081 Annual MEI LCF risk - SRS – 5×10^{-9} to 6×10^{-9} - LANL – 6×10^{-9} to 5×10^{-8} Project total MEI LCF risk - SRS – 7×10^{-8} to 1×10^{-7} - LANL – 4×10^{-8} to 1×10^{-6} Risk to the public would be small.	Annual population dose (person-rem) - SRS – 0.46 to 0.72 - LANL – 0.025 to 0.21 Annual population LCFs - SRS – 0 (3×10^{-4} to 4×10^{-4}) - LANL – 0 (2×10^{-5} to 1×10^{-4}) Project total population LCFs - SRS – 0 (4×10^{-3} to 7×10^{-3}) - LANL – 0 (1×10^{-4} to 3×10^{-3}) Annual MEI dose (millirem) – - SRS – 0.0053 to 0.0077 - LANL – 0.0097 to 0.081 Annual MEI LCF risk - SRS – 3×10^{-9} to 5×10^{-9} - LANL – 6×10^{-9} to 5×10^{-8} Project total MEI LCF risk - SRS – 6×10^{-8} to 9×10^{-8} - LANL – 4×10^{-8} to 1×10^{-6} Risk to the public would be small.	Annual population dose (person-rem) - SRS – 0.71 to 0.97 - LANL – 0.025 to 0.21 Annual population LCFs - SRS – 0 (4×10^{-4} to 6×10^{-4}) - LANL – 0 (2×10^{-5} to 1×10^{-4}) Project total population LCFs - SRS – 0 (6×10^{-3} to 9×10^{-3}) - LANL – 0 (1×10^{-4} to 3×10^{-3}) Annual MEI dose (millirem) – - SRS – 0.0077 to 0.010 - LANL – 0.0097 to 0.081 Annual MEI LCF risk - SRS – 5×10^{-9} to 6×10^{-9} - LANL – 6×10^{-9} to 5×10^{-8} Project total MEI LCF risk - SRS – 8×10^{-8} to 1×10^{-7} - LANL – 4×10^{-8} to 1×10^{-6} Risk to the public would be small.

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Human Health – Facility Accidents	Limiting design-basis accident at SRS (overpressurization of oxide storage can at PDCF): - Frequency – extremely unlikely - Population LCFs – 0 (1×10^{-1}) - MEI LCF risk – 3×10^{-4} Design-basis earthquake with fire at SRS: - Frequency – unlikely to beyond extremely unlikely - Population LCFs – 0 (6×10^{-2}) - MEI LCF risk – 1×10^{-4} Beyond-design-basis earthquake with fire at SRS: - Up to 7 LCFs from high radiation exposure and uptake of radionuclides; numerous worker and public injuries and deaths are expected from collapsed buildings in a severe earthquake postulated to significantly damage highly engineered facilities working with plutonium. Limiting design-basis accident at LANL (fire in TA-55 vault or hydrogen deflagration from plutonium dissolution): - Frequency – extremely unlikely to beyond extremely unlikely - Population LCFs – 0 (2×10^{-2}) - MEI LCF risk – 7×10^{-5} Design-basis earthquake with spill plus fire at LANL: - Frequency – extremely unlikely to beyond extremely unlikely - Population LCFs – 0 (2×10^{-1}) - MEI LCF risk – 9×10^{-4} Beyond-design-basis earthquake with spill plus fire at LANL: - Up to 1 LCF from high radiation exposure and uptake of radionuclides; numerous worker and public injuries and deaths are expected from collapsed buildings in a severe earthquake postulated to significantly damage highly engineered facilities working with plutonium. Risk to the public from accidents would be small.	Limiting design-basis accident at SRS (explosion in metal oxidation furnace during immobilization): - Frequency – extremely unlikely to beyond extremely unlikely - Population LCFs – 0 (4×10^{-1}) - MEI LCF risk – 1×10^{-3} Design-basis earthquake with fire at SRS: - Frequency –unlikely to beyond extremely unlikely - Population LCFs – 0 (up to 2×10^{-1}) - MEI LCF risk – up to 3×10^{-4} Beyond-design-basis earthquake with fire at SRS: - Up to 12 LCFs from high radiation exposure and uptake of radionuclides; numerous worker and public injuries and deaths are expected from collapsed buildings in a severe earthquake postulated to significantly damage highly engineered facilities working with plutonium. Limiting design-basis accident at LANL: same as under the No Action Alternative Design-basis earthquake with spill plus fire at LANL: - Frequency – extremely unlikely to beyond extremely unlikely - Population LCFs – up to 1 (5×10^{-1}) - MEI LCF risk – up to 2×10^{-3} Beyond-design-basis earthquake with spill plus fire at LANL: - Up to 2 LCFs from high radiation exposure and uptake of radionuclides; numerous worker and public injuries and deaths are expected from collapsed buildings in a severe earthquake postulated to significantly damage highly engineered facilities working with plutonium. Risk to the public from accidents would be small.	Limiting design-basis accident at SRS (overpressurization of oxide storage can at PDCF or level-wide fire at HB-Line): - Frequency –extremely unlikely - Population LCFs – 0 (2×10^{-1}) - MEI LCF risk – up to 3×10^{-4} Design-basis earthquake with fire at SRS: - Frequency – unlikely to beyond extremely unlikely - Population LCFs – 0 (2×10^{-1}) - MEI LCF risk – up to 4×10^{-4} Beyond-design-basis earthquake with fire at SRS: - Up to 16 LCFs from high radiation exposure and uptake of radionuclides; numerous worker and public injuries and deaths are expected from collapsed buildings in a severe earthquake postulated to significantly damage highly engineered facilities working with plutonium. Accident risks to the public at LANL would be the same as under the Immobilization to DWPF Alternative. Risk to the public from accidents would be small.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Socio-economics (impacts in peak year)	***Construction***				
	- SRS direct employment, peak – 722 - SRS indirect employment, peak – 455 - Value added to local economy near SRS, peak – $67 million Impacts on housing and traffic would be small.	- SRS direct employment, peak – 252 to 943 - SRS indirect employment, peak – 159 to 595 - Value added to local economy near SRS, peak – $23 million to $87 million - LANL direct employment, peak – 0 to 46 - LANL indirect employment, peak – 0 to 26 - Value added to local economy near LANL, peak – $0 to $3.8 million Impacts on housing and traffic would be small.	- SRS direct employment, peak – 275 to 741 - SRS indirect employment, peak – 173 to 467 - Value added to local economy near SRS, peak – $25 million to $68 million - LANL impacts would be the same as under the Immobilization to DWPF Alternative Impacts on housing and traffic would be small.	- SRS direct employment, peak – 275 to 741 - SRS indirect employment, peak – 173 to 467 - Value added to local economy near SRS, peak – $25 million to $68 million - LANL impacts would be the same as under the Immobilization to DWPF Alternative Impacts on housing and traffic would be small.	- SRS direct employment, peak – 285 to 741 - SRS indirect employment, peak – 180 to 467 - Value added to local economy near SRS, peak – $26 million to $68 million - LANL impacts would be the same as under the Immobilization to DWPF Alternative Impacts on housing and traffic would be small.
	Operations				
	- Direct employment at SRS, peak – 1,677 - Indirect employment at SRS, peak – 1,995 - Value added to local economy near SRS, peak – $250 million - Total worker-years (includes construction) – 36,400 - Direct employment at LANL, peak – 85 - Indirect employment at LANL, peak – 86 - Value added to local economy at LANL, peak – $11 million - Total worker-years – 600 Impacts on housing and traffic would be small.	- Direct employment at SRS, peak – 1,596 to 2,111 - Indirect employment at SRS, peak – 1,898 to 2,511 - Value added to local economy at SRS, peak – $240 million to $320 million - Total worker-years (includes construction) – up to 43,300 - Direct employment at LANL, peak – 85 to 253 - Indirect employment at LANL, peak – 86 to 256 - Value added to local economy at LANL, peak – $11 million to $32 million - Total worker-years (includes construction) – 600 to 5,900 Impacts on housing and traffic would be small.	- Direct employment at SRS, peak – 1,357 to 1,716 - Indirect employment at SRS, peak – 1,614 to 2,041 - Value added to local economy at SRS, peak – $200 million to $260 million - Total worker-years (includes construction) – Up to 41,100 LANL impacts would be the same as under the Immobilization to DWPF Alternative Impacts on housing and traffic would be small.	- Direct employment at SRS, peak – 1,242 to 1,676 - Indirect employment at SRS, peak – 1,430 to 1,993 - Value added to local economy at SRS, peak – $180 million to $250 million - Total worker-years (includes construction) – Up to 38,800 LANL impacts would be the same as under the Immobilization to DWPF Alternative Impacts on housing and traffic would be small.	- Direct employment at SRS, peak – 1,257 to 1,716 - Indirect employment at SRS, peak – 1,495 to 2,041 - Value added to local economy at SRS, peak – $190 million to $260 million - Total worker-years (includes construction) – Up to 39,700 LANL impacts would be the same as under the Immobilization to DWPF Alternative Impacts on housing and traffic would be small.

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Waste Management (cubic meters over life of the project)	***SRS Construction***				
	TRU waste – 0 MLLW – 0 LLW – 0 Hazardous – 56 Nonhazardous (solid) – 1,300 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	TRU waste – 0 to 23 MLLW – 100 LLW – 2,500 Hazardous – 100 to 160 Nonhazardous (solid) – 2,500 to 3,800 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	TRU waste – 10 to 33 MLLW – 0 to 210 LLW – 0 to 12,000 Hazardous – 0 to 7,000 Nonhazardous (solid) – 0 to 6,800 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	TRU waste – 0 to 23 Remainder same as under the MOX Fuel Alternative. Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	Same as under the MOX Fuel Alternative. Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.
	SRS Operations				
	TRU waste – 5,900 MLLW – 0 LLW – 16,000 Hazardous – 10 Nonhazardous (solid) – 29,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	TRU waste – 10,000 to 12,000 MLLW – 800 to 830 LLW – 12,000 to 33,000 Hazardous – 810 Nonhazardous (solid) – 16,000 to 2,800,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	TRU waste – 9,900 to 12,000 MLLW – 14 to 34 LLW – 20,000 to 32,000 Hazardous – 7 to 8 Nonhazardous (solid) – 1,200,000 to 2,800,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	TRU waste – 6,700 to 8,500 MLLW – 31 to 34 LLW – 27,000 to 37,000 Hazardous – 7 to 8 Nonhazardous (solid) – 2,600,000 to 2,800,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	TRU waste – 14,000 to 16,000 MLLW – 0 to 34 LLW – 11,000 to 32,000 Hazardous – 6 to 7 Nonhazardous (solid) – 15,000 to 2,800,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.
	LANL Construction				
	Not applicable.	TRU waste – 0 to 19 MLLW – 0 to 56 LLW – 0 to 37 Hazardous – 0 Nonhazardous (solid) – 0 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.
	LANL Operations				
	TRU waste – 70 MLLW – 2 LLW – 200 Hazardous – 0 Nonhazardous (solid) – 0 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	TRU waste – 70 to 1,200 MLLW – 2 to 31 LLW – 200 to 4,000 Hazardous – 0 to 4 Nonhazardous (solid) – 0 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Transportation (total health effects)	***Construction Material and Hazardous Waste Shipments at SRS and LANL***				
	Shipments – 42,000 Accident fatalities – 0 (0.2)	Shipments – 1,300 to 43,000 Accident fatalities – 0 (0.01 to 0.2)	Shipments – <10 to 43,000 Accident fatalities – 0 (0.0004 to 0.2)	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Radioactive Material and Waste Shipments from Operations at SRS and LANL				
	Shipments – 3,300 *Incident-free* - Crew LCFs – 0 (0.1) - Population LCFs – 0 (0.09) *Accidents* - Population LCF risk – 0 (0.00007) - Traffic fatalities – 0 (0.4)	Shipments – 4,300 to 4,800 *Incident-free* - Crew LCFs – 0 (0.2) - Population LCFs – 0 (0.1) *Accidents* - Population LCF risk – 0 (0.00007 to 0.00009) - Traffic fatalities – 1 (0.5)	Shipments – 4,100 to 4,800 *Incident-free* - Crew LCFs – 0 (0.1 to 0.2) Population LCFs – 0 (0.09 to 0.1) *Accidents* - Population LCF risk – 0 (0.00009 to 0.0001) - Traffic fatalities – 1 (0.5 to 0.6)	Shipments – 3,900 to 4,400 *Incident-free* Crew LCFs – 0 (0.1 to 0.2) Population LCFs – 0 (0.09 to 0.1) *Accidents* - Population LCF risk – 0 (0.00008 to 0.0001) - Traffic fatalities – 0 to 1 (0.4 to 0.5)	Shipments – 4,400 to 5,700 *Incident-free* - Crew LCFs – 0 (0.2) - Population LCFs – 0 (0.1) *Accidents* - Population LCF risk – 0 (0.00008 to 0.0001) - Traffic fatalities – 1 (0.5 to 0.7)
	SRS and LANL Operations Including Fresh MOX Fuel Shipments to BFN and SQN				
	Not applicable; no shipments to the Browns Ferry or Sequoyah Nuclear Plants are planned under the No Action Alternative.	Shipments – 6,400 to 6,900 *Incident-free* - Crew LCFs – 0 (0.2) - Population LCFs – 0 (0.1) *Accidents* - Population LCF risk – 0 (0.00007 to 0.00009) - Traffic fatalities – 1 (0.5 to 0.6)	Shipments –7,000 to 7,700 *Incident-free* - Crew LCFs – 0 (0.2) - Population LCFs – 0 (0.1) *Accidents* - Population LCF risk – 0 (0.00009 to 0.0001) - Traffic fatalities – 1 (0.5 to 0.6)	Shipments – 6,500 to 7,000 *Incident-Free* - Crew LCFs – 0 (0.1 to 0.2) - Population LCFs – 0 (0.1) *Accidents* - Population LCF risk – 0 (0.00008 to 0.0001) - Traffic fatalities – 1 (0.5)	Shipments – 7,000 to 8,300 *Incident-Free* - Crew LCFs – 0 (0.2) - Population LCFs – 0 (0.1 to 0.2) *Accidents* - Population LCF risk – 0 (0.00008 to 0.0001) - Traffic fatalities – 1 (0.6 to 0.7)
	SRS and LANL Operations Including Fresh MOX Fuel Shipments to a Generic Reactor				
	Shipments – 6,700 *Incident-Free* - Crew LCFs – 0 (0.2) - Population LCFs – 0 (0.3) *Accidents* - Population LCF risk – 0 (0.00007) - Traffic fatalities – 1 (0.7)	Shipments – 7,700 to 8,200 *Incident-Free* - Crew LCFs – 0 (0.2 to 0.3) - Population LCFs – 0 (0.3) *Accidents* - Population LCF risk – 0 (0.00007 to 0.00009) - Traffic fatalities – 1 (0.8)	Shipments – 8,600 to 9,300 *Incident-Free* - Crew LCFs – 0 (0.3) - Population LCFs – 0 (0.3) *Accidents* - Population LCF risk – 0 (0.00009 to 0.0001) - Traffic fatalities – 1 (0.9 to 1)	Shipments – 8,000 to 8,500 *Incident-Free* - Crew LCFs – 0 (0.2 to 0.3) - Population LCFs – 0 (0.3) *Accidents* - Population LCF risk – 0 (0.00008 to 0.0001) - Traffic fatalities – 1 (0.8 to 0.9)	Shipments – 8,500 to 9,800 *Incident-Free* - Crew LCFs – 0 (0.3) - Population LCFs – 0 (0.3) *Accidents* - Population LCF risk – 0 (0.00008 to 0.0001) - Traffic fatalities – 1 (0.9 to 1)

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Environmental Justice	***Construction***				
	No disproportionately high and adverse impacts on minority or low-income populations are expected.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
	Operations				
	No disproportionately high and adverse impacts on minority or low-income populations are expected.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Land and Visual Resources	***Construction***				
	- No exterior construction or land disturbance at E-, H-, or S-Areas at SRS is expected. - PDCF would require 50 acres adjacent to built-up portions of F-Area at SRS. - Minimal impacts on land use and no change in the Visual Resource Management Class IV designation are expected.	- Impacts within E-, F-, H-, and S-Areas at SRS would be similar to those described under the No Action Alternative. - Immobilization capability would require 2 acres of previously disturbed land within the built-up portion of K-Area at SRS. - Modifications at LANL would require up to 2 acres of land in TA-55. - Minimal impacts on land use and no change in the Visual Resource Management Class IV designation are expected.	- Impacts within E-, F-, H-, and S-Areas at SRS would be similar to those described under the No Action Alternative. - PDC would require up to 30 acres of land within K-Area at SRS. - Impacts at LANL would be the same as under the Immobilization to DWPF Alternative. - Minimal impacts on land use and no change in the Visual Resource Management Class IV designation are expected.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Operations				
	- No additional impact on land use at E-, H-, K-, and S-Areas at SRS is expected. - PDCF would occupy less than 23 acres of previously unoccupied land within F-Area at SRS. - No additional impact on land use at LANL is expected. - Minimal impacts on land use and no change in the Visual Resource Management Class IV designation are expected.	Same as under the No Action Alternative.	- Same as under the No Action Alternative, except that optional operation of PDC would require up to 18 acres of land within K-Area at SRS. - Impacts at LANL would be the same as under the No Action Alternative. - Minimal impacts on land use and no change in the Visual Resource Management Class IV designation are expected.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Geology and Soils	***Construction***				
	- SRS crushed stone, sand, and gravel – 190,000 tons - SRS soil – 130,000 cubic yards - Total quantities of geologic materials would be small percentages of regionally plentiful resources. - BMPs would be used to limit soil erosion at construction sites. Therefore, adverse impacts on geology and soils are not likely.	- SRS crushed stone, sand, and gravel – 1,200 to 190,000 tons - SRS soil – 9,500 to 140,000 cubic yards - LANL requirements for crushed stone and soil would be minimal. - Total quantities of geologic materials would be small percentages of regionally plentiful resources. - BMPs would be used to limit soil erosion at construction sites. Therefore, adverse impacts on geology and soils are not likely.	- SRS crushed stone, sand, and gravel – minimal to 530,000 tons - SRS soil – minimal to 130,000 cubic yards. - LANL requirements for crushed stone and soil would be minimal. - Total quantities of geologic materials would be small percentages of regionally plentiful resources. - BMPs would be used to limit soil erosion at construction sites. Therefore, adverse impacts on geology and soils are not likely.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Operations				
	Because there would be no ground disturbance and little or no use of geologic and soils materials at SRS or LANL, no impacts on geology and soils are expected.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Water Resources	***Construction***				
	Surface Water: Impacts on SRS surface water are expected to be minimal. Construction wastewater would be collected, temporarily stored, treated, and/or disposed of as required by SCDHEC regulations. Potential impacts from stormwater discharges during construction would be mitigated by compliance with the Storm Water Pollution Prevention Plan. *Groundwater*: Impacts on SRS groundwater are expected to be minimal. Groundwater use for facility construction would be well within available SRS capacity.	SRS impacts would be the same as under the No Action Alternative. *Surface Water*: Impacts on LANL surface water are expected to be minimal. Construction wastewater would be collected, temporarily stored, treated, and/or disposed of as required by NMED regulations. Potential impacts from stormwater discharges during construction would be mitigated by compliance with the Storm Water Pollution Prevention Plan. *Groundwater*: Impacts on LANL groundwater are expected to be minimal. Groundwater use for facility construction would be well within available LANL capacity.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Water Resources (cont'd)	***Operations***				
	Surface Water: Impacts on SRS and LANL surface water are expected to be minimal. Nonhazardous facility wastewater, stormwater runoff, and other industrial waste streams would be managed and disposed of in compliance with NPDES permit limits and requirements. *Groundwater*: Impacts on groundwater are expected to be minimal. Groundwater use for facility operations would be well within available SRS or LANL capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Noise	***Construction***				
	Impacts from SRS onsite noise sources would be small and construction traffic noise impacts would be unlikely to result in increased annoyance to the public.	Impacts at SRS would be similar to those under the No Action Alternative. Impacts from LANL onsite noise sources would be small and construction traffic noise impacts would be unlikely to result in increased annoyance to the public.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.
	Operations				
	- Noise from operational activities is not expected to result in increased annoyance to the public. - Noise from traffic associated with the operation of facilities is expected to increase by less than 1 decibel at SRS as a result of the increase in staffing and unchanged at LANL. - Noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats.	Same as under the No Action Alternative except for slight additional traffic noise at LANL due to an increase in staffing.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Ecological Resources	***Construction***				
	Land disturbed at SRS for PDCF construction was already disturbed during clearing for MFFF. No threatened or endangered species would be affected. Therefore, no major additional impacts are expected.	SRS impacts would be the same as under the No Action Alternative, except that previously disturbed land at K-Area would be used for construction of supporting structures for the immobilization capability. No major impacts are expected. Modification of PF-4 at LANL could result in temporarily disturbance of up to 2 acres of land; the preference would be to avoid previously undisturbed land in TA-55. No threatened or endangered species would be affected. Therefore, no major additional impacts are expected.	Impacts at SRS would be the same as under the No Action Alternative, except that previously disturbed land at K-Area would be used for construction of supporting structures for optional construction of PDC including 5 acres of previously undisturbed land. No major impacts are expected. LANL impacts would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Operations				
	No additional impacts are expected to result from operational activities at SRS or LANL.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Cultural Resources	***Construction***				
	- SRS Prehistoric Resources – No construction would be done in undisturbed areas; therefore, no impacts would occur within E-, K-, and S-Areas. Two NRHP-eligible sites at F-Area would be avoided. - SRS Historic Resources – No impacts would occur on NRHP-eligible sites within E-, F-, and S-Areas. - SRS American Indian Resources – No disturbance of American Indian resources would occur. - SRS Paleontological Resources – No disturbance of paleontological resources would occur.	- SRS Historic Resources – Impacts would be the same as under the No Action Alternative, except for several NRHP-eligible structures in K-Area. Work to install an immobilization capability in K-Area, or to modify NRHP-eligible H-Canyon would require consultation with the State Historic Preservation Office. - Other SRS resource impacts would be the same as under the No Action Alternative. - LANL Cultural Resources – Ground disturbance associated with installing temporary trailers will require the use of LANL's formal Permit Requirements Identification process to make sure all permits are in place and no cultural or natural resources are impacted.	- SRS Historic Resources – Impacts would be the same as under the No Action Alternative, except that construction of PDC within K-Area modification of the NRHP-eligible H-Canyon would require consultation with the State Historic Preservation Office. - LANL cultural resource impacts would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Operations				
	No impacts on cultural resources at SRS or LANL are expected.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/HB-Line to DWPF***	***WIPP***
Infrastructure (per year)	***Construction***				
	- SRS Electricity (megawatt-hours) – 15,000 - SRS Fuel (gallons) – 390,000 - SRS Water (gallons) – 2.6 million Utility usage would remain well within SRS's available capacities.	- SRS Electricity (megawatt-hours) – 9,000 to 24,000 - SRS Fuel (gallons) – 5,000 to 400,000 - SRS Water (gallons) – 2,000 to 2.6 million Utility usage would remain well within SRS's available capacities. - LANL Electricity (megawatt-hours) – 0 to 80 - LANL Fuel (gallons) – 0 to 2,800 - LANL Water (gallons) – 0 to 340,000 Utility usage would remain within LANL's available capacities.	- SRS Electricity (megawatt-hours) – minimal to 15,000 - SRS Fuel (gallons) – minimal to 390,000 - SRS Water (gallons) – minimal to 2.6 million Utility usage would remain well within SRS's available capacities. LANL infrastructure requirements would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Operations				
	- SRS Electricity (megawatt-hours) – 270,000 - SRS Fuel (gallons) – 320,000 - SRS Water (gallons) – 41 million Utility usage would remain well within SRS's available capacities. - LANL Electricity (megawatt-hours – 960 - LANL Fuel (gallons) – No additional - LANL Water (gallons) – 480,000 Utility usage would remain well within LANL's available capacities	- SRS Electricity (megawatt-hours) – 220,000 to 310,000 - SRS Fuel (gallons) – 300,000 to 340,000 - SRS Water (gallons) – 42 million to 58 million Utility usage would remain well within SRS's available capacities. - LANL Electricity (megawatt-hours) – 960 to 1,900 - LANL Fuel (gallons) – No additional - LANL Water (gallons) – 480,000 to 1,200,000 Utility usage would remain well within LANL's available capacities.	- SRS Electricity (megawatt-hours) – 170,000 to 270,000 - SRS Fuel (gallons) – 280,000 to 450,000 - SRS Water (gallons) – 25 million to 41 million Utility usage would remain well within SRS's available capacities. LANL infrastructure requirements would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.

BFN = Browns Ferry Nuclear Plant, BMPs = best management practices, DWPF = Defense Waste Processing Facility, LANL = Los Alamos National Laboratory, LCF = latent cancer fatality, LLW = low-level radioactive waste, MEI = maximally exposed (offsite) individual, MFFF = Mixed Oxide Fuel Fabrication Facility, MLLW = mixed low-level radioactive waste, MOX = mixed oxide, NMED = New Mexico Environment Department, NPDES = National Pollutant Discharge Elimination System; NRHP = National Register of Historic Places, PDC = Pit Disassembly and Conversion Project, PDCF = Pit Disassembly and Conversion Facility, PF-4 = Plutonium Facility, SCDHEC = South Carolina Department of Health and Environmental Control, SQN = Sequoyah Nuclear Plant, SRS = Savannah River Site, TA-55 = Technical Area 55, TRU = transuranic, WIPP = Waste Isolation Pilot Plant.

Notes: To convert miles to kilometers, multiply by 1.6093; cubic meters (solid) to cubic yards, multiply by 1.3079; cubic meters (liquid) to cubic feet, multiply by 35.314; liters to gallons, multiply by 0.26418; acres to hectares, multiply by 0.40469.

2.6.2 Summary of Cumulative Impacts

Council on Environmental Quality regulations (40 CFR Parts 1500–1508) define cumulative impacts as effects on the environment that result from implementing any of the action alternatives when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR 1508.7). Thus, the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource irrespective of the proponent.

A cumulative impacts analysis was conducted to determine those resource areas that have the greatest potential for cumulative impacts including the proposed surplus plutonium disposition activities at SRS and LANL. Based on an analysis of the impacts presented in Chapter 4 of this *SPD Supplemental EIS*, these resource areas were considered to be land use, air quality, human health, socioeconomics, infrastructure, waste management, transportation, and environmental justice. For the full discussion of cumulative impacts, refer to Chapter 4, Section 4.5.

Land Use. Cumulative land use at SRS could occupy 10,567 to 10,617 acres (4,276 to 4,297 hectares) of land. Cumulative land use would be generally compatible with existing land use plans and allowable uses of the site, and would involve up to 5.4 percent of the 198,344 acres (80,268 hectares) encompassing SRS. Activities proposed under the *SPD Supplemental EIS* alternatives would disturb a maximum of 52 acres (21 hectares) of land, or approximately 0.03 percent of available SRS land. Existing activities currently occupy approximately 9,900 acres (4,000 hectares) of SRS land.

Modification of PF-4 would not contribute to cumulative impacts at LANL, as less than 2 acres (0.8 hectares) of land would be disturbed.

Air Quality. Effects on air quality from construction, excavation, and remediation activities at SRS could result in temporary increases in air pollutant concentrations at the site boundary and along roads to which the public has access. These impacts would be similar to the impacts that would occur during construction of a similar-sized housing development or a commercial project. Emissions of fugitive dust from these activities would be controlled using water sprays and other engineering and management practices, as appropriate. The maximum ground-level concentrations off site and along roads to which the public has regular access would be below ambient air quality standards. Because earthmoving activities related to the actions considered in this cumulative impacts analysis would occur at different times and locations, air quality impacts are not likely to be cumulative.

DOE expects that the recent replacement of the boilers in D-, K-, and L-Areas with new biomass-fired cogeneration and heating facilities will decrease overall annual air pollutant emissions rates for particulate matter by about 360 metric tons (400 tons), nitrogen oxides by about 2,300 metric tons (2,500 tons), and sulfur dioxide by about 4,500 metric tons (5,000 tons). Annual emissions of carbon monoxide would increase by about 180 metric tons (200 tons) and volatile organic compounds by about 25 metric tons (28 tons) (DOE 2008e).

The cumulative maximum concentrations of nonradiological air pollutants at the site boundary from operation of all SRS facilities at the site boundary would meet regulatory standards. It is unlikely that actual concentrations would be as high as those projected for existing activities at SRS because the values for existing activities are based on maximum permitted allowable emissions and not on actual emissions. In general, the contribution from *SPD Supplemental EIS* alternatives would be less than significant impact levels except for nitrogen dioxide 1-hour contributions for all alternatives and $PM_{2.5}$ and sulfur dioxide short-term contributions for some alternatives.

Because of the small amount of land (2 acres [0.8 acres]) that could be disturbed during modifications at PF-4, LANL cumulative impacts associated with construction would not be expected to change. There would be no increase in emissions of criteria or nonradioactive toxic air pollutants from operation of PF-4; therefore, it would not contribute to cumulative impacts (see Chapter 4, Section 4.1.1).

Human Health. Radiological health effects are estimated in terms of radiological dose and excess LCF risk for the offsite population, hypothetical MEI, and radiological workers. The maximum cumulative regional population dose is estimated to be 25 person-rem per year (including impacts from SRS and the Vogtle Electric Generating Plant). This population dose is expected to result in no LCFs. Activities proposed under the *SPD Supplemental EIS* alternatives could result in annual doses of 0.54 to 0.97 person-rem and no LCFs.

The maximum cumulative dose to the SRS MEI is estimated to be 0.44 millirem per year, well below applicable DOE regulatory limits (10 millirem per year from the air pathway, 4 millirem per year from the liquid pathway, and 100 millirem per year for all pathways).[16] This MEI dose does not include contributions from the Vogtle Electric Generating Plant because the distance between the two sites precludes the same receptor receiving both doses.

The maximum cumulative annual SRS worker dose could total 540 to 860 person-rem, resulting in 0 to 1 LCFs. Activities proposed under the *SPD Supplemental EIS* alternatives could produce annual worker doses of 300 to 620 person-rem, resulting in no LCFs. ALARA principles would be implemented to maintain individual worker doses below the Administrative Control Level required by DOE regulations (10 CFR 835.1002), set at 2,000 millirem per year.

The maximum cumulative population dose is estimated to be 38 person-rem per year for the population living within a 50-mile (80-kilometer) radius of LANL. This population dose would not be expected to result in any LCFs. Activities proposed under the *SPD Supplemental EIS* alternatives could result in an annual dose of up to 0.21 person-rem and no LCFs.

The maximum cumulative dose to the LANL MEI is estimated to be 8.6 millirem per year, which is below the applicable DOE limit for air emissions (the only viable pathway). This is a very conservative estimate of potential dose to an MEI because the activities contributing to this dose are not likely to occur at the same time and location.

The maximum cumulative annual LANL worker dose could total 570 to 740 person-rem; no LCFs would be expected as a result of these doses. Activities proposed under the *SPD Supplemental EIS* alternatives could produce annual worker doses of 29 to 190 person-rem, resulting in no LCFs. ALARA principles would be implemented to maintain individual worker doses below the Administrative Control Level required by DOE regulations (10 CFR 835.1002), set at 2,000 millirem per year.

Socioeconomics. Cumulative employment at SRS could reach 9,000 to 9,900 persons under the alternatives being considered in this *SPD Supplemental EIS*. These values are conservative estimates of short-term future employment at SRS. Some of the employment would occur at different times and may not be additive. Future employment due to surplus plutonium disposition activities could reduce the adverse socioeconomic effects of a recent SRS workforce reduction of approximately 1,240 workers (Pavey 2011). Activities proposed under the *SPD Supplemental EIS* alternatives could produce direct employment of about 1,200 (under the H-Canyon/HB-Line to DWPF Alternative including the PF-4 and MFFF Option for pit disassembly and conversion) to about 2,100 (under the Immobilization to DWPF Alternative including the PDCF Option for pit disassembly and conversion). By comparison, approximately 215,000 people are employed in the ROI. In the ROI, in addition to the direct jobs, an

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[16] *As derived from DOE Order 458.1,* Radiation Protection of the Public and the Environment.

estimated 2,500 indirect jobs[17] could be created. Anticipated fluctuations in ROI employment are unlikely to greatly stress housing and community services in the ROI.

In addition to activities at SRS, construction of the Vogtle Electric Generating Plant Units 3 and 4 is estimated to result in peak construction employment of up to 4,300 workers. An in-migration of 2,500 construction workers is estimated to support construction activities. Although the Vogtle Electric Generating Plant is located outside the SRS ROI in nearby Burke County, Georgia, the socioeconomic impacts associated with activity at the Vogtle Electric Generating Plant would affect conditions in Richmond and Columbia Counties in Georgia, which are included in the SRS ROI. Both adverse and beneficial socioeconomic impacts are anticipated from construction at the Vogtle Electric Generating Plant. The impacts in both scenarios are estimated to be small to moderate (NRC 2011a).

If higher levels of pit disassembly and conversion were performed at PF-4 under any of the action alternatives, there would be an increase of approximately 253 LANL employees. This additional employment would result in no change in the cumulative socioeconomic conditions of the LANL ROI, but would help to offset workforce reductions currently being pursued at LANL. The number of LANL employees supporting pit disassembly operations at PF-4 would represent a small fraction of the LANL workforce (approximately 13,500 in 2010) and an even smaller fraction of the regional workforce (approximately 163,000 in 2011). However, future employment due to surplus plutonium disposition activities at LANL could reduce the adverse socioeconomic effects of an expected workforce reduction of up to 800 workers (LANL 2012b). In the LANL ROI, in addition to the direct jobs, an estimated 256 indirect jobs[18] could be created if higher levels of pit disassembly and conversion were performed in PF-4. Any fluctuations in ROI employment are unlikely to greatly stress housing and community services in the ROI.

Infrastructure. Including activities proposed in this *SPD Supplemental EIS*, projected SRS site activities would annually require approximately 460,000 to 600,000 megawatt-hours of electricity and 380 million to 410 million gallons (1.4 billion to 1.6 billion liters) of water to support operation of the proposed surplus plutonium disposition capabilities and other SRS operations. SRS would remain well within its capacity to deliver electricity and water.

Including activities proposed in this *SPD Supplemental EIS*, projected LANL and Los Alamos County activities would annually require approximately 880,000 megawatt-hours of electricity and 1.7 billion gallons (6.3 billion liters) of water to support operation of the proposed pit disassembly and conversion activities and other LANL and Los Alamos County operations. LANL would remain within its capacity to deliver electricity and water.

Waste Management. **Table 2–4** lists cumulative volumes of LLW, MLLW, hazardous waste, and solid nonhazardous sanitary wastes that would be generated at SRS under the *SPD Supplemental EIS* alternatives. Cumulative waste volumes from existing site activities at SRS are projected over 30 years, a period of time that exceeds the projected periods of construction or operation of all plutonium facilities under the action alternatives addressed in this *SPD Supplemental EIS*. TRU waste projections are presented in Table 2–6. LLW, MLLW, hazardous waste, and solid nonhazardous waste are expected to have increased generation rates under all alternatives. The waste volumes also include wastes from possible disposal of greater-than-Class C low-level radioactive waste at SRS pursuant to the *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (DOE 2011a:1-9, 5-89).

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[17] *Indirect jobs were estimated for the area surrounding SRS using the 2.19 employment multiplier provided in Chapter 3, Section 3.1.8, of this* SPD Supplemental EIS.

[18] *Indirect jobs were estimated for the area surrounding LANL using the 2.0 employment multiplier provided in Chapter 3, Section 3.2.8, of this* SPD Supplemental EIS.

Table 2–4 Total Cumulative Waste Generation at the Savannah River Site (cubic meters)

Activity (duration)		***Solid LLW***	***Solid MLLW***	***Solid Hazardous Waste***	***Solid Nonhazardous Waste*** [a]
Present and Reasonably Foreseeable Future Actions		**466,000**	**6,100**	**5,800**	**3,200,000**
SPD Supplemental EIS Alternatives [b]	No Action	16,000	0	66	31,000
	Immobilization to DWPF [c]	15,000 – 36,000	900 – 930	910 – 960	18,000 – 2,800,000
	MOX Fuel [c]	20,000 – 42,000	14 – 220	7 – 7,000	1,200,000 – 2,800,000
	H-Canyon/HB-Line to DWPF [c]	27,000 – 49,000	31 – 240	7 – 7,000	2,600,000 – 2,800,000
	WIPP	11,000 – 33,000	0 – 210	6 – 7,000	15,000 – 2,800,000
Total [d]		**480,000 – 520,000**	**6,100 – 7,000**	**5,800 – 13,000**	**3,200,000 – 6,000,000**

DWPF = Defense Waste Processing Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Includes sanitary solid waste (e.g., trash) plus construction and demolition debris.

[b] Waste generation values at SRS for the alternatives addressed in this chapter. The projected rates have been rounded.

[c] Under the MOX Fuel and H-Canyon/HB-Line to DWPF Alternatives, some surplus plutonium would be dissolved at H-Canyon/HB-Line and vitrified with HLW at DWPF. These alternatives would respectively generate approximately 48 additional canisters containing vitrified HLW. Under the Immobilization to DWPF Alternative, approximately 95 additional canisters containing vitrified HLW would be produced at DWPF. All vitrified HLW would be safely stored at the SRS Glass Waste Storage Buildings pending their offsite disposition.

[d] Total is a range that includes the minimum and maximum values from the *SPD Supplemental EIS* alternatives. Total may not equal the sum of the contributions due to rounding.

Note: To convert cubic meters to cubic feet, multiply by 35.314.

Under the H-Canyon/HB-Line to DWPF Alternative, some surplus plutonium materials would be dissolved at H-Canyon/HB-Line, mixed with HLW, and vitrified at DWPF. Because the dissolved plutonium would displace some of the HLW feed to DWPF, implementation of the H-Canyon/HB-Line to DWPF Alternative could result in generation of up to approximately 48 additional canisters containing vitrified HLW. Under the Immobilization to DWPF Alternative, approximately 95 additional canisters containing vitrified HLW could be produced at DWPF. DOE would store canisters of vitrified HLW at SRS in S-Area GWSBs pending their offsite disposition.

LLW would be sent to E-Area for disposal in a low-activity waste vault or engineered trench, or transported off site to commercial disposal facilities or the Nevada Nuclear Security Site. MLLW would be temporarily stored at permitted SRS storage facilities and transported to offsite treatment, storage, and disposal facilities. Consistent with the ROD for the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (63 FR 41810), hazardous wastes would continue to be disposed of off site. Solid nonhazardous waste would continue to be disposed of at the Three Rivers Regional Landfill, consistent with current practices. Also, although operation of the proposed biomass cogeneration and heating plants at D-, K-, and L-Areas would generate wood ash that would be disposed of at landfills such as the Three Rivers Regional Landfill, compared with current conditions, DOE expects an overall decrease in the quantities of solid nonhazardous wastes requiring disposal. This is because the biomass fuels to be burned in the new plants would reduce the amount of fly and bottom ash (compared to coal ash) entering SRS landfills by more than 95 percent. Furthermore, the biomass fuels to be burned would otherwise require disposal space in landfills (DOE 2008e:36).

Table 2–5 lists cumulative volumes of LLW, MLLW, hazardous waste, and solid nonhazardous sanitary wastes that would be generated at LANL under the *SPD Supplemental EIS* alternatives. Cumulative waste volumes from existing site activities are projected over 30 years, a period of time that exceeds the projected periods of construction or operation of all plutonium disposition facilities under the action alternatives addressed in this *SPD Supplemental EIS*. TRU waste projections for SRS and LANL are presented in **Table 2–6**. Waste generation volumes from existing site activities are derived from the

Final Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (CMRR-NF SEIS) (DOE 2011g:4-119), which updates project waste generation volumes presented in the *Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (LANL SWEIS)* (DOE 2008f). Since publication of the *CMRR-NF SEIS*, the Los Alamos Science and Engineering Complex project, referred to in the *LANL SWEIS* as the "Science Complex," was cancelled; however, projected waste generation from this project is negligible. The cumulative waste volumes also include wastes from possible disposal of greater-than-Class C waste at LANL pursuant to the *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (DOE 2011a:1-9, 5-89). Also considered in the cumulative analysis is the maximum potential waste generation under the Removal with Off-Site Disposal Alternative as presented in the *Final Environmental Assessment for the Expansion of Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 of Sandia Canyon at LANL* (DOE 2010e:78).

Table 2–5 Total Cumulative Waste Generation at LANL (cubic meters)

Activity (duration)		*Solid LLW*	*Solid MLLW*	*Solid Hazardous Waste*	*Solid Nonhazardous Waste*
Present and Reasonably Foreseeable Future Actions					
Existing site activities (30 years) [a]		25,000 – 105,000	320 – 14,000	1,650 – 3,000	135,000 – 160,000
GTCC facilities (DOE 2011a:5-89) [b]		12	0	128	230,000
GTCC disposal at LANL (DOE 2011a:1-9)		12,000	170	0	0
Expansion of SERF and environmental restoration of Reach S-2 of Sandia Canyon (DOE EA 1736) [c]		0	0	38,300	38,300
Subtotal Baseline Plus Other Actions		*37,000 – 117,000*	*490 – 14,000*	*40,000 – 41,000*	*400,000 – 430,000*
SPD Supplemental EIS Alternatives	No Action	200	2	0 – 4	0
	Immobilization to DWPF	200 – 4,000	2 – 87	0 – 4	0
	MOX Fuel	200 – 4,000	2 – 87	0 – 4	0
	H-Canyon/ HB-Line to DWPF	200 – 4,000	2 – 87	0 – 4	0
	WIPP	200 – 4,000	2 – 87	0 – 4	0
Total		**37,000 – 121,000**	**490 – 14,000**	**40,000 – 41,000**	**400,000 – 430,000**

DWPF = Defense Waste Processing Facility; GTCC = Greater-Than-Class C; LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; MOX = mixed oxide; SERF = Sanitary Waste Reclamation Facility; WIPP = Waste Isolation Pilot Plant.

[a] Volumes were obtained from Chapter 4, Table 4–57, of the *CMRR-NF SEIS* (DOE 2011g:4-119), which provides a revised annual average waste generation rate for LANL operations subsequent to the *LANL SWEIS* (DOE 2008f) and assuming the annual average generation rates continue for 30 years. Chemical waste is reported as pounds; assumed 4,000 pounds per cubic meter and hazardous waste.

[b] Highest potential construction and operations generation volume from either the trench, borehole, or vault alternative as shown in Table 5.3.11-1 of the *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C Low-Level Radioactive Waste and GTCC-Like Waste* (DOE 2011a:1-9, 5-89).

[c] Under the Removal with Off-Site Disposal Alternative, up to 76,500 cubic meters of solid hazardous and nonhazardous waste could be generated; half was assumed for each type of waste.

Note: Total may not equal the sum of the contributions due to rounding. To convert cubic meters to cubic feet, multiply by 35.314.

Table 2–6 Cumulative Transuranic Waste Generation at Savannah River Site and Los Alamos National Laboratory (cubic meters)

	Alternatives				
Activity	***No Action***	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/ HB-Line to DWPF***	***WIPP***
Subtotal baseline plus other actions at SRS	9,660 [a]				
Subtotal baseline plus other actions at LANL	10,200 [a]				
SPD Supplemental EIS alternatives	6,000	11,000 – 13,000	11,000 – 12,000	7,900 – 8,500	15,000 – 17,000
Percent of unsubscribed WIPP capacity [b]	30	58 – 67	57 – 63	40 – 43	78 – 88

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; MOX = mixed oxide; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] Baseline TRU waste volumes at SRS and LANL are already included in the subscribed TRU waste projected in the *Annual Transuranic Waste Inventory Report – 2011* (DOE 2011k:Table 3–1); therefore, these quantities are not included in the percent of unsubscribed WIPP capacity calculations.

[b] WIPP unsubscribed capacity is approximately 19,700 cubic meters. The greatest impact on the WIPP unsubscribed capacity (about 88 percent) occurs under the WIPP Alternative assuming generation of approximately 16,000 cubic meters of TRU waste at SRS and 1,200 cubic meters of TRU waste at LANL.

Note: To convert cubic meters to cubic feet, multiply by 35.314.

Generation rates of LLW, MLLW, hazardous waste, and solid nonhazardous waste are expected to remain relatively unchanged at LANL under all alternatives.

Because TRU waste from both SRS and LANL would be shipped to WIPP, the range of TRU waste volume generation needs to be evaluated considering both SRS and LANL inclusively under the different alternatives, assuming pit and disassembly and conversion operations only occur at one site. Table 2–6 lists the ranges of cumulative TRU waste generation under all *SPD Supplemental EIS* alternatives and the impact this volume of TRU waste would have on unsubscribed WIPP capacities.

The total WIPP capacity for TRU waste disposal is set at 175,600 cubic meters (6.2 million cubic feet) pursuant to the WIPP Land Withdrawal Act, or 168,485 cubic meters (5.95 million cubic feet) of contact-handled TRU waste (DOE 2008k:16). Estimates in the *Annual Transuranic Waste Inventory Report – 2011* indicate that about 148,800 cubic meters (5.25 million cubic feet) of contact-handled TRU waste would be disposed of at WIPP (DOE 2011k:Table C–1), approximately 19,700 cubic meters (696,000 cubic feet) less than the current contact-handled TRU waste capacity. Depending on the alternative for surplus plutonium disposition, the volume of TRU waste that could be generated would represent 30 to 88 percent of this unsubscribed WIPP disposal capacity. Since the TRU waste projections from baseline activities at SRS and LANL are already included in subscribed estimates for these sites, implementation of surplus plutonium disposition would leave approximately 2,700 cubic meters (95,000 cubic feet) to 13,700 cubic meters (480,000 cubic feet) of unsubscribed capacity at WIPP to support other activities. Under the MOX Fuel and WIPP Alternatives, less TRU waste would be generated, representing a smaller percentage of the unsubscribed WIPP disposal capacity, if the portion of non-pit plutonium inventory that is unirradiated FFTF fuel was shipped as waste directly to WIPP, and if criticality control containers were used for packaging surplus plutonium for WIPP disposal rather than the assumed POCs.[19] Future decisions about the disposal of any significant quantities of TRU waste would be made in the context of the needs of the entire DOE complex.

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[19] *If both options were implemented, the cumulative TRU waste volume under the MOX Fuel Alternative would drop from a maximum of 63 percent of the unsubscribed WIPP disposal capacity (assuming 2 metric tons [2.2 tons] of surplus plutonium are disposed of at WIPP) to approximately 53 percent. The cumulative TRU waste volume under the WIPP Alternative would drop from 88 percent of the unsubscribed WIPP disposal capacity to approximately 63 percent.*

Transportation. The impacts from transportation in this *SPD Supplemental EIS* are quite small compared with overall cumulative transportation impacts. The collective worker dose from all types of shipments (including those under the alternatives in this *SPD Supplemental EIS*, historical shipments, reasonably foreseeable actions, and general transportation) was estimated to be about 420,000 person-rem (resulting in 252 LCFs) for the period 1943 through 2073 (131 years). The general population collective dose was estimated to be about 436,000 person-rem (resulting in 262 LCFs). Worker doses under *SPD Supplemental EIS* alternatives would be about 240 to 560 person-rem (no [0.1 and 0.3] LCFs). General population doses under *SPD Supplemental EIS* alternatives would be about 180 to 580 person-rem (no [0.09 and 0.3] LCFs). To place these numbers in perspective, the National Center for Health Statistics indicates that the annual average number of cancer deaths in the United States from 1999 through 2004 was about 560,000, with less than a 1 percent fluctuation in the number of deaths in any given year (CDC 2012). The total number of LCFs (among the workers and general population) estimated to result from radioactive material transportation over the period between 1943 and 2073 is 514, or an average of about 4 LCFs per year. The transportation-related LCFs would represent about 0.0007 percent of the overall annual number of cancer deaths. The majority of the cumulative risks to workers and the general population would be due to the general transportation of radioactive material unrelated to activities evaluated in this *SPD Supplemental EIS*.

Environmental Justice. Cumulative environmental justice impacts occur when the net effect of regional projects or activities results in disproportionately high and adverse human health and environmental effects on minority or low-income populations. As discussed in Chapter 4, Section 4.1.6, of this *SPD Supplemental EIS*, an analysis of the potential environmental impacts associated with the proposed surplus plutonium disposition activities at SRS and LANL was performed for both minority and low-income populations as well as nonminority and non-low-income populations concluded that no disproportionately high and adverse human health and environmental effects would be incurred by minority or low-income populations as a result of implementing any of the alternatives under consideration in this *SPD Supplemental EIS.* Chapter 4, Section 4.5.3.8, of this *SPD Supplemental EIS* evaluated the cumulative impacts of additional activities in the areas surrounding SRS and LANL and reached the same conclusion.

CHAPTER 3
AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

In Chapter 3, affected environment descriptions for the Savannah River Site (SRS), Los Alamos National Laboratory (LANL), and the Tennessee Valley Authority's (TVA's) Browns Ferry Nuclear Plant and Sequoyah Nuclear Plant are presented. The affected environments for SRS and LANL are described for the following resources areas: land resources; geology and soils; water resources; meteorology, air quality, and noise; ecological resources; human health; cultural and paleontological resources; socioeconomics; infrastructure; waste management; and environmental justice. Because of the limited range of potential environmental impacts at the TVA nuclear plants, a reduced set of resource areas are described: air quality and noise; radiation exposure and risk; waste management; and environmental justice.

In accordance with the Council on Environmental Quality's National Environmental Policy Act regulations (40 *Code of Federal Regulations* [CFR] Parts 1500 through 1508), this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement* (*SPD Supplemental EIS*) succinctly describes the areas that could be affected by the alternatives under consideration. The affected environment descriptions provide the context for understanding the environmental consequences described in Chapter 4 of this supplemental environmental impact statement (SEIS), and serve as baselines from which any potential environmental impacts can be evaluated.

For this SEIS, each resource area that may be affected by the Proposed Action and alternatives is described. The level of detail varies depending on the potential for impacts for each resource area. A number of site-specific and recent project-specific documents that are important sources of information for describing the existing environment are summarized and/or incorporated by reference in this chapter.

An important component in analyzing impacts is identifying or defining the region of influence (ROI) for each resource area. The ROIs are specific to the type of effect evaluated and encompass geographic areas within which potential impacts could be expected to occur. **Table 3–1** briefly describes the ROIs by site for each resource area evaluated in this SEIS. Note that transportation is included in Table 3–1 because this resource area is evaluated and the impacts presented in Chapter 4. However, it is not included among the resource areas described in Chapter 3.

This chapter begins with descriptions of the affected environment for the Savannah River Site (SRS) in Section 3.1, followed by Los Alamos National Laboratory (LANL) in Section 3.2, then the Tennessee Valley Authority's (TVA's) Browns Ferry Nuclear Plant and Sequoyah Nuclear Plant in Section 3.3.

Table 3–1 General Regions of Influence for Resource Areas

Resource Area	***Site***	***Region of Influence***
Land use and visual resources	SRS and LANL	Land use and visual resources within SRS and LANL, and nearby offsite areas
	BFN and SQN	Not applicable [a]
Geology and soils	SRS and LANL	Geologic and soil resources within SRS, LANL, and nearby offsite areas
	BFN and SQN	Not applicable [a]
Water resources	SRS and LANL	Surface-water bodies and groundwater within SRS and LANL, and nearby offsite areas
	BFN and SQN	Not applicable [a]
Air quality and noise	SRS, LANL, BFN and SQN	SRS, LANL, BFN and SQN and nearby offsite areas within local air quality control regions and the transportation corridors for the sites
Ecological resources	SRS and LANL	SRS, LANL, and adjacent offsite areas where aquatic and terrestrial ecological communities exist, including non-sensitive and sensitive habitats and species
	BFN and SQN	Not applicable [a]
Human health risk	SRS, LANL, BFN and SQN	SRS, LANL, BFN and SQN, and offsite areas (within 50 miles [80 kilometers] of the sites) where worker and general population radiation, radionuclide, and hazardous chemical exposures may occur
Cultural and paleontological resources	SRS and LANL	SRS, LANL, and adjacent offsite areas where cultural and paleontological resources exist
	BFN and SQN	Not applicable [a]
Socioeconomics	SRS	The four counties surrounding SRS: Aiken and Barnwell in South Carolina, and Columbia and Richmond in Georgia
	LANL	The four counties surrounding LANL: Los Alamos, Santa Fe, Sandoval, and Rio Arriba
	BFN and SQN	Not applicable [a]
Infrastructure	SRS and LANL	Power, fuel supply, water supply, and road systems within SRS and LANL
	BFN and SQN	Not applicable [a]
Waste management	SRS, LANL, BFN and SQN	Waste treatment, storage, and disposal facilities within SRS, LANL, BFN and SQN
Transportation	SRS and LANL	The population living within 0.5 miles (0.80 kilometers) of either side of an offsite route for incident-free impacts, and a population within 50 miles (80 kilometers) of an accident
	BFN and SQN	Not applicable [a]
Environmental justice	SRS, LANL, BFN and SQN	The minority and low-income populations within 50 miles (80 kilometers) of SRS, LANL, BFN and SQN

BFN = Browns Ferry Nuclear Plant; LANL = Los Alamos National Laboratory; SQN = Sequoya Nuclear Plant; SRS = Savannah River Site.

[a] Consistent with the *SPD EIS*, four resource areas were considered for the two potential TVA reactor sites, Browns Ferry and Sequoyah Nuclear Plants: air quality and noise, radiation exposure and risk, waste management, and environmental justice.

3.1 Savannah River Site

This section describes the SRS environment in general and the facility areas (E-, F-, H-, K-, and S-Areas) in which activities described in Chapter 2 have been proposed. The descriptions in this section update information provided in Chapter 3, Section 3.5, of the *Surplus Plutonium Disposition Final Environmental Impact Statement* (*SPD EIS*) (DOE 1999b) for SRS, and provide additional information on the specific facility areas, as appropriate.

3.1.1 Land Resources

Land resources include both land use and visual resources.

3.1.1.1 Land Use

Land use is defined as the way land is developed and used in terms of the kinds of human activities that occur (e.g., agriculture, residential areas, and industrial areas) (EPA 2006).

General Site Description

Located in southwestern South Carolina, SRS occupies an area of 198,344 acres (80,268 hectares) in a generally rural area about 25 miles (40 kilometers) southeast of Augusta, Georgia, and 12 miles (19 kilometers) south of Aiken, South Carolina, the nearest population centers. It is bordered by the Savannah River to the southwest and includes portions of three South Carolina counties: Aiken, Allendale, and Barnwell. SRS is a controlled area, public access being limited to through traffic on State Highway 125 (SRS Road A), U.S. Highway 278 (SRS Road 1), and the CSX railway line (DOE 1999b:3-163; SRNS 2009b:1-1).

Predominant regional land uses in the vicinity of SRS include urban, residential, industrial, agricultural, and recreational. SRS is bordered mostly by forest and agricultural land, with limited urban and residential development. The nearest residences are located to the west, north, and northeast, some within 200 feet (61 meters) of the SRS boundary (NRC 2005a:3-36). Farming is diversified throughout Aiken, Allendale, and Barnwell Counties and includes such crops as corn, hay, peanuts, cotton, and winter wheat (USDA 2008). Industrial areas are also present within 25 miles (40 kilometers) of the site; industrial facilities include textile mills, polystyrene foam and paper plants, chemical processing plants, the Barnwell low-level radioactive waste (LLW) facility, and a commercial nuclear power plant. Open water and nonforested wetlands occur along the Savannah River Valley. Recreational areas within 50 miles (80 kilometers) of SRS include Sumter National Forest, Santee National Wildlife Refuge, and Clark's Hill/Strom Thurmond Reservoir. State, county, and local parks include Redcliffe Plantation, Rivers Bridge, Barnwell State Park, and the Aiken State Natural Area in South Carolina, and Mistletoe State Park in Georgia. The Crackerneck Wildlife Management Area occupies a portion of SRS along the Savannah River and is open to the public for hunting and fishing at certain times of the year (NRC 2005a:3-36).

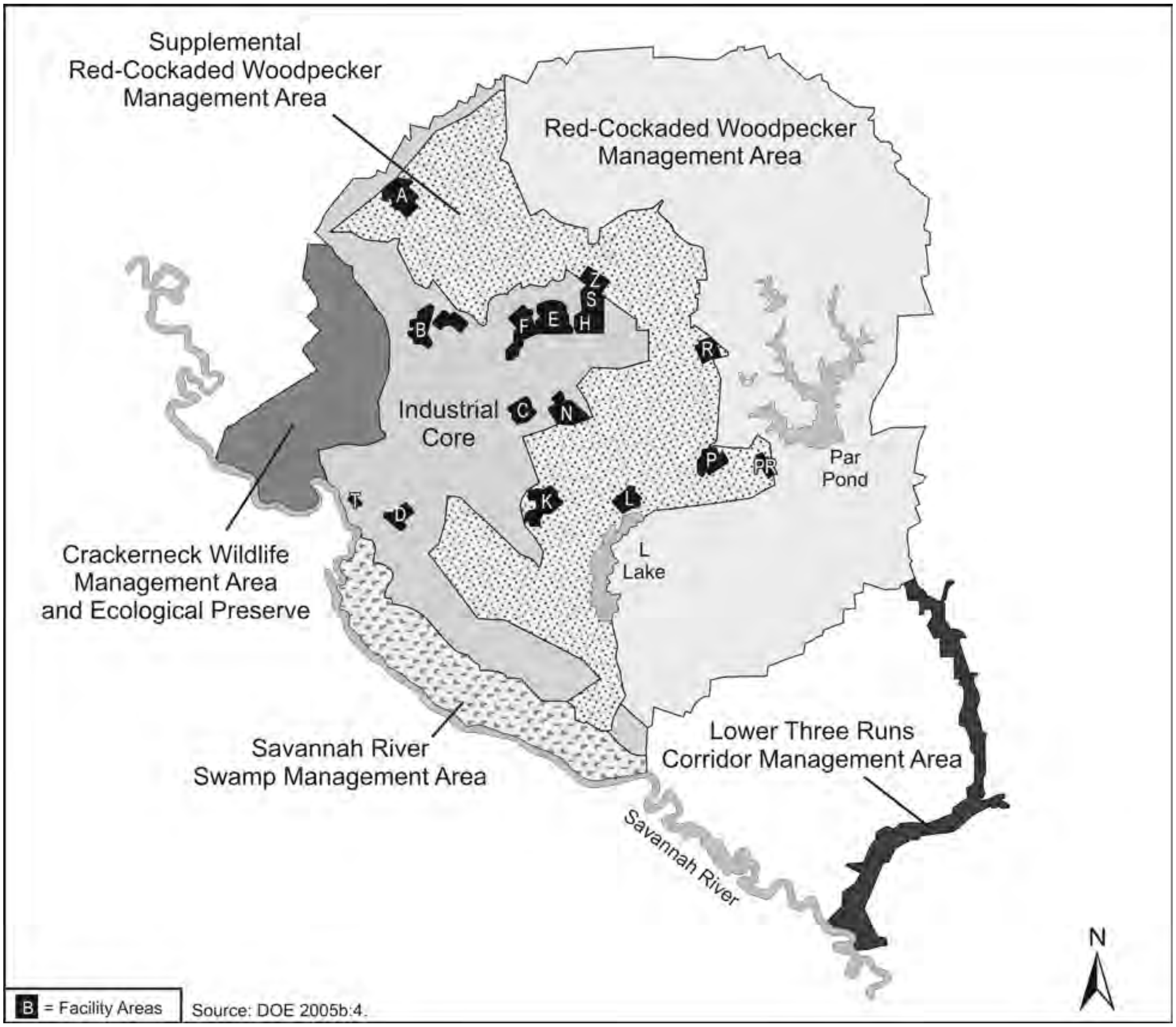
The State of South Carolina Councils of Governments were formed in 1967, when the state was divided into 10 planning districts. Six counties are included in the Lower Savannah River Planning District, including Aiken, Allendale, and Barnwell Counties, the three counties within which SRS is located (SCARC 2010). Private lands bordering SRS are subject to the planning regulations of these three counties (DOE 1999b:3-163).

Land use at SRS can be classified into three major categories: forest/undeveloped, water/wetlands, and developed facilities. Open fields and pine and hardwood forests make up 73 percent of the site, while 22 percent is wetlands, streams, and two lakes. Production and support areas, roads, and utility corridors account for the remaining 5 percent of the land area (DOE 2005c:3-8). The U.S. Forest Service, under an interagency agreement with the U.S. Department of Energy (DOE), manages timber production on about 149,000 acres (60,300 hectares) (USFS-Savannah River 2004:12). Public hunts for white-tailed deer (*Odocoileus virginianus*), feral hogs (*Sus scrofa*), wild turkeys (*Meleagris gallopavo*), and coyote (*Canis latrans*) are allowed on site. In 2008, 432 deer and 110 hogs were harvested from SRS (SRNS 2009b:5-8). Soil map units that meet the requirements for prime farmland soils exist on the site. However, the Natural Resources Conservation Service of the U.S. Department of Agriculture does not identify these as prime farmlands because the land is not available for agricultural production (DOE 1999b:3-163–3-165).

Decisions on future land uses at SRS are made by DOE through site development, land use, and future planning processes. SRS has established a Land Use Technical Committee comprising representatives from DOE, the management and operating contractor, and other SRS organizations (DOE 1999b:3-165). DOE has prepared a number of documents addressing the future of SRS, including the *Savannah River Site End State Vision* report (DOE 2005c) and the *Savannah River Site Comprehensive Plan/Ten Year Plan, FY 2011-2020* (SRNS 2010c). As noted in these documents, the Environmental Management Cleanup Project and mission will be complete by 2031 and ongoing National Nuclear Security Administration (NNSA) nuclear industrial missions will continue. SRS is a site with an enduring mission and is not a closure site; thus, SRS land will be federally owned, controlled, and maintained in perpetuity (DOE 2005c:4, SRNS 2010c:E-5).

As depicted in **Figure 3–1**, the site has been divided into six management areas based on existing biological and physical conditions, operations capability, and suitability for mission objectives. The 38,444-acre (15,558-hectare) Industrial Core Management Area contains the major SRS facilities. The primary objective of this area is to support facilities and site missions. Other important objectives are to promote conservation and restoration, provide research and educational opportunities, and generate revenue from the sale of forest products. Protection of the red-cockaded woodpecker (*Picoides borealis*) dominates natural resource decisions in the 87,200-acre (35,289-hectare) Red-cockaded Woodpecker Management Area and the 47,100-acre (19,061-hectare) Supplemental Red-cockaded Woodpecker Management Area (DOE 2005b:4-6). The Crackerneck Wildlife Management Area and Ecological Reserve is 10,400 acres (4,209 hectares) in size, and is managed by the South Carolina Department of Natural Resources (SCDNR 2010a). The primary objective of this management area is to enhance wildlife habitat through forestry and wildlife management practices. The management objective of the 10,000-acre (4,047-hectare) Savannah River Swamp and 4,400-acre (1,780-hectare) Lower Three Runs Corridor Management Area is to improve the physical and biological quality of the wetland environment (DOE 2005b:4-6).

In 1972, all of SRS was designated as a National Environmental Research Park. The purpose of the National Environmental Research Park is to conduct research and education activities to assess and document environmental effects associated with energy and weapons material production, explore methods for eliminating or minimizing adverse effects of energy development and nuclear materials on the environment, train people in ecological and environmental sciences, and educate the public (SREL 2010a). DOE has also established a set-aside program to provide reference areas for understanding human impacts on the environment. The SRS set-aside program currently contains 30 research reserves totaling 14,006 acres (5,668 hectares). These reserves were chosen as representatives of the eight major vegetation communities on the site (SREL 2010b).



Source: DOE 2005b:4.

Figure 3–1 Savannah River Site Management Areas

No onsite areas are subject to American Indian treaty rights. However, five American Indian 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 the National Environmental Policy Act (DOE 1999b:3-165).

Proposed Facility Locations

The locations of the areas described in this section are depicted in Figure 3–1.

E-Area is located in the Industrial Core Management Area between the F- and H-Areas. E-Area comprises approximately 330 acres (134 hectares) and includes the Old Burial Ground, Mixed Waste Management Facility, transuranic (TRU) waste pads, and E-Area Vaults. E-Area receives solid LLW, TRU waste, and mixed waste from across SRS. E-Area facilities are maintained to manage previously received waste and to prepare for the receipt of waste from new site operations. The current land use designation for E-Area is industrial (DOE 2005c:53). Existing facilities in E-Area would be used for storage, staging, and shipping of TRU waste, LLW, and mixed low-level radioactive waste (MLLW) that would be generated by surplus plutonium disposition activities. In addition, most of the LLW that would be generated by surplus plutonium disposition activities would be disposed of in vaults and trenches in E-Area.

F-Area is a highly developed area covering approximately 364 acres (147 hectares) near the center of SRS (DOE 2002b:3-32). It is located 5.8 miles (9.3 kilometers) from the site boundary and is within the Industrial Core Management Area (DOE 1999b:3-163). The area includes nuclear, industrial, warehouse, laboratory, and administrative facilities. F-Area is the location for the Mixed Oxide Fuel Fabrication Facility (MFFF) and Waste Solidification Building (WSB), both of which are currently under construction.

H-Area covers 395 acres (160 hectares) and is located near the center of SRS, 6.8 miles (11 kilometers) from the site boundary (DOE 2002b:3-32). Like F-Area, H-Area is located within the Industrial Core Management Area. The area includes nuclear, industrial, warehouse, and administrative facilities. H-Area is the last operational nuclear chemical separation area at SRS; H-Canyon/HB-Line is located in this area (SRNS 2010c:3-67).

K-Area is a 3,558-acre (1,440-hectare) area situated near the center of SRS and located just outside of the Industrial Core Management Area within the Supplemental Red-Cockaded Woodpecker Management Area. The area is 5.5 miles (8.9 kilometers) from the site boundary. K-Area is one of five SRS reactor areas with the original mission of producing material for the U.S. nuclear weapons program; however, the K-Area production reactor is in a shutdown condition with no restart capability. The K-Area Material Storage Area is located in the K-Area Complex (SRNS 2010c:3-85).

S-Area is situated in the Industrial Core Management Area and is located just north of H-Area, approximately 6.2 miles (10 kilometers) from the site boundary. This area is approximately 272 acres (110 hectares) in size. Facilities located in S-Area are related to liquid radioactive waste immobilization and interim storage (DOE 1999b:3-165; WSRC 2007b:2-15). The Defense Waste Processing Facility (DWPF) and the two Glass Waste Storage Buildings are located in S-Area.

3.1.1.2 Visual Resources

Visual resources are natural and manmade 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 more visual variety that exists with harmony, the more aesthetically pleasing the landscape (DOE 1999b:3-166).

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 comprises bottomland hardwood forests, scrub oak and pine forests, and forested wetlands. Facilities are scattered throughout SRS and are brightly lit at night. These facilities are generally not visible off site, 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 U.S. Highway 278 (DOE 1999b:3-166).

The developed areas and utility corridors (transmission lines and aboveground pipelines) of SRS are consistent with a Visual Resource Management Class IV designation. The remainder of SRS is consistent with a Visual Resource Management Class II or Class III designation. Management activities within Class II and Class III areas may be seen, but do not dominate the view; management activities in Class IV areas dominate the view and are the focus of viewer attention (DOI 1986:6, 7).

Proposed Facility Locations

Industrial facilities within E-, F-, H-, K-, and S-Areas consist of large concrete structures, smaller administrative and support buildings, trailers, and parking lots. The structures range in height from 10 to 100 feet (3 to 30 meters), with a few stacks and towers that reach up to 200 feet (61 meters). The facilities in these areas are brightly lit at night and visible when approached via SRS access roads (DOE 1999b:3-164). Visual resource conditions in each of the proposed facility locations are consistent with a Visual Resource Management Class IV designation. E-, F-, H-, and S-Areas are about 4.3 to 6.8 miles (6.9 to 11 kilometers) from State Highway 125 and 5.3 to 6.8 miles (8.5 to 11 kilometers) from U.S. Highway 278. K-Area is about 1.2 miles (1.9 kilometers) from State Highway 125 and 10 miles (16 kilometers) from U.S. Highway 278. Public views of the facilities within each of the proposed locations are restricted by heavily wooded areas and the nature of the terrain bordering segments of State Highway 125 and U.S. Highway 278. Moreover, facilities are not visible from the Savannah River, which is no closer than 5.5 miles (8.9 kilometers) from any of the locations in which proposed activities would occur (DOE 1999b:3-166).

3.1.2 Geology and Soils

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. A detailed description of the geology at SRS is included in the MFFF license application (DCS 2006:1-375–1-549).

Soil resources are the loose surface materials of the Earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts. A detailed description of the soil conditions at SRS is included in the *SRS Ecology Environmental Information Document* (WSRC 2006b:1-1–1-14).

3.1.2.1 Geology

General Site Description

SRS is primarily located on the Aiken Plateau, within the southern portion of the South Carolina Upper Atlantic Coastal Plain. The Aiken Plateau, on which the central and northeastern portions of SRS are located, is highly dissected and characterized by broad flat areas cut by narrow, steep-sided valleys. The southwestern portions of SRS are located on erosional terraces. The terraces are the result of successive marine recessions during the glacial periods about 10,000 to 1 million years ago (WSRC 2006b:1-1).

The loosely consolidated Atlantic Coastal Plain sediments are located above bedrock that consists of Paleozoic-age metamorphic and igneous rock (e.g., granite) and Triassic-age sedimentary rock (e.g., siltstone) of the Dunbarton Basin (NRC 2005a:3-3). The Atlantic Coastal Plain sediments consist of layers of sandy clays and clayey sands, along with occasional beds of clays, silts, sands, gravels, and carbonate that dip gently and thicken to the southeast from near zero at the fall line to about 4,000 feet (1,219 meters) at the South Carolina coast (NRC 2005a:3-3; WSRC 2006b:1-1, 2006g:54). The Atlantic Coastal Plain sediments at SRS are approximately 600 to 1,400 feet (183 to 427 meters) thick (DOE 2002b:3-1).

The Atlantic Coastal Plain sedimentary sequence near the center of SRS consists of about 700 feet (213 meters) of late Cretaceous quartz sand, pebbly sand, and kaolinitic clay, overlain by about 60 feet (18 meters) of Paleocene clayey and silty quartz sand, glauconitic sand, and silt. The Paleocene beds are overlain by about 350 feet (107 meters) of Eocene quartz sand, glauconitic quartz sand, clay, and limestone grading into calcareous sand, silt, and clay. In places, especially at higher elevations, the sequence is capped by deposits of pebbly and clayey sand, conglomerate, and clay from the Miocene or Oligocene era (DCS 2006:1-380).

The overlying Tinker/Santee Formation consists of 60 feet (18 meters) of Paleocene-age clayey and silty quartz sand, and silt with occasional beds of clean sand, gravel, clay, or carbonate. This layer is noteworthy because it contains small, discontinuous, thin calcareous sand zones (i.e., sand containing calcium carbonate) that are subject to dissolution by water. These "soft-zone" areas could subside, potentially causing settling of the ground surface (NRC 2005a:3-3). Soft zones occur throughout SRS, but are more prevalent moving across the site to the southeast. The soft zones consist of soil rather than open water-filled cavities (WSRC 1999:16, 74). These zones were encountered in exploratory borings in F-, H-, K- and S-Areas at depths between 100 and 150 feet (30 and 46 meters) (NRC 2005a:3-3; WSRC 2008a:1).

Dissolution of the carbonate materials in the soft zones is so slow (if it is occurring at all) that it is not expected to affect any present or future SRS facility. Because of the depth of the soft zones, there are no static stability issues. It is conservatively assumed that the arches supporting the soft zones would lose strength during a seismic event, resulting in a small amount of surface subsidence (WSRC 1999:vi, 75).

Geophysical studies of SRS have identified seven subsurface faults: Pen Branch, Steel Creek, Advanced Tactical Training Area, Crackerneck, Ellenton, Upper Three Runs, and an unnamed fault that passes approximately 0.5 miles (0.8 kilometers) south of F-Area, between F-Area and Fourmile Branch (DOE 2002b:3-5). The actual faults do not reach the surface, stopping several hundred feet below grade (CSRACT 2007:34). The only known faults capable of producing an earthquake within a 200-mile (320-kilometer) radius of SRS are within the Charleston seismic zone (located approximately 70 miles [110 kilometers] southeast of SRS) (NRC 2005a:3-4).

The Charleston, South Carolina, earthquake of 1886 (estimated Richter scale magnitude of 6.8) is the most damaging earthquake known to have occurred in the southeastern United States and one of the largest historic shocks in eastern North America. At SRS, this earthquake had an estimated Richter scale magnitude ranging from 6.5 to 7.5. The SRS area experienced an estimated peak ground acceleration[1] of 0.10 *g* (one-tenth the acceleration of gravity) during this event (NRC 2005a:3-4).

Earthquake-produced ground motion is expressed in units of percent *g* (force of acceleration relative to that of Earth's gravity). The latest probabilistic peak (horizontal) ground acceleration (PGA) data from the U.S. Geological Survey were used to indicate seismic hazard. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual occurrence probability of about 1 in 2,500. At the center of SRS, the calculated PGA is approximately 0.17 *g* (USGS 2010b). Most of the PGA is related to the proximity of SRS to the Charleston seismic zone and not from locally generated earthquakes.

Since 1973, 17 minor earthquakes (ranging in magnitude from 2.1 to 3.7) have been recorded within a 62-mile (100-kilometer) radius of SRS. Three of these earthquakes occurred within or near the SRS boundary. In 1985, an earthquake occurred with a local magnitude of 2.7. In 2001 and 2009, earthquakes occurred with local magnitudes of 2.6 (USGS 2010a). Earthquakes capable of producing structural damage are not likely to originate in the vicinity of SRS (DOE 1999b:3-149).

Richter Scale

The magnitude of an earthquake is a measure of the energy released during the event. It is often measured on the Richter scale, which runs from 0.0 upwards. The Richter scale is logarithmic; a quake of magnitude 5 releases over 10 times more energy than a quake of magnitude 4. Earthquakes greater than magnitude 6.0 can be regarded as significant, with a high likelihood of damage and loss of life (NRC 2005a:3-4). The largest recorded earthquake in the United States occurred at Prince William Sound, Alaska in 1964 and had a magnitude of 9.2.

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[1] *Peak ground acceleration is the maximum acceleration amplitude (change in velocity with respect to time) measured by a seismic recording of an earthquake (called a strong motion accelerogram) (NRC 2005a:34).*

No evidence of liquefaction[2] has been discovered at SRS. Nonetheless, due to the critical importance of SRS facilities, site-specific liquefaction assessments are completed for new facilities (WSRC 2008a:1).

There are no volcanic hazards at SRS. The area has not experienced volcanic activity within the last 230 million years. Future volcanism is not expected because SRS is located along the passive continental margin of North America (DOE 1999b:3-151).

The mixed sands, gravels, and clays commonly found beneath SRS are widespread and therefore are of limited commercial value. A possible exception might be well-sorted quartz sand, which is valuable as a filtration medium, an abrasive, and engineering backfill (WSRC 2008a:1).

Proposed Facility Locations

Geology and soil conditions in K-Area are consistent with subsurface conditions found throughout SRS. Soft zones underlying K-Area primarily occur in three intervals of the Santee Formation, at 120 to 130 feet (37 to 40 meters), 135 to 150 feet (41 to 46 meters), and 155 to 170 feet (47 to 52 meters) below the ground surface. The 135- to 150-foot (41- to 46-meter) depth is the primary interval in which the soft zones are encountered (WSRC 1999:19). Soft zones are limited in size and areal extent, and are poorly interconnected. The most well-developed soft zone measures approximately 50 feet (15 meters) wide by 200 feet (61 meters) long. The most well-developed soft zones are approximately 15 feet (4.6 meters) thick. There are no documented occurrences of surface depressions developed as a result of soft zone collapse at K-Area (WSRC 1999:19). Total ground surface settlements from design-basis earthquake loading of the soft zones were estimated to be between 1.4 and 1.75 inches (3.6 and 4.5 centimeters) (WSRC 1999:18).

Site-specific investigations of the subsurface conditions at MFFF in F-Area and DWPF in S-Area indicate that the geology and soils present in these areas are consistent with subsurface conditions found throughout SRS (DCS 2006:1-485; DOE 1994:3-2). Subsurface conditions in E- and H-Areas are expected to be predominantly the same as those in F- and S-Areas.

Several subsurface investigations conducted at SRS waste management areas (E-, S-, and Z-Areas), DWPF, and MFFF encountered soft sediments classified as calcareous sands within the Santee Formation. The calcareous sands were encountered in borings in F-Area between 108 and 115 feet (33 and 35 meters) below ground surface, and at DWPF between 110 and 150 feet (34 and 46 meters) below the 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 (DCS 2006:1-538; DOE 1994:3-2, 1999b:3-151; NRC 2005a:3-3). The soft zones at SRS are stable under static conditions. The geologic record shows that the soft zones have withstood earthquakes that have occurred since their formation. Therefore, no subsidence under static or dynamic conditions due to the presence of the soft zones is expected (DCS 2006:1-539). Total potential ground surface settlements at MFFF from numerical modeling of the soft zones were estimated to be between 3.2 and 4 inches (8.1 and 10.2 centimeters) (NRC 2005d:11-11).

Analyses indicate that surface soils within the vicinity of MFFF would experience no liquefaction as a result of the design-basis earthquake (DCS 2006:1-538). In addition, no appreciable differential settlement[3] is expected to occur at the MFFF foundation level due to liquefaction of soft strata that occur below the water table at a depth of 60 feet (18 meters) or greater (NRC 2005d:11-12).

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[2] *Liquefaction – A process by which water-saturated sediment temporarily loses strength and acts as a fluid. This effect can be caused by earthquake shaking.*

[3] *Differential settlement – The vertical displacement due to settlement of one point of a foundation with respect to another point of the foundation.*

No sizable economically valuable deposits of quartz sand are evident at the surface or in the shallow subsurface in K-Area (WSRC 2008a:1). Except for some small gravel deposits, no economically viable geologic resources occur in the vicinity of F-Area (NRC 2005a). This is also expected to be true for E-, H-, and S-Areas.

3.1.2.2 Soils

General Site Description

The Natural Resources Conservation Service identifies 28 soil series occurring on SRS. These soil series are grouped into seven broad soil-association groups (WSRC 2006b:1-4, 1-8). Generally, sandy soils occupy the uplands and ridges, and loamy-clayey soils occupy the stream terraces and floodplains (CSRACT 2007:33).

The Fuquay–Blanton–Dothan Association consists of nearly level to sloping, well-drained soils on the broad upland ridges, including most undisturbed soils near E-, F-, H-, K-, and S-Areas. This association covers approximately 47 percent of SRS and is composed of about 20 percent Fuquay soils, 20 percent Blanton soils, 12 percent Dothan soils, and 48 percent other soils (WSRC 2006b:1-10).

Fuquay and Dothan soils are well drained, and Blanton soils are somewhat excessively drained. These soils have moderately thick to thick sandy surface and subsurface layers and loamy subsoil. Most of these soils are suited for cultivated crops, timber production, sanitary facilities, and building sites (WSRC 2006b:1-10). The soils at SRS are considered acceptable for standard construction techniques (DOE 1999b:3-151).

Proposed Facility Locations

Most soils within the fence lines of E-, F-, H-, K-, and S-Areas have been disturbed to accommodate buildings, parking lots, and roadways. Disturbed soils within these areas are considered to be urban land where covered by structures or udorthents (NRCS 2010a, 2010b). Udorthents are well-drained, heterogeneous soil materials that are the spoil or refuse from excavations and major construction activities and are often heavily compacted. Some udorthents have slight limitations for site development due to their shrink-swell potential when the soils are dried out or wetted, respectively (DOE 2007b:129).

Undisturbed soils near F- and K-Areas are classified as the Fuquay–Blanton–Dothan Association. These soils are nearly level to sloping and are well drained. Soils along the Pen Branch floodplain are classified as the Vaucluse–Ailey Association. These soils are sloping and strongly sloping soils of low permeability (WSRC 2006b:1-8, 1-10).

Soils along the Upper Three Runs floodplain are classified as the Troup–Pickney–Lucy Association (NRC 2005a:3-5). These soils range from moderately steep to steep sloping on uplands, and are nearly level on the floodplains. Troup and Lucy soils are well drained, while Pickney soils are poorly drained (WSRC 2006b:1-11). Erosion-induced slope instability has not been a significant regional issue (NRC 2005a:3-5).

Soil conditions in E-, H-, and S-Areas are predominantly the same as those in F- and K-Areas (WSRC 2006b:1-8). Undisturbed soils near DWPF consist primarily of sandy surface layers above subsoil containing a mixture of sand, silt, and clay. These soils are well drained to somewhat excessively drained, with slopes ranging from 0 to 10 percent. The permeability of these soils is generally high, with a slight erosion hazard (DOE 1994:3-1).

3.1.3 Water Resources

Water resources encompass the sources of water that are useful or potentially useful to plants, animals, and humans in a particular area. Changes in the environment can potentially affect a hydrologic system's equilibrium, water quality, and the availability of usable water.

3.1.3.1 Surface Water

General Site Description

The Savannah River is the principal surface-water feature in the region, forming the southwestern border of SRS for approximately 35 miles (56 kilometers) (WSRC 2006g:1). The Savannah River reach along the SRS boundary has a wide channel, numerous tributaries, and extensive floodplain swamps (WSRC 2006b:4-250). Five major watershed[4] tributaries of the Savannah River Basin within SRS discharge into the Savannah River: Upper Three Runs, Beaver Dam Creek, Fourmile Branch, Steel Creek, and Lower Three Runs. Pen Branch is also a major stream at SRS, but does not flow directly into the Savannah River (DOE 2002b:3-7). No streams or tributaries at SRS are federally designated Wild and Scenic Rivers or state designated Scenic Rivers (NRC 2005a:3-6; USFWS 2010:1-22; SCDNR 2006:1).

There are two manmade lakes at SRS, L-Lake, which discharges to Steel Creek, and Par Pond, which discharges to Lower Three Runs (see Figure 3–1). Additionally, there are approximately 50 other small manmade ponds and 300 natural Carolina bays (closed depressions capable of containing water) at SRS. No direct effluent discharges are released into the Carolina bays; however, they do receive stormwater runoff (NRC 2005a:3-6).

The Savannah River, except for sections of the river near the coast, is classified as a freshwater source (Class FW) that is suitable for primary- and secondary-contact recreation, including drinking water supply (after appropriate treatment), fishing, and industrial and agricultural uses (NRC 2005a:3-9; SCDNR 2009:4-1; 7-37–7-39). The nearest downstream water intake is the Beaufort–Jasper Water and Sewer Authority (BJWSA) Purrysburg Water Treatment Plant, which is approximately 90 river miles (140 river kilometers) from the easternmost extent of the SRS boundary. The BJWSA is permitted to withdraw 100 million gallons (379 million liters) of water per day. The treatment plant produces approximately 15 million gallons (57 million liters) of water per day for Beaufort and Jasper Counties, South Carolina. Water for SRS is obtained from the Savannah River water intake, which is located about 1 mile (1.6 kilometers) from the plant, and a 180-million-gallon (681-million-liter) dedicated reservoir. The river intake is approximately 78.5 hours of river travel time from SRS. The BJWSA plans to have its plant at the full treatment design capacity of 45 million gallons (170 million liters) per day within the next 20 years. Over the next two decades, the average water demand is estimated to increase to 56 million gallons (212 million liters) per day with a maximum water demand of 96 million gallons (363 million liters) per day (City of Hardeeville 2009:6-3).

The South Carolina Department of Health and Environmental Control (SCDHEC) is the regulatory authority for the physical properties and concentrations of chemicals and metals in SRS effluents under the National Pollutant Discharge Elimination System (NPDES) program. In 2008, SRS discharged water into onsite streams and the Savannah River under three NPDES permits: two for industrial wastewater (SC0047431, D-Area Powerhouse; SC0000175, remainder of site) and one for stormwater runoff (SCR000000, industrial discharge) (SRNS 2009b:3-9). The stormwater runoff permit requires the

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[4] *A watershed is a hydrologically defined drainage area with a single drainage discharge point. It represents the land area within which surface runoff and groundwater seepage collects and drains into a central feature — usually a wetland, lake, river, or stream.*

implementation and maintenance of approved best management practices to assure that SRS stormwater discharges do not impair the water quality of receiving water resources (DOE 2007b:1).

A fourth permit (SCR100000, Construction General Permit) authorizes stormwater discharges from large and small construction activities in South Carolina. Sampling is not required under this permit unless requested by SCDHEC; no requests were made in 2008 (SRNS 2009b). Applications of dewatered sludge and related sanitary wastewater treatment facility sampling are covered by a no-discharge land applications permit (ND0072125) (SRNS 2009b:4-8). In February 2006, the responsibility for D-Area Permit SC0047431 was transferred from South Carolina Electric and Gas to DOE/SRS (WSRC 2007f:49-50).

Industrial wastewater monitoring results are reported to SCDHEC through monthly discharge monitoring reports. Results from 5 of the 4,529 sample analyses performed during 2008 exceeded permit limits, which is a 99.89 percent compliance rate; a higher rate than the DOE-mandated 98 percent compliance rate (SRNS 2009b:4-8). In 2008, SRS received two notices of violations involving sanitary wastewater releases; no administrative hearings were held to determine if the alleged violations occurred and no fines were assessed (SRNS 2009b). Approximately 69 cubic yards (53 cubic meters) of dewatered sludge from onsite sanitary waste treatment plants were applied to SRS's land application site in 2006 in accordance with the no-discharge land applications permit (WSRC 2007f:49-50).

Proposed Facility Locations

The proposed alternatives would take advantage of existing developed areas and infrastructure at E-, F-, H-, K-, and S-Areas. E-, F-, and H-Areas are centrally located inside the SRS boundary, just south of the confluence of Tinker Creek and McQueen Branch with Upper Three Runs. Surface elevations range from approximately 270 to 320 feet (82 to 98 meters) above mean sea level for E-, F-, and H-Areas (DOE 2002b:3-7). E-, F-, and H-Areas are located on a drainage divide that separates the drainage into Upper Three Runs and Fourmile Branch. Approximately half of the area drains into each stream (DOE 2002b:3-7). E-, F-, and H-Areas are drained by Upper Three Runs to the north and west and by Fourmile Branch to the south (DOE 2002b: 3-7–3-9). Data collected at Fourmile Branch in the vicinity of E-Area indicated an average annual flow of 0.40 cubic meters per second (14 cubic feet per second) (WSRC 2004:22).

K-Area is located toward the south of SRS, where it drains into Pen Branch and its major tributary, Indian Grave Branch (WSRC 2006b:4-103). Land surrounding S-Area drains into Upper Three Runs and Fourmile Branch tributaries (DOE 1999b:3-154). Stormwater runoff from most of the area near DWPF is collected and discharged into a retention basin north of S-Area. Stormwater and wastewater discharges from E-, F-, K-, and S-Areas do not affect L-Lake or Par Pond (see Chapter 1, Figure 1–2). A summary of E-, F-, H-, K-, and S-Area outfalls is presented in **Table 3–2**.

No SRS facilities are located within the 100-year floodplain (DOE 1999b:3-152). Reports have indicated that SRS streams are unlikely to flood existing facilities. DOE Order 420.1B outlines the requirements for natural phenomena hazard (including flood events) mitigation for new and existing DOE facilities. In 2000, SRS was required to determine the flood elevations as a function of the return period up to 100,000 years, and to determine the flood recurrence intervals for SRS facilities. The facility-specific probabilistic flood hazard curve defines the annual probability of occurrence (or the return period in years) as a function of water elevation. In 2000, the calculated results of the probabilistic flood hazard curve were reported to illustrate that the probabilities of flooding in E-, F-, H-, K-, and S-Areas are significantly less than 0.00001 per year (WSRC 2000:9).

Table 3–2 Summary of E-, F-, H-, K-, and S-Area Outfalls

Facility Location	*Outfall*	*Receiving Stream*	*Drainage (acres)*	*Sources*
E-Area	E-01	Unnamed tributary to Fourmile Branch	113	Stormwater
	E-02	Unnamed tributary to Upper Three Runs	128	
	E-03	Crouch Branch to Upper Three Runs	42.5	
	E-04		50.4	
	E-05	Unnamed tributary to Fourmile Branch	27	
	E-06	Crouch Branch to Upper Three Runs	14.6	
F-Area	F-02	Upper Three Runs	23.7	Stormwater
	F-08	Fourmile Branch	178	Non-process facility cooling water; cooling tower blowdown, overflow, and drain; Effluent Treatment Project radiological control basins; well flush water; and stormwater
	F-3B [a]	Unnamed tributary to Upper Three Runs	46.5	Stormwater
H-Area	H-02	Crouch Branch to Upper Three Runs	58.8	Non-process cooling water, steam condensate, and stormwater runoff after treatment in a constructed wetland wastewater treatment plant
	H-04B		203	Stormwater
	H-05	Upper Three Runs	6.11	Stormwater
	H-06		9.35	
	H-07	McQueen Branch	17.6	Cooling tower blowdown, condensate, well flush water, stormwater
	H-7A	McQueen Branch to Upper Three Runs	17.2	Stormwater
	H-7B		3.05	
	H-7C		20.8	
	H-08	Fourmile Branch	20.2	Well flush water, stormwater
	H-12		162	Process and non-process cooling water, cooling tower and air compressor blowdown, steam condensate, radiological control basins, well flush water, and stormwater
	H-16 (TH-1; TH-2)	Upper Three Runs	None	F/H Area process wastewater batch release from the Effluent Treatment Project
K-Area	K-01	Pen Branch	1.50	Stormwater
	K-02		2.55	
	K-04		6.12	
	K-New [b]		1.24	
	K-06	Indian Grave Branch	0.02	Stormwater
	K-12		None	Sanitary wastewater
	K-18		5.1	Cooling water basin, water treatment plant, reactor building processes, sanitary treatment plant wastewater, and stormwater
S-Area	S-04	McQueen Branch	None	Currently, no influents or discharges; outfall previously received Defense Waste Processing Facility chemical and industrial wastewater, stream condensate, cooling tower blowdown, and miscellaneous flushing and rinsing
	S-10	McQueen Branch	9.15	Stormwater

[a] To implement the proposed action for the environmental assessment (DOE 2007b:3-4), this outfall and permit requirement would be eliminated. The South Carolina Department of Health and Environmental Control approved the request by SRS to eliminate the outfall permit requirement.

[b] To implement the proposed action for the environmental assessment (DOE 2007b:3-4), this portion of K-Area would be subdivided into four drainage areas, resulting in the addition of a new outfall (K-New).

Note: To convert acres to hectares, multiply by 0.40469

Source: DOE 2007b:3-4; SCDHEC 2003b; SRNS 2012.

3.1.3.2 Groundwater

General Site Description

Topography and lithology are major factors controlling the direction and relative rate of groundwater flow. Groundwater can flow in aquifers both horizontally and vertically to points of discharge such as streams, swamps, underlying aquifers, and sometimes to overlying aquifers, depending on the surrounding lithology and topography. SRS is underlain by sediment of the Atlantic Coastal Plain, which consists of a southeast-dipping wedge of unconsolidated sediment that extends from its contact with the Piedmont Province at the fall line to the edge of the continental shelf. The sediment, comprising layers of sand, muddy sand, and clay with subordinate calcareous sediments, rests on crystalline and sedimentary basement rock. Water flows easily through the sand layers, but is slowed by less-permeable clay beds, creating a complex system of aquifers (WSRC 2007f:7-87).

Groundwater recharge is a result of infiltration of precipitation at the land surface. The precipitation moves downward through the unsaturated zone to the water table. The depth to the water table varies throughout SRS. Upon entering the saturated zone at the water table, water moves predominantly in a horizontal direction toward local discharge zones along the headwaters and midsections of streams, while some water moves into successively deeper aquifers. Groundwater velocities at SRS range from several inches to several feet per year in aquitards and from tens to hundreds of feet per year in aquifers (WSRC 2007f:7-90).

Although many different systems have been used to describe groundwater systems at SRS, for this *SPD Supplemental EIS*, the same system used in the *SPD EIS* and in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c) 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 1999b:3-154). Other groundwater hydrostratigraphic unit classification systems applicable to SRS are presented in the *Savannah River Site Environmental Report for 2010* (SRNS 2011:7-1–7-4).

SRS hydrogeology is complex due to heterogeneities in the vadose zone[5] and in the multilayer aquifer system (SRNS 2009b). The SRS groundwater flow system is characterized by four major aquifers separated by confining units. All aquifers are defined by the *South Carolina Pollution Control Act* (SC Code § 48-1-10 et seq.) as potential sources of drinking water (WSRC 2008d:A-6). None of these aquifers, however, is designated as a sole-source aquifer. A sole-source aquifer is defined as an aquifer that supplies at least 50 percent of the drinking water to the area above the aquifer (EPA 2011a:1). These areas can have no other water supply capable of physically, legally, or economically providing drinking water to local populations (NRC 2005a:3-10).

The Cretaceous Aquifer is an important water resource for the SRS region. Groundwater withdrawn in and around SRS is used extensively for domestic, industrial, and municipal purposes. Groundwater is regularly withdrawn from the Cretaceous and water table aquifers (DOE 1999b:3-155).

Drinking water for SRS is supplied by seven regulated water supply systems, all of which utilize groundwater sources. The A-, D-, and K-Area domestic water systems are actively regulated by SCDHEC, while the remaining four smaller water systems have a reduced level of regulatory oversight. The SRS groundwater withdrawal network includes 8 domestic water wells and approximately 32 process water wells. Samples are collected and analyzed by SRS and SCDHEC to ensure that water systems meet

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[5] *The vadose zone is the region of unsaturated sediments between the surface and the saturated water table, which isolates near surface water from underlying groundwater (Burns et al. 2000:1-2).*

SCDHEC and U.S. Environmental Protection Agency (EPA) bacteriological and chemical drinking water quality standards. All samples collected in 2008 met these standards (SRNS 2009b:3-8). De-ionized water (water treated to remove anions and cations) is primarily used in H-Canyon. It is procured by an offsite vendor and brought into H-Area by a portable trucking system (SRNS 2012).

No relevant South Carolina state case law regarding common-law ownership of groundwater resources has been reported (Myszewski et al. 2005:28; SCDNR 2009:2-7). However, the State has enacted statutes to restrict water use. The South Carolina Groundwater Use and Reporting Act of 2000 (S.C.C.A. § 49-5-10 to § 49-5-150) and Surface Water Withdrawal, Permitting Use, and Report Act of 2010 (S.C.C.A. § 49-4-10 to § 49-4-180) mandates that any person[6] withdrawing groundwater or surface water for any purpose in excess of 3 million gallons (11 million liters) during any one month from a single or multiple wells or intakes under common ownership and within 1 mile (1.6 kilometers) of an existing or proposed well or intake must register with, annually report to, and be permitted by SCDHEC (SCDHEC 2005:1-2).

Groundwater and surface-water consumption for fiscal year 2010 are summarized in **Tables 3–3** and **3–4**. For the 12-month reporting period from 2009 to 2010, approximately 316 million gallons (1.2 billion liters) of domestic water were used at SRS. SRS has a sitewide total water supply capacity of 2.95 billion gallons (11.2 billion liters) and an available capacity of 2.64 billion gallons (10 billion liters). As shown in Table 3–4, for the five areas reporting fiscal year 2010 domestic water use, H-Area recorded approximately 60 percent of the total water consumption, or 143 million gallons (541 million liters).

Table 3–3 Fiscal Year 2010 Water Consumption (thousand gallons)

	Groundwater					
2009–2010	***Domestic Water*** [a]	***Process Water*** [b]	***Service Water*** [b]	***Monthly Total***	***River Water*** [c]	***Grand Total*** [d]
October	28,585	14,602	20,734	*63,921*	88,560	*152,481*
November	30,455	15,089	21,424	*66,968*	91,512	*158,480*
December	26,289	14,602	20,734	*61,625*	88,560	*150,185*
January	22,327	15,089	21,424	*58,840*	91,512	*150,352*
February	25,999	15,089	21,424	*62,512*	91,512	*154,024*
March	23,126	13,628	19,352	*56,106*	80,192	*136,298*
April	26,814	15,089	21,424	*63,327*	91,512	*154,839*
May	21,896	14,602	20,734	*57,232*	85,920	*143,152*
June	26,941	15,089	21,424	*63,454*	91,512	*154,966*
July	29,963	14,602	20,734	*65,299*	86,831	*152,130*
August	26,589	15,089	21,424	*63,102*	93,796	*156,898*
September	26,962	15,089	21,424	*63,475*	92,795	*156,270*
Total	**315,946**	**177,659**	**252,256**	**745,861**	**1,074,214**	**1,820,075**

[a] Domestic Water: Potable water provided to each area on site from dedicated domestic water wells. The Central Domestic Water Plant serves A-, B-, C-, F-, G-, H-, K-, L-, and N-Areas. The Central Domestic Water Plant is located in A-Area and is serviced from Wells 905-112G and 905-67B.

[b] Process/Service Water: Used to provide water for once-through cooling, boilers and other applications, fire water storage tanks, and flushing and washdown; as well as a supply of makeup water for cooling tower water systems. Service water is water that is pumped from the ground, minimally treated for pH adjustment, and then introduced into the piping system for consumption. Service water becomes process water when it reaches a cooling tower. Process/Service Water is provided from dedicated wells in each of the operating areas.

[c] River Water: Water pumped directly from the Savannah River. Pump 681-3G currently provides makeup water to L-Lake and for L-Area fire protection needs and steam production (Ameresco Plant). Pump 681-3G currently provides boiler feed water for the 484-D Powerhouse.

[d] Sum of groundwater and river water monthly total use.

Note: To convert gallons to liters, multiply by 3.7854.

Source: SRNS 2012.

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[6] *A person is defined as an individual, firm, partnership, trust, estate, association, public or private institution, municipality, or political subdivision, governmental agency, public water system, private or public corporation, or other legal entity organized under the laws of the State or any other state or county (S.C.C.A. §§ 49-5-30 and 49-4-20).*

Table 3–4 Fiscal Year 2010 Domestic Water Consumption by Area (thousand gallons)

E-Area	*F-Area*	*H-Area*	*K-Area*	*S-Area*	*Total*
19,865	60,655	142,530	3,595	12,141	238,786

Note: To convert gallons to liters, multiply by 3.7854.
Source: SRNS 2012.

There has been a major decline in withdrawals since annual reporting of SRS groundwater usage began in 1983. Groundwater withdrawals were reduced by more than two-thirds, from 10.8 million gallons (40.9 million liters) per day from 1983 to 1986 to 3.4 million gallons (12.9 million liters) per day in 2010. Total annual water use was reduced by approximately 22 percent between 2008 and 2010 (from 2.3 billion gallons [8.7 billion liters] to 1.8 billion gallons [6.8 billion liters]). Facility shutdowns, site population reductions, and water supply system upgrades and consolidation have measurably reduced SRS water use demands (SRNS 2011:7-5).

It was estimated that in 2007, users within a 10-mile (16-kilometer) radius of SRS withdrew 3.4 billion gallons (13 billion liters) per year (WSRC 2007f:3-25), which is almost twice the SRS withdrawal rate of 1.8 billion gallons (6.8 billion liters) for fiscal year 2010 (Table 3–3). Of the current 103 registered or permitted water use facilities within the Savannah River Basin, there are 55 surface-water facilities, 43 groundwater facilities, and 5 dual withdrawal facilities. Primary basin water use categories include agriculture, golf course irrigation, hydroelectric, industrial, irrigation, mining, thermoelectric, water supply, and other water uses. In 2004, approximately 54.5 percent of basin water use was attributed to flow-through hydroelectric facilities; surface-water withdrawals accounted for 99.8 percent of water uses (SCDHEC 2005:5). A summary of reported water uses for the SRS South Carolina region (Aiken, Allendale, and Barnwell Counties) is presented in **Table 3–5**.

Table 3–5 South Carolina Region 2004 Surface-Water and Groundwater Withdrawal [a] Summary (million gallons per month)

County	*Agriculture*	*Golf Course*	*Industrial*	*Water Supply*	*Mining*	*Total*
Surface-Water Withdrawals						
Aiken	0	179.52	1,251.75	1,459.11	0	2,890.38
Allendale	0	0	0	0	0	0
Barnwell	0	0	0	0	0	0
Total	**0**	**179.52**	**1,251.75**	**1,459.11**	**0**	**2,890.38**
Groundwater Withdrawals						
Aiken	5.07	29	1,323.18	3,951.06	29.16	5,337.47
Allendale	710.07	0	890.42	0	0	1,600.49
Barnwell	0	0	0	56.17	0	56.17
Total	**715.14**	**29**	**2,213.60**	**4,007.23**	**29.16**	**6,994.13**
Grand Total	**715.14**	**208.52**	**3,465.35**	**5,466.34**	**29.16**	**9,884.51**

[a] For registered and/or permitted sources, *withdrawal* is defined as withdrawing groundwater or surface water in excess of 3 million gallons in a given month from a single well or intake or multiple wells or intakes under common ownership.
Source: SCDHEC 2005:7-10.

To meet state and Federal laws and regulations, extensive groundwater monitoring is conducted around SRS waste sites and operating facilities, using approximately 3,000 monitoring wells. Major contaminants include volatile organic compounds, metals, and radionuclides. Monitoring methods are generally based on the source constituent inventory, mobility, and toxicity data; correlations between contamination and groundwater resources; and the relative contribution of the contamination from the unit. Groundwater monitoring objectives, strategies, schedules, and implementation plans are presented in the *Savannah River Site Groundwater Management Strategy and Implementation Plan* (WSRC 2008b).

Groundwater quality varies across the site. The Cretaceous Aquifer is generally unaffected except for an area near A-Area, where trichloroethylene has been reported. Trichloroethylene has also been reported in A- and M-Areas in the Congaree Aquifer. Hydrogen-3 (tritium) has been reported in the Congaree Aquifer in the General Separations Area, which includes F- and H-Areas. 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, but groundwater contamination has not been detected beyond SRS boundaries (DOE 1999b:3-155). All drinking water samples collected and analyzed by SRS and SCDHEC met the SCDHEC and EPA bacteriological and chemical drinking-water quality standards in 2008 (SRNS 2009b:3-8).

Proposed Facility Locations

The depth to the water table and the direction of groundwater flow varies by site location. The water table at K-Area is encountered at approximately 70 feet (21 meters), and flows in the southwest direction toward Indian Grave Branch at about 75 feet (23 meters) per year (WSRC 2008a). Groundwater flow in the General Separations Area is toward Upper Three Runs and its tributaries to the north and Fourmile Branch to the south; this is primarily due to the topography in the vicinity of E-, F-, and H-Areas (DOE 2002b: 3-9–3-12). The depth to the water table underlying E-Area generally ranges from 60 to 80 feet (18 to 24 meters) (SRNS 2012), while for F-Area, the depth to the water table is about 100 feet (30 meters) (WSRC 2008a). E-Area is located on a groundwater divide that causes groundwater on one side of the divide to flow north toward Upper Three Runs, while groundwater on the other side of the divide flows south toward Fourmile Branch (SRNS 2012). Groundwater underlying F-Area generally flows north toward Upper Three Runs. For both locations, groundwater typically flows at about 130 feet (40 meters) per year. At H-Area, the water table is encountered at approximately 40 feet (12 meters). Here, groundwater flows either north toward Upper Three Runs or west toward McQueen’s Branch at about 80 feet (24 meters) per year, depending on the starting point. At S-Area, the water table is encountered at about 40 feet (12 meters), and groundwater flows west toward McQueen’s Branch at about 80 feet (24 meters) per year (WSRC 2008a).

For the proposed facility locations, the thickness of the vadose zone ranges from approximately 40 feet (12 meters) to approximately 100 feet (30 meters). Surface water and potential waterborne contaminants must pass through the vadose zone to reach groundwater systems. E-Area is a principal facility for disposing of LLW. Historically, these wastes were disposed of in shallow (within 26 feet [8 meters] of the surface), sometimes unlined, trenches. A Vadose Zone Monitoring System was developed and implemented to monitor water and contaminant migration from the trenches through undisturbed portions of the vadose zone. Monitoring results demonstrate that the E-Area disposal trenches are in compliance with the requirements of DOE Order 435.1 (Burns et al. 2000:2).

Historically, the chemical and radioactive waste byproducts of SRS nuclear material production have been treated, stored, and disposed of at various locations across SRS, resulting in the contamination of soil and water resources. Waste sites typically included seepage basins, tanks, ponds, trenches, pits (burial and burning), and/or landfills that ranged in size from several square feet to tens of acres. Approximately 5 to 10 percent of SRS groundwater resources have been contaminated with radionuclides (e.g., tritium, gross alpha, and nonvolatile beta emitters), industrial solvents (e.g., trichloroethylene and tetrachloroethylene), metals, and other chemicals. Constituents of primary concern include radionuclides and industrial solvents (ATSDR 2007:28-31; SRNS 2009b:7-8).

Groundwater contamination sites are primarily located in proximity to the reactor facilities (C-, K-, L-, P-, and R-Areas), the General Separations Area (F- and H-Areas), and the waste management areas (E-, S-, and Z-Areas). For the reactor facilities, tritium and trichloroethylene are the primary contaminants identified in groundwater plumes; concentrations of other radionuclides and organics and metals are also present. The General Separations Area and waste management areas include smaller, frequently overlapping groundwater plumes that include trichloroethylene and tetrachloroethylene, radionuclides, metals, and other constituents. A 2007 evaluation by the U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR) determined that, based on existing conditions and operations, SRS posed no apparent public health hazard to surrounding communities from groundwater or surface-water exposure (ATSDR 2007:28-29). SRS groundwater monitoring results are presented in **Table 3–6**.

Table 3–6 Savannah River Site Areas 2009 Groundwater Contamination Summary

SRS Location	*Groundwater Monitoring Results*
F-Area and H-Area Hazardous Waste Management Facilities	Groundwater flow direction and velocity remained relatively unchanged in each area from the previous year with the exception of changes related to the installation of corrective action groundwater barrier walls.[a]
	Compliance monitoring data showed that organic, inorganic, and radionuclide constituents in both areas exceeded groundwater protection standards.[a]
	During detection monitoring, no new constituents were detected in either area above the estimated quantitative limit.[a]
	Corrective actions include groundwater barriers and base injection systems in F-Area and groundwater barriers in H-Area; treatments are having positive effects on the aquifer.[b]
Mixed Waste Management Facility	No changes in groundwater flow direction or velocity from the previous year were identified.[a]
	Compliance monitoring data indicated that 26 constituents exceeded groundwater protection standards.[a]
	Detection monitoring identified 5 constituents not on the current groundwater protection standards list in several point-of-compliance wells.[a]
	A DHEC approved phytoremediation system corrective action is being used to reduce tritium levels.[b]
K-Area Burning/Rubble Pit Operable Unit	Groundwater sampling was conducted in accordance with Industrial Solid Waste Permit #025800-1601.[c]
	Compliance monitoring identified upper aquifer concentrations of tetrachloroethylene and trichloroethylene at levels exceeding maximum contaminant levels that remained relatively unchanged from previous year values; monitoring of natural attenuation continues.[b, c]
288-F Ash Basin	Groundwater samples were collected from the Upper and Lower Aquifer Zones.[d]
	No downgradient constituent monitoring results exceeded background levels.[d]

[a] SRNS 2010b.
[b] WSRC 2008b.
[c] Hennessey 2010.
[d] SRNS 2010a.

3.1.4 Meteorology, Air Quality, and Noise

3.1.4.1 Meteorology

The climate and meteorology of the SRS region are described in the *SPD EIS* (DOE 1999b) and the *Savannah River Site High-Level Waste Tank Closure Final Environmental Impact Statement* (DOE 2002b). Recent data are presented in the *Savannah River Site Annual Meteorology Report for 2009* (SRNL 2010). The historical average temperature is largely unchanged from that reported in the *SPD EIS* and the historical average annual precipitation has increased to 48.2 inches (122 centimeters) (SRNL 2010) from 45 inches (114 centimeters) in the *SPD EIS*.

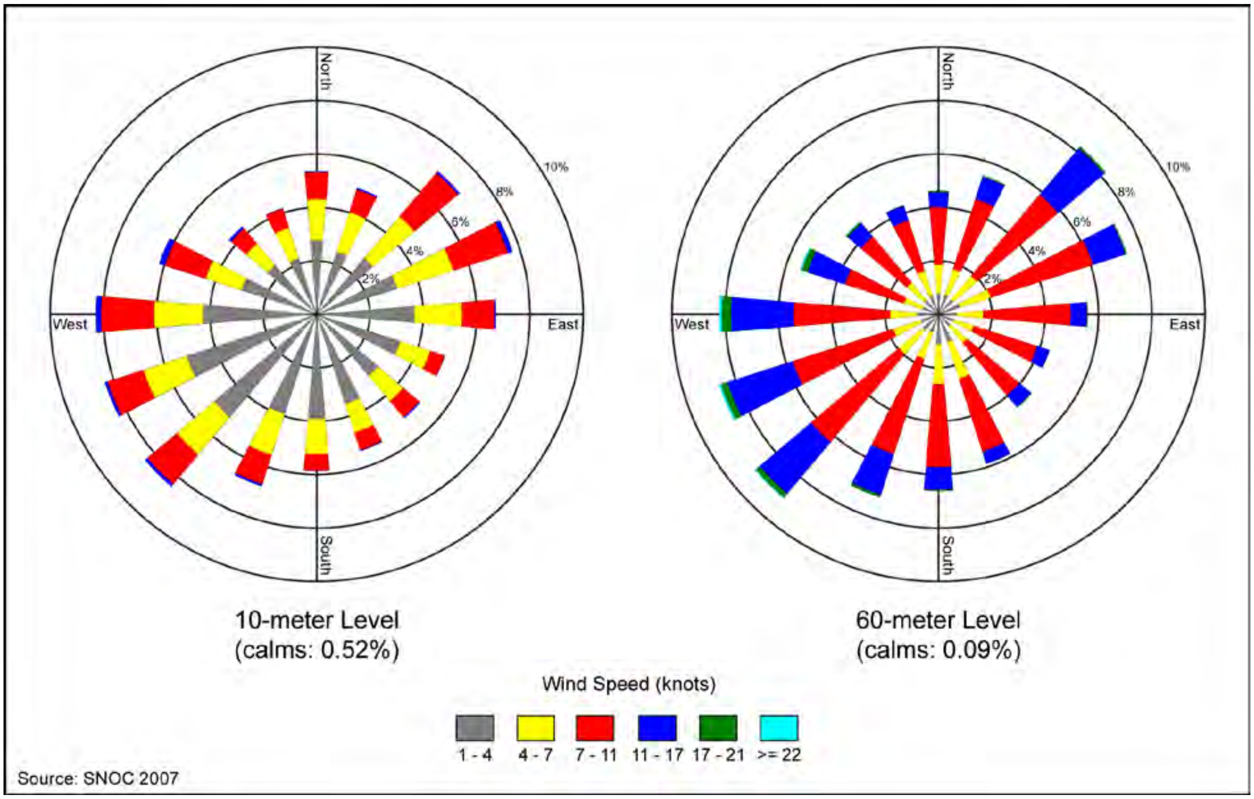
SRS has a temperate climate with short, mild winters and long, humid summers. The climate is frequently affected by warm, moist maritime air masses. The average annual temperature at SRS is 64.3 degrees Fahrenheit (°F) (17.9 degrees Celsius [°C]); temperatures vary at Augusta, Georgia, from an average daily minimum of 33.1°F (0.6°C) in January to an average daily maximum of 92 °F (33.3 °C) in July. The average annual precipitation is about 48.2 inches (122 centimeters). Precipitation is distributed fairly evenly throughout the year, with the highest in summer and the lowest in autumn. The average annual windspeed at the Augusta National Weather Service Station is 5.7 miles per hour (2.5 meters per second) (DOE 1999b:3-128; NOAA 2009a; SRNL 2010). The maximum windspeed in Augusta (highest 1-minute average) is 52 miles per hour (23 meters per second) (NOAA 2009b:65). The Augusta station is about 12 miles (19 kilometers) west of SRS. Wind roses for the Central Climatology Tower for 2009 are provided in **Figure 3–2**. Typical wind direction patterns for the 200-foot (61-meter) elevation consist of higher frequencies of wind from the northeast section and the southwest to west sections. Typical variation of winds with elevation show higher frequencies of southeasterly winds and lower frequencies of northeast and southwest winds nearer the ground (SRNL 2010).

Notes: Windrose plot depicts the frequency of occurrence of wind direction sector (direction from which the wind blows) by wind speed category. The Central Climatology Tower is near N-Area

Source: SRNL 2010.

Figure 3–2 Annual Wind Rose Plots for 2009, Central Climatology, All Levels

Wind roses for the Vogtle Electricity Generating Plant for 1998–2002 are provided in **Figure 3–3**.



Source: SNOC 2007

Figure 3–3 Annual Wind Rose Plots for 1998–2002, Vogtle Electric Generating Plant, 10- and 60-Meter Levels

Damaging hailstorms rarely occur in Aiken County (NCDC 2010). The average annual snowfall is 1.4 inches (3.6 centimeters) (NOAA 2009a).

Thirty-three tornadoes were reported in Aiken County between January 1950 and August 2010. There are typically several occurrences of high winds every year, mostly associated with thunderstorms (NCDC 2010). Hurricanes struck South Carolina 36 times during the period from 1700 to 1992, which equates to an average recurrence frequency of one hurricane every 8 years. A hurricane-force wind of 75 miles per hour (34 meters per second) has been observed at SRS only once, during Hurricane Gracie in 1959 (DOE 2002b:3-20, 3-22).

3.1.4.2 Air Quality

Air pollutants are any substances in the air that could harm humans, animals, vegetation, or structures, or that could unreasonably interfere with the comfortable enjoyment of life and property. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

General Site Description

SRS is near the center of the Augusta-Aiken Interstate Air Quality Control Region #53. None of the areas within SRS or its surrounding counties are designated as nonattainment areas with respect to the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (EPA 2009a, 2009b). Although the Augusta-Aiken area is part of an early action compact to control ozone concentrations (GDNR 2002), under the more stringent ozone 8-hour standard, soon to be implemented, the area could eventually be designated a nonattainment area for ozone.

The primary sources of air pollutants at SRS are the biomass boilers in K- and L-Areas, diesel-powered equipment throughout SRS, DWPF, soil vapor extractors, groundwater air strippers, the Biomass Cogeneration Facility and back-up oil-fired boiler on Burma Road, and various other processing facilities. Other emissions and sources include fugitive particulates from vehicles and controlled burning of forestry areas, as well as temporary emissions from various construction-related activities (DOE 1999b:3-130; NRC 2005a: 3-18; SRNS 2011).

There are no Prevention of Significant Deterioration Class I areas within 62 miles (100 kilometers) of SRS. Class I areas are areas in which very little increase in air pollution is allowed due to the pristine nature of the area. A Prevention of Significant Deterioration permit for the new Biomass Cogeneration Facility and biomass boilers in K- and L-Areas has been issued by SCDHEC to Ameresco Federal Solutions (see Chapter 4, Section 4.5.2.1.1). These facilities are subject to the Prevention of Significant Deterioration permit process as a result of carbon monoxide emissions (Bulgarino 2008; SCDHEC 2008). Wood chips are the primary fuel source for the cogeneration plant and the two biomass-fired steam generating units; fuel oil is used as the back-up fuel supply. These plants began operating in late 2010 (SRNS 2011:4-6). SRS has a sitewide Title V Operating Permit (SRNS 2011:3-8).

Table 3–7 presents the applicable ambient standards and ambient air pollutant concentrations attributable to sources at SRS. These concentrations are based on potential emissions (SRNS 2010e). Only those hazardous pollutants that would be emitted under any of the surplus plutonium disposition alternatives are presented. Other toxic air pollutants are discussed in the modeling report (SRNS 2010e). Concentrations shown in Table 3–7 attributable to SRS are in compliance with applicable guidelines and regulations. Recent data from nearby ambient air monitors in Aiken, Barnwell, Edgefield, and Richland Counties in South Carolina are presented in **Table 3–8**. The data indicate that the NAAQS for particulate matter, lead, ozone, sulfur dioxide, and nitrogen dioxide are not exceeded in the area around SRS (EPA 2007b, 2010; SCDHEC 2010a, SRNS 2010e).

The "natural greenhouse effect" is the process by which part of the terrestrial radiation is absorbed by gases in the atmosphere, thereby warming the Earth's surface and atmosphere. This greenhouse effect and the Earth's radiative balance are affected largely by water vapor, carbon dioxide, and trace gases, all of which are absorbers of infrared radiation and commonly referred to as "greenhouse gases." Other trace gases include nitrous oxide, chlorofluorocarbons, and methane. Additional discussion of climate change is provided in Section 4.5.4.2, Global Climate Change.

Based on the number of employee vehicle trips estimated from employment at SRS (see Section 3.1.8) and fuel and electricity use (see Section 3.1.9), emissions of carbon dioxide attributable to SRS activities were estimated to be 0.502 million metric tons per year, which is less than 0.008 percent of the total U.S. emissions of 6.8 billion metric tons of carbon dioxide equivalent per year (EPA 2012:ES-4-ES-6). Emissions of 42,000 metric tons of carbon dioxide equivalents of other greenhouse gases have been estimated from wastewater treatment, business travel, and refrigerant use/recovery from activities at SRS (SRNS 2012). Carbon dioxide emissions from shipment of materials have not been estimated.

Reduction in greenhouse gas emissions is expected to be realized with the conversion of steam and energy production at SRS to biomass. Impacts from conversion to biomass energy production are discussed in the *Environmental Assessment for Biomass Cogeneration and Heating Facilities at the Savannah River Site* (DOE 2008e).

Table 3–7 Comparison of Ambient Air Concentrations from Existing Savannah River Site Sources with Applicable Standards or Guidelines

Pollutant	***Averaging Period***	***More Stringent Standard or Guideline (micrograms per cubic meter)*** [a]	***Concentration (micrograms per cubic meter)***
Criteria Pollutants			
Carbon monoxide	8 hours	10,000 [b]	292
	1 hour	40,000 [b]	1,118.2
Nitrogen dioxide	Annual	100 [b]	42.1
Ozone	8 hours	147 [c]	(e)
PM_{10}	24 hours	150 [b]	50.7
$PM_{2.5}$ [f]	Annual	15 [b]	(g)
	24 hours (98th percentile over 3 years)	35 [b]	(g)
Sulfur dioxide	Annual	80 [b]	10.2
	24 hours	365 [b]	155.1
	3 hours	1,300 [b]	723
Lead	Rolling 3-month average	0.15 [b]	0.11
Other Regulated Pollutants			
Gaseous fluoride	30 days	0.8 [d]	0.03
	7 days	1.6 [d]	0.21
	24 hours	2.9 [d]	0.23
	12 hours	3.7 [d]	0.35
Hazardous and Other Toxic Compounds			
Benzene	24 hours	150 [d]	0.082

PM_n = particulate matter less than or equal to *n* microns in aerodynamic diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. Methods of determining whether standards are attained depend on pollutant and averaging time. NAAQS (EPA 2009c), 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 8-hour ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average concentration is less than or equal to the standard. The 24-hour PM_{10} standard is attained when the expected number of days with a 24-hour average concentration above the standard is less than or equal to 1. The 24-hour $PM_{2.5}$ standard is attained when the 3-year average of the 98th percentile 24-hour averages is less than or equal to the standard. The annual $PM_{2.5}$ standard is attained when the 3-year average of the annual means is less than or equal to the standard.

[b] Federal and state standard.

[c] Federal standard.

[d] State standard.

[e] No concentration reported.

[f] EPA revoked the annual PM_{10} standard in 2006.

[g] $PM_{2.5}$ values are not yet available from the modeling for the Title V permit application because the modeling methodology for $PM_{2.5}$ is still under discussion with SCDHEC. Currently, the SCDHEC policy is to use demonstration of PM_{10} compliance as a surrogate for $PM_{2.5}$ compliance (SRNS 2010e).

Note: 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 of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c). Values may differ from those of the source document due to rounding. Concentrations were based on the permit-allowable emissions and meteorological data for 2002 through 2006 as discussed in the air dispersion modeling report (SRNS 2010e). EPA recently promulgated 1-hour ambient standards for nitrogen dioxide and sulfur dioxide. The 1-hour standard for nitrogen dioxide is 188 micrograms per cubic meter and the 1-hour standard for sulfur dioxide is 197 micrograms per cubic meter. EPA recently promulgated a lead standard of 0.15 micrograms per cubic meter based on a 3-month rolling average. No modeling results were available for comparison to these standards (EPA 2009c).

Source: EPA 2009c; SCDHEC 2012; SRNS 2010e.

Table 3–8 Ambient Air Quality Standards and Monitored Levels in the Vicinity of the Savannah River Site

Pollutant	*Averaging Time*	*Ambient Standard (micrograms per cubic meter)*	*Concentration (micrograms per cubic meter)*	*Location*
Carbon monoxide	8 hours	10,000	2,863 [a]	Richland County, South Carolina
	1 hour	40,000	3,550 [a]	Richland County, South Carolina
Nitrogen dioxide	Annual	100	6.6 [a]	Aiken County, South Carolina
Ozone	8 hours	147	133 [b]	Aiken, South Carolina
PM_{10}	24 hours	150	61 [a]	Aiken, South Carolina
	Annual	15	14.5 [c]	Aiken, South Carolina
	24 hours (98th percentile over 3 years)	35	29 [c]	Aiken, South Carolina
Sulfur dioxide	Annual	80	3.9 [a]	Barnwell, South Carolina
	24 hours	365	18.3 [a]	Barnwell, South Carolina
	3 hours	1,300	39.3 [a]	Barnwell, South Carolina
Lead	Calendar quarter	1.5	0.002 [a]	Richland County, South Carolina

PM_n = particulate matter less than or equal to *n* microns in aerodynamic diameter.

[a] 2007 data.

[b] 2009 3-year average.

[c] 2006 data.

Note: EPA recently promulgated 1-hour standards for nitrogen dioxide and sulfur dioxide and a rolling 3-month average standard for lead for which monitoring data are not yet available. The nearby monitor in Barnwell County has been discontinued.

Source: EPA 2007b, 2009c; SCDHEC 2010a, 2011; SRNS 2010e.

Proposed Facility Locations

The meteorological conditions described for SRS in Section 3.1.4.1 are considered to be representative of E-, F-, H-, K-, and S-Areas. Information on air pollutant emissions from these areas is included in the overall site emissions described earlier in this section.

The air pollutant sources of importance for permitting include the boiler in K-Area, process emissions and diesel generators in F- and H-Areas, and the vitrification process and diesel generators in S-Area (SCDHEC 2003a; SRNS 2009b; WSRC 2007f). There are no nonradioactive air pollutant sources in E-Area that require permits (SCDHEC 2003a).

3.1.4.3 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities, diminish the quality of the environment, or if loud enough, cause discomfort and even hearing loss.

General Site Description

Major noise sources at SRS occur primarily in developed or active areas and include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, public address 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 1996c:3-233–3-235). Another important contributor to noise levels is traffic to and from SRS along access highways through the nearby towns of New Ellenton, Jackson, and Aiken, South Carolina.

Most industrial facilities at SRS are far enough from the site boundary that noise levels at the boundary from these sources would not be measurable or would be barely distinguishable from background levels. The noise environment at SRS is generally the same as that described in the *SPD EIS*.

Proposed Facility Locations

No distinguishing noise characteristics have been identified in E-, F-, H-, K-, or S-Areas. 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, public address systems, and fans (NUS 1990:App. B). Facilities in these areas are far enough from the site boundary that noise levels from sources in these areas would not be measurable or would be barely distinguishable from background levels.

3.1.5 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 purpose of this *SPD Supplemental EIS*, ecological resources are differentiated by habitat type (aquatic and wetland versus terrestrial) and sensitivity (threatened, endangered, and other special-status species).

3.1.5.1 Terrestrial Resources

General Site Description

Terrestrial cover types can be classified as both forested and nonforested. Forested cover types at SRS include bottomland hardwood, pine forest, mixed forest, and forested wetland. Nonforested cover types include scrub shrub, emergent wetland, industrial, grassland, clearcut, bare soil/borrow pit, and open water. Approximately 90 percent of the land cover at SRS is bottomland hardwood forests, pine forests, and mixed forests (DOE 1999b:3-156; WSRC 2006b:2-7). **Table 3–9** identifies the amount of land of each SRS cover/land use type.

Table 3–9 Cover/Use Types and Approximate Area on the Savannah River Site

Vegetation Type	*Acres*
Bottomland Hardwood Forests	44,138
Pine Forest	64,676
Mixed Forest	32,839
Forested Wetland	31,596
Scrub Shrub	9,036
Emergent Wetland	1,212
Industrial	2,244
Grassland	1,852
Clearcut	7,556
Bare Soil/Borrow Pit	194
Open Water	3,914
Total	199,257

Note: To convert acres to hectares, multiply by 0.40469.
Source: WSRC 2006b:2-6, Figure 2-2.

The biodiversity within SRS is extensive due to the variety of plant communities and the mild climate. Animal species known to inhabit SRS include 44 species of amphibians, 59 species of reptiles, 255 species of birds, and 54 species of mammals. Common species include the eastern box turtle (*Terrapene carolina*), Carolina chickadee (*Poecile carolinensis*), common crow (*Corvus brachyrhynchos*), eastern cottontail (*Sylvilagus floridanus*), and gray fox (*Urocyon cinereoargenteus*).

Game animals include a number of species, two of which, the white-tailed deer (*Odocoileus virginianus*), and feral hogs (*Sus scrofa*), are hunted on the site. Raptors, such as the Cooper's hawk (*Accipiter cooperii*) and the black vulture (*Coragyps atratus*), and carnivores, such as the gray fox, are ecologically important groups at SRS (DOE 1999b:3-157).

Proposed Facility Locations

The majority of the land within the E-, F-, H-, K-, and S-Areas has been developed for industrial use. As a result, the majority of natural land cover is no longer present. Outside of these developed areas, a variety of habitat types are present as indicated in the General Site Description and in Table 3–9. E-, F-, H-, and S areas fall within the Industrial Core habitat management area while K-Area falls within the Supplemental red-cockaded woodpecker management area.

In addition, within F-Area, a total of 152 acres (61.5 hectares) were disturbed during construction of MFFF and WSB, and in anticipation of construction of the Pit Disassembly and Conversion Facility (PDCF). Disturbance of land required for construction of MFFF, WSB, and PDCF has been analyzed in previous NEPA documentation (NRC 2005a). Habitat types included within the disturbed area included mainly bottomland hardwood, pine forest, and disturbed land.

3.1.5.2 Aquatic Resources

General Site Description

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 bottomland hardwood forests. Among the 300 Carolina bays found throughout SRS, fewer than 20 have permanent fish populations. Redfin pickerel (*Esox americanus americanus*), mud sunfish (*Acantharchus pomotis*), lake chubsucker (*Erimyzon sucetta*), and mosquito fish (*Gambusia affinis*) are present in these bays. Although sport and commercial fishing is not permitted within SRS, the Savannah River is used extensively for both. Important commercial species are the American shad (*Alosa sapidissima*), hickory shad (*Alosa mediocris*), and striped bass (*Morone saxatilis*), all of which are anadromous (fish that live in the sea and breed in freshwater). The most important warm-water game fish are bass, pickerel, crappie, bream, and catfish (DOE 1999b:3-157).

Proposed Facility Locations

Most of the land within E-, F-, H-, K-, and S-Areas has been developed for industrial use. As a result, no wetlands currently exist within these locations, although manmade impoundments occur throughout the developed portions of these areas, including a large impoundment adjacent to the main processing building at the K-Area Complex. There are, however, aquatic resources, including small streams, wetlands, and manmade impoundments located downstream from MFFF, WSB, and the proposed PDCF in F-Area.

3.1.5.3 Wetlands

General Site Description

SRS wetlands, most of which are associated with floodplains, streams, and impoundments, include bottomland hardwood, cypress–tupelo, scrub–shrub, emergent vegetation, Carolina bays, and open water. Bottomland hardwood forest is the most extensive wetlands vegetation type along the Savannah River (DOE 1999b:3-159).

Proposed Facility Locations

As indicated in Section 3.1.5.2, the majority of the land within the E-, F-, H-, K-, and S-Areas has been developed for industrial use. As a result, no wetlands currently exist within these locations. There are, however, wetlands located downstream from MFFF, WSB, and the proposed PDCF in F-Area.

3.1.5.4 Threatened and Endangered Species

General Site Description

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. No critical habitat for threatened or endangered species exists on SRS (DOE 1999b:3-159, WSRC 2006b:3-43). **Table 3–10** presents the threatened and endangered species that are known to occur on SRS.

Proposed Facility Locations

No threatened or endangered species are known to occur within the developed portion of the E-, F-, H-, K-, and S-Areas.

Table 3–10 Federal or South Carolina Endangered or Threatened Plants and Animals Known to Occur on the Savannah River Site

	Status and Occurrence	
Species	***Federal***	***State***
Plants		
Smooth purple coneflower *(Echinacea laevigata)*	Endangered Three colonies on SRS	Endangered
Pondberry *(Lindera melissifolia)*	Endangered At least one colony known on SRS	Endangered
Animals		
Bald eagle *(Haliaeetus leucocephalus)*	Not listed	Endangered [a]
Red-cockaded woodpecker *(Picoides borealis)*	Endangered Numerous colonies on SRS	Endangered
Wood stork *(Mycteria americana)*	Endangered Feed in SRS swamps and reservoirs	Endangered
Shortnose sturgeon *(Acipenser brevirostrum)*	Endangered Eggs and larvae collected from Savannah River adjacent to SRS	Endangered
American swallow-tailed kite *(Elanoides forficatus)*	Not listed	Endangered One sighting reported
Gopher tortoise *(Gopherus polyphemus)*	Not listed	Endangered One reported; habitat on site
Southeastern big-eared bat *(Corynorhinus rafinesquii)*	Not listed	Endangered [a]

SRS = Savannah River Site.

[a] Occurrence data not available.

Source: SCDNR 2010b, WSRC 2006b:3-45.

3.1.6 Human Health

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

3.1.6.1 Radiation Exposure and Risk

General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of SRS are assumed to be the same as those to an average individual in the U.S. population. These are shown in **Table 3–11**. Background radiation doses are unrelated to SRS operations. Annual background radiation doses to individuals are expected to remain constant over time.

Table 3–11 Radiation Exposure of Individuals in the Savannah River Site Vicinity Unrelated to Savannah River Site Operations [a]

Source	*Effective Dose (millirem per year)*
Natural background radiation	
Cosmic and external terrestrial radiation	54
Internal terrestrial radiation	29
Radon-220 and -222 in homes (inhaled)	228
Other background radiation	
Diagnostic x-rays and nuclear medicine	300
Occupational	0.5
Industrial, security, medical, educational, and research	0.3
Consumer products	13
Total (rounded)	**620**

[a] An average for the United States.
Source: NCRP 2009:12.

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 are listed in the annual SRS environmental reports. The annual doses to the public from recent releases of radioactive materials (2006 through 2010) and the average annual doses over this 5-year period are presented in **Table 3–12**. These doses fall within radiological limits established per DOE Order 458.1 and are much lower than background radiation.

Using a risk estimator of 600 latent cancer fatalities (LCFs) per 1 million person-rem (or 0.0006 LCFs per rem) (DOE 2004d:22), the annual average LCF risk to the maximally exposed member of the public due to radiological releases from SRS operations from 2006 through 2010 is estimated to be 8×10^{-8}. That is, the estimated probability of this person developing a fatal cancer at some point in the future from radiation exposure associated with 1 year of SRS operations is 1 in 13 million. (Note: It takes a number of years from the time of radiation exposure until a cancer manifests.)

According to the same risk estimator, no excess fatal cancers are projected in the population living within 50 miles (80 kilometers) of SRS from 1 year of normal operations during the 2006–2010 time period. To put this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The average annual mortality rate associated with cancer for the entire U.S. population from 2003 through 2007 (the last 5 years for which final data are available) was 188 per

100,000 (HHS 2006:Table C, 2007:Table C, 2008:Table B, 2009:Table B, 2010:64).[7] Based on this national mortality rate, the number of fatal cancers that were expected to occur in 2010 in the population living within 50 miles (80 kilometers) of SRS is 1,470.

Table 3–12 Annual Radiation Doses to the Public from Savannah River Site Operations for 2006–2010 (total effective dose)

Members of the Public	***Year***	***Atmospheric Releases [a]***	***Liquid Releases [b]***	***Total [c]***
Maximally exposed individual (millirem)				
	2006	0.11	0.09	**0.20**
	2007	0.04	0.05	**0.10**
	2008	0.04	0.08	**0.12**
	2009	0.04	0.08	**0.12**
	2010	0.06	0.06	**0.12**
	2006–2010 Average	0.06	0.07	**0.13**
Population within 50 miles (person-rem) [d]				
	2006	5.0	2.9	**7.9**
	2007	1.8	2.1	**3.9**
	2008	1.8	3.8	**5.6**
	2009	2.0	2.2	**4.2**
	2010	1.7	1.9	**3.6**
	2006–2010 Average	2.5	2.6	**5.1**
Average individual within 50 miles (millirem) [e]				
	2006	0.0070	0.0033	**0.010**
	2007	0.0025	0.0024	**0.0049**
	2008	0.0025	0.0043	**0.0068**
	2009	0.0028	0.0025	**0.0053**
	2010	0.0022	0.0022	**0.0044**
	2006–2010 Average	0.0034	0.0029	**0.0063**

[a] DOE Order 458.1 and Clean Air Act regulations in 40 CFR Part 61, Subpart H, establish a compliance limit of 10 millirem per year to a maximally exposed individual.

[b] Includes all water pathways, not just the drinking water pathway. Though not directly applicable to radionuclide concentrations in surface water or groundwater, an effective dose equivalent limit of 4 millirem per year for the drinking water pathway only is frequently used as a measure of performance. It is inspired by the National Primary Drinking Water Regulations maximum contaminant level for beta and photon activity that would result in a dose equivalent of 4 millirem per year (40 CFR 141.166).

[c] DOE Order 458.1 establishes an all-pathways dose limit of 100 millirem per year to individual members of the public.

[d] About 713,500 for 2006–2009, based on 2000 census data, and about 781,000 for 2010, based on 2010 census data. For liquid releases occurring from 2006 through 2010, an additional 161,300 water users in Port Wentworth, Georgia, and Beaufort, South Carolina (about 98 river miles downstream), are included in the assessment.

[e] Obtained by dividing the population dose by the number of people living within 50 miles of SRS for atmospheric releases; for liquid releases, the number of people includes water users who live more than 50 miles downstream of SRS.

Note: To convert miles to kilometers, multiply by 1.609.

Source: SRNS 2009b:Ch. 6, 2010f:Ch. 6, 2011:Ch. 6; WSRC 2007f:Ch. 6, 2008d:Ch. 6.

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[7] *Preliminary data for 2008 and 2009 indicate that mortality rates were lower by less than 2 percent from the 2003–2007 average rate (HHS 2010:Table 7, 2011:Table B).*

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 3–13** presents the annual average individual and collective worker doses from SRS operations from 2006 through 2010, the latest 5-year period for which data are available. These doses fall within the regulatory limits of DOE's "Occupational Radiation Protection" (10 CFR Part 835). Using the risk estimator of 600 LCFs per 1 million person-rem, the calculated average annual LCF risk of 0.008 in the workforce indicates a low probability of a single cancer fatality in the worker population.

Table 3–13 Radiation Doses to Savannah River Site Workers from Operations During 2006–2010 (total effective dose equivalent)

	From Onsite Releases and Direct Radiation by Year					
Occupational Personnel	*2006*	*2007*	*2008*	*2009*	*2010*	*Average*
Average radiation worker (millirem) [a]	45	53	59	50	70	55
Total worker dose (person-rem)	107	112	127	109	180	127
Number of workers receiving a measurable dose	2,387	2,135	2,151	2,183	2,587	2,289

[a] No standard is specified for an "average radiation worker;" however, the maximum dose to a worker is limited as follows: the radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, DOE's goal is to maintain radiological exposure as low as reasonably achievable. DOE has therefore established the Administrative Control Level of 2,000 millirem per year; the site contractor sets facility administrative control levels below the DOE level (DOE 2009a).

Source: DOE 2007a:3-10, 2008b:3-10, 2009c:3-10, 2010b:3-10, 2011b:3-10.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the annual SRS environmental reports. The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on site and off site) are also presented in that report.

Proposed Facility Locations

External radiation doses and concentrations in air of gross alpha, various plutonium isotopes, neptunium-237, and americium-241 have been measured near the center of SRS. From 2005 through 2009, the average annual external dose near the site center was 121 millirem. This is higher than the average annual dose of 84 millirem measured at the offsite control location situated near U.S. Highway 301. During the 2006–2010 time period, the average concentration of gross alpha near the center of SRS was about 0.001 picocuries per cubic meter compared with the approximately 0.0011 picocuries per cubic meter measured at the offsite control location. These values are virtually the same. During the same time period, the average concentration of plutonium-239 in the air was less than 0.00001 picocuries per cubic meter near the site center and at the offsite control location (SRNS 2012).

3.1.6.2 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, or food through ingestion). Hazardous chemicals can cause cancer and noncancerous health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Sections 3.1.3, "Water Resources," and 3.1.4, "Meteorology, Air Quality and Noise."

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., from the National Emission Standards for Hazardous Air Pollutants (NESHAPs) and NPDES permits) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of environmental monitoring information and inspection of mitigation measures. Health impacts on the public may occur through inhalation of air containing hazardous chemicals released to the atmosphere during normal SRS operations. Risks to public health from other pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those from inhalation.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.1.4. 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.

During normal operations, SRS workers may be exposed to hazardous materials by inhaling contaminants in the workplace atmosphere or by direct contact. The potential for health impacts varies among facilities and workers. Workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, materials substitution, and engineering and management controls. They are also protected by adherence to the Occupational Safety and Health Administration Process Safety Management and workplace limits, and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and quantity of chemicals used in the operational processes ensure that these standards are not exceeded. DOE also 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.

3.1.6.3 Health Effects Studies

In 2002, ATSDR evaluated the public health impacts of releases of tritium from SRS into the environment and concluded that the levels of tritium contamination in the environment around SRS are low, and the radiation doses to members of the public from tritium in drinking water and food are correspondingly low. Individual annual doses are approximately 0.1 millirem, even taking into account possible contributions from organically bound tritium in foodstuffs (ATSDR 2002:1, 10).

ATSDR found the nominal lifetime risk of cancer from the annual intake of tritium around SRS to be 2.7×10^{-8} (ATSDR 2002:11). This nominal risk is less than 1 in 10 million, a value that is defined by ATSDR to represent "no increased risk." ATSDR concluded that any impact on health would be very small and certainly not detectable compared with any potential impact from the natural background radiation.

In 2007, ATSDR also issued an assessment of groundwater migration to offsite areas and surface-water contamination at SRS (ATSDR 2007:Summary). That assessment focused on the period from the end of the Centers for Disease Control and Prevention dose reconstruction evaluation timeframe (1992) to the time of the report (2007). ATSDR reached the following conclusions:

- According to the information evaluated by ATSDR, under existing conditions and normal operations, SRS currently poses no apparent public health hazard to the surrounding community from exposure to groundwater or surface water.

- There is no evidence of historical (pre-1993) migration of site-related radiological or chemical contaminants to offsite groundwater, and the monitoring data evaluated since 1993 indicate that the groundwater plumes have not migrated beyond the site boundaries. However, A- and M-Areas, which are close to the northwest SRS boundary, could potentially impact offsite groundwater resources in the future. NOTE: Separate from the ATSDR conclusions, no further offsite groundwater exposure is anticipated. This expectation is based on a consideration of the natural groundwater flow paths, the ongoing capture of the primary groundwater plume in A- and M-Areas, and the continued removal of dense nonaqueous phase liquid sources by technologies such as dynamic underground stripping.

- Unless onsite processes change and begin releasing additional chemical or radioactive substances, offsite surface-water exposures should remain the same or decrease as onsite remediation projects are completed.

The Centers for Disease Control and Prevention has a long-term program to evaluate the historical releases of radioactive and chemical materials to the environment from SRS, as well as other DOE sites (CDC 2001, 2005). This multi-year program, called the Dose Reconstruction Project, independently evaluated the historical releases from SRS to the environment and estimated the impacts on the surrounding population in terms of radiological dose. Phase I identified and collected the data on historical releases from SRS over a 39-year period, from the inception of SRS in 1954 to the end of 1992, when the main production activities ceased. Phase II reported the quantities of radionuclides and chemicals that were released from SRS during that period (CDC 2001). The report from Phase III presents screening estimates of the radiation dose and associated cancer risks for hypothetical persons living near SRS and performing representative activities (CDC 2005).

The results from the Phase III screening calculations indicate that calculated doses and risks to the hypothetical receptors summed over the 39-year period studied appear to be small. The largest point estimate dose was 0.94 rem for the “Outdoor Family Child” born in 1955; the corresponding risk of cancer incidence is 0.10 percent and the corresponding risk of cancer fatality is 0.024 percent (CDC 2005:Ex. Summary page viii). The “Outdoor Family Child” was defined as a hypothetical child who lived in Jackson, South Carolina, adjacent to the northwestern SRS boundary; ate food that was grown in Jackson; boated on the Savannah River; swam and spent time along the shoreline at the Jackson Boat Ramp on the Savannah River; and ate fish caught in the river below its confluence with Lower Three Runs Creek.

For all exposure scenarios, most of the hypothetical dose from air releases came from iodine-131, argon-41, and tritium. Plutonium releases represented a small fraction of the estimated doses. The SRS Dose Reconstruction Project was completed in September 2006 (CDC 2012).

The National Cancer Institute publishes national, state, and county incidence rates of various types of cancer (NCI 2011). However, the published information does not provide an association of these rates with their causes, e.g., specific facility operations and human lifestyles. **Table 3–14** presents incidence rates for the United States, South Carolina, Georgia, and the four counties adjacent to SRS. Additional information about cancer profiles in the vicinity of SRS is available in *State Cancer Profiles, Incidence Rates Report* (NCI 2011).

The National Institute for Occupational Safety and Health provided funding to researchers from the University of North Carolina to determine if working with hazardous agents may have led to more deaths at SRS than would be expected in the general population. In a report addressing leukemia mortality among workers at that site hired between 1950 and 1986 and followed through 2002 (Richardson and Wing 2007), evidence is presented that, for 15 years after exposure to radiation, SRS workers have a higher chance of dying from leukemia than if they were not exposed. Although not stated in the report, it should be noted that radiation doses to SRS workers are generally lower today, and have been lower for a number of years, than during the years of operation covered by the study.

Table 3–14 Cancer Incidence Rates [a] for the United States, South Carolina, Georgia, and Counties Adjacent to the Savannah River Site, 2004–2008

	All Cancers	*Thyroid*	*Breast*	*Lung and Bronchus*	*Leukemia*	*Prostate*	*Colon and Rectum*
United States	465	11	121.1	67.9	12.4	152.7	47.6
South Carolina	463.2	8.2	119.9	72.4	11.6	165.5	47.4
Aiken County [b]	398	10.3	112.2	64.2	9	125	40.3
Barnwell County [b]	421.1	(c)	114.4	54.8	13.6	144.5	43.6
Allendale County	403.1	(c)	113.8	66.2	(c)	188.4	55.4
Georgia	460.9	9.1	119.2	72.2	11.5	167.4	46.7
Burke County	473.3	(c)	107.3	86.1	15.7	143.2	58.2

[a] Age-adjusted incidence rates; cases per 100,000 persons per year.
[b] SRS is located in Aiken and Barnwell Counties.
[c] Data have been suppressed by the National Cancer Institute to ensure confidentiality and stability of rate estimates when annual average count is three or fewer cases.
Source: NCI 2011.

3.1.6.4 Accident History

SRS annual environmental reports were reviewed to determine if there were any unplanned releases of radioactivity to the environment around the site during the most recent 5 years for which data are available (2006-2010). These are the same years for which annual radiation doses to the public from SRS operations are given in Section 3.1.6.1. For each of these years, there were no unplanned radiological (or nonradiological) releases that required sampling or analysis (SRNS 2009b:3-16, 2010f:3-16, 2011:3-19; WSRC 2007f:36, 2008d:3-14).

Unplanned radioactivity releases to the environment occurred during earlier site operations. A discussion of unplanned releases is presented in the *SPD EIS* (DOE 1999b: 3-145, 3-146).

3.1.6.5 Emergency Preparedness

Every site in the DOE complex has an established emergency management program that is activated in the event of an accident. These programs have been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. Emergency management programs address emergency planning, training, preparedness, and response for both onsite and offsite personnel.

These programs involve providing specialized training and equipment for local fire departments and hospitals, state public safety organizations, and other government entities that may participate in response actions, as well as specialized assistance teams (DOE Order 151.1C, *Comprehensive Emergency Management System*). These programs also provide for notification of local governments whose constituencies could be threatened in the event of an accident. Broad ranges of exercises are run to ensure the systems are working properly, from facility-specific exercises to regional responses. In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at the Hanford Site in Richland, Washington, in May 1997.

The emergency management system at SRS includes emergency response facilities and equipment, trained staff, and effective interface and integration with offsite emergency response authorities and organizations. SRS personnel maintain the necessary apparatus, equipment, and a state-of-the-art Emergency Operations Center to respond effectively to virtually any type of emergency, not only at SRS, but throughout the local community.

The elements of the SRS emergency management program are implemented by a number of site and facility organizations. To facilitate development and ensure consistency of implementation, the site contractor has established standards that govern many elements of the program. Document revisions are reviewed against these standards by the site contractor's emergency preparedness group to ensure consistency among SRS facilities and with the sitewide program.

For operational emergencies that do not involve safeguards and security, the site contractor is the primary responding element. For emergencies involving safeguards and security, the DOE Emergency Manager is responsible for the overall direction of emergency response activities. The response capability of each SRS facility is exercised annually. Exercises are realistic simulations of emergencies to include command, control, and communication functions and event-scene activities. Training and drills are performed periodically to develop and maintain specific emergency response capabilities. Drills provide supervised, hands-on training for members of emergency response organizations. Exercises are used to validate the elements of the emergency management program. An annual comprehensive site-level exercise is conducted to test and demonstrate the site's integrated emergency response capability. Federal, state, local, and private organizations that support the site/facility's response capability or may be affected by a facility emergency are invited to participate in exercises at least once every 3 years.

3.1.7 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal and state laws, regulations, and guidelines. DOE views cultural resources as archeological materials (artifacts) and sites from prehistoric, historic, or ethnohistoric periods that are located on or beneath the ground surface; standing structures that are over 50 years old or represent a major historical theme or era; cultural and natural places, certain natural resources, and sacred objects that are important to American Indians and other ethnic groups; and American folklife traditions and arts (DOE 2010c).

As a result of these Federal and state laws and regulations, in 1973 the Savannah River Archaeological Research Program of the South Carolina Institute of Archaeology and Anthropology at the University of South Carolina began a phased approach to archeological compliance involving reconnaissance surveys, general intensive watershed surveys, specific intensive surveys, data recovery, and coordination with major land users on and around SRS (SRARP 2010a). These field studies and surveys continue today under separate agreements. Originally, cultural resources at SRS were managed under the terms of a Programmatic Memorandum of Agreement among the DOE Savannah River Operations Office, South Carolina State Historic Preservation Office (SHPO), and Advisory Council on Historic Preservation (SRARP 1989:App. C). DOE uses this agreement to identify cultural resources, assess their eligibility for listing on the National Register of Historic Places (NRHP), and to consult with the South Carolina SHPO to develop mitigation plans for affected resources (DOE 2005d:14). Guidance on the management of cultural resources at SRS is included in the *Archeological Resource Management Plan of the Savannah River Archeological Research Program* (SRARP 1989). Given SRS's ongoing missions, it was recognized that site operations may affect NRHP-eligible Cold War properties, so DOE developed a Programmatic Agreement in consultation with the South Carolina SHPO, the Advisory Council on Historic Preservation, the SRS Citizen Advisory Board, Citizens for Nuclear Technology Awareness, and the Cities of Aiken, Augusta, and New Ellenton for the preservation, management, and treatment of such properties within the SRS Cold War Historic District (DOE 2004a). As a result, the *Savannah River Site's Cold War Built Environment Cultural Resources Management Plan* was developed and contains the decision process for managing NRHP-eligible Cold War historic properties (DOE 2005a:1, 2).

As of fiscal year 2010, the Savannah River Archaeological Research Program has surveyed approximately 65,055 acres (26,327 hectares), or 33.7 percent of the 193,276 acres (78,217 hectares) of SRS suitable for survey (i.e., excluding SRS wetlands and developed areas). These efforts have resulted in the inventory of 1,885 sites. Through analysis, 925 of these sites have been determined to be prehistoric sites, 487 to be historic sites, and the remaining 473 to be mixed historic and prehistoric sites. During fiscal year 2010, 8 new sites were recorded and delineated; however, based on the level of survey sampling conducted, adequate information was not obtained from the sites to allow for NRHP eligibility determinations (SRARP 2010b:2, 45).

3.1.7.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records (DOE 1999b:3-160).

General Site Description

In general terms, prehistoric sites on SRS consist of village sites, base camps, limited-activity sites, quarries, and workshops (NRC 2005a:3-37).

Proposed Facility Locations

The proposed capabilities would be installed in existing facilities or built in E-, F-, H-, K-, or S-Area, all of which are designated as site industrial, so there is little likelihood that prehistoric resources with research potential would be found. The majority of E-Area was disturbed when establishing the 200-acre (81-hectare) Old Burial Grounds that were in operation from 1952 to 1995, the 114,000-square-foot (10,591-square-meter) TRU waste pads that have been in operation since 1974, and E-Area vaults that became operational in 1994 and occupy 100 acres (DOE 2005c:4-53–4-75; Nukeworker 2010). The construction of F-, H-, and K-Areas during the 1950s likely destroyed any such resources in those areas (DOE 2005a:34–51); however, four prehistoric sites (two of which are eligible for listing on the NRHP) were identified in F-Area where MFFF and WSB are being constructed. These sites were mitigated in part through data recovery as described in a data recovery plan approved by the South Carolina SHPO. Five additional eligible sites located in the vicinity of the construction site are being monitored by Savannah River Archaeological Research Program staff members during ground-disturbing activities and in accordance with the Programmatic Memorandum of Agreement (NRC 2005a:3-38, 5-14, B-19–B-21). S-Area was extensively surveyed prior to construction of DWPF, and no archaeological (prehistoric or historic) artifacts were found (DOE 1982:4-3).

3.1.7.2 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 (DOE 1999b:3-161).

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 (DOE 1999b:3-161).

In November 2002, a resource study of SRS Cold War history and facilities was completed. In total, 732 SRS facilities were inventoried, all of which were constructed between 1950 and 1989. The study, conducted using the NRHP criteria, yielded 232 site facilities that were deemed historically eligible, including the SRS layout, classified as a NRHP-eligible Cold War Historic District because it possesses national, state, and local significance. SRS is an exceptionally important historic resource that provides information about our nation's twentieth-century Cold War history. It contains a well-preserved group of buildings and structures placed within a carefully defined site plan that are historically linked, sharing a common designer and aesthetic (DOE 2005a:1, 22; 2008l).

Proposed Facility Locations

Numerous facilities either individually or collectively in F-, H-, K-, and S-Areas were identified as NRHP-eligible, as they relate to one of two major themes: SRS's Cold War production mission and its role within the Atomic Energy Commission's program to develop peaceful uses for atomic energy. Sub-themes were defined that parallel processes and link significant buildings and building types to those themes. Facilities within E-, F-, and S-Areas that could be used under the proposed alternatives are newer and, therefore, not considered historic. However, H-Canyon is considered eligible due to its separations sub-theme as part of the historic district, and K-Reactor is individually eligible for listing, as well as many other buildings and areas based on sub-themes in association with the historic district (DOE 2005a: 24, 34, 51).

3.1.7.3 American Indian Resources

American Indian resources are sites, areas, and materials important to American Indians for religious or heritage reasons. In addition, cultural values are placed on natural resources, such as plants, that have multiple purposes within various American Indian groups. Of primary concern are concepts of sacred space that create the potential for land use conflicts (DOE 1999b:3-162).

General Site Description

American Indian tribes with traditional ties to the SRS area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. Main villages of both the Cherokee and Creek were located southwest and northwest of SRS, respectively, but both tribes may have used the area for hunting and gathering activities. American Indian resources in the region include remains of villages or townsites, ceremonial lodges, burials, cemeteries, and natural areas containing traditional plants used in religious ceremonies and for medicinal purposes (DOE 1999b:3-162).

In 1991, DOE conducted a survey of American Indian concerns about religious rights in the central Savannah River Valley. During this study, three American Indian 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 traditionally used in tribal ceremonies—for example, redroot (*Lachnanthes caroliniana*), button snakeroot (*Eryngium yuccifolium*), and American ginseng (*Panax quinquefolius*)—could exist on SRS (DOE 1999b:3-162; NRC 2005a:3-39). Redroot and button snakeroot are known to occur on SRS (Batson, Angerman, and Jones 1985:6, 21).

Proposed Facility Locations

Due to the developed nature of E-, F-, H-, K-, and S-Areas, it is highly unlikely that plants of concern to American Indians would be found. Further, no traditional cultural properties were identified during surveys conducted in association with construction of MFFF in F-Area (NRC 2005a:B-4).

3.1.7.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age (DOE 1999b:3-162).

General Site Description

Paleontological materials from the SRS area date largely from the Eocene Age (54 to 39 million years ago) and include fossilized plants, 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 (NRC 2005a:3-39).

Proposed Facility Locations

Paleontological resources are unlikely to be found within E-, F-, H-, K-, and S-Areas due to the highly disturbed nature of these areas and, in fact, no such resources have been recorded in either F- or S-Area (DOE 1999b:3-163).

3.1.8 Socioeconomics

In this *SPD Supplemental EIS*, "socioeconomics" refers to the relationship between the economic activity associated with proposed DOE actions involving surplus plutonium disposition and the impacts that such actions may have on the ROI. Socioeconomic impacts may be defined as the environmental consequences of a proposed action in terms of potential demographic and economic changes.

Table 3–15 provides residence information for the four-county ROI. As shown in this table, approximately 86 percent of SRS employees reside in this ROI. In 2010, 8,730 persons were directly employed at SRS. Direct onsite employment accounts for approximately 4.1 percent of employment in the ROI.

Table 3–15 Distribution of Employees by Place of Residence in the Savannah River Site Region of Influence in 2010

County	*Number of Employees*	*Percent of Total Site Employment*
Aiken	4,496	52
Barnwell	580	7
Columbia	1,324	15
Richmond	1,082	12
Region of Influence Total [a]	**7,482**	**86**

[a] Totals may not add due to rounding.
Source: SRNS 2012.

Indirect employment generated by SRS operations has been calculated using a weighted average of RIMS II [Regional Input-Output Modeling System] direct-effect employment multipliers from the U.S. Bureau of Economic Analysis for select industries that most accurately reflect the major activities at the site. The Bureau of Economic Analysis develops RIMS II multipliers using input–output tables that show the distribution of inputs purchased and outputs sold for each industry. A national input–output table, representing close to 500 different industries, is adjusted using Bureau of Economic Analysis regional economic accounts to accurately reflect the structure of a given area. The detailed industries included in the RIMS II models that were used to develop the SRS site-specific operations multiplier include Management of Companies and Enterprises; Scientific Research and Development; Investigation and Security Services; Waste Management and Remediation; Other Basic Inorganic Chemical Manufacturing; Forest Nurseries, Forest Products, and Forest Tracts; Environmental and Other Technical Consulting Services; and Construction. This method resulted in an estimated SRS direct-effect employment multiplier of 2.19. Therefore, the direct employment of 8,730 at SRS would generate indirect employment of 10,383 within the ROI, resulting in a total employment of 19,113, or 8.9 percent of the employment in the ROI.

3.1.8.1 Regional Economic Characteristics

Between 2000 and 2011, the civilian labor force of the ROI increased at an average annual rate of 0.9 percent, to 236,950. At the same time, employment in the ROI increased at an average annual rate of

0.4 percent to 215,297, resulting in a 5.3 percentage point increase in the unemployment rate. Unemployment in the ROI was 9.1 percent in 2011, up from the 2000 level of 3.8 percent. Georgia and South Carolina experienced similar trends in unemployment rates, increasing 6.3 percentage points and 6.7 percentage points over the 12-year period, respectively (BLS 2012). **Figure 3–4** illustrates the change in unemployment rates in the ROI, Georgia, and South Carolina from 2000 through 2010.

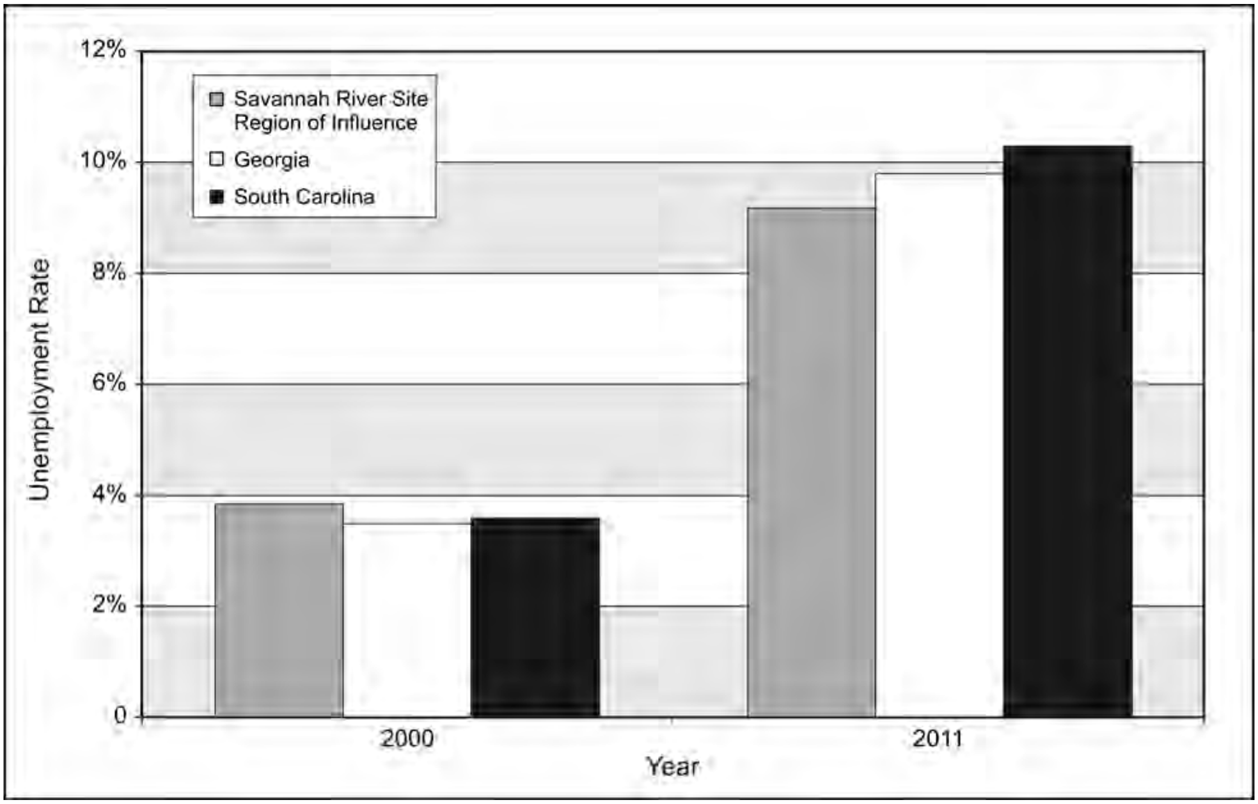


Figure 3–4 Unemployment Rates for the Savannah River Site Region of Influence, Georgia, and South Carolina from 2000 through 2011

From 2000 to 2009, the average real per capita income of the ROI increased by approximately 4 percent in 2009 dollars, to $32,678. South Carolina experienced a slightly smaller increase than in the ROI, increasing 4 percent to $32,505. The per-capita income of Georgia decreased 4 percent to $34,129 over the same time period. Over the 10-year period, real per capita income in the ROI peaked in 2009 at $32,678. Real per capita income in Georgia and South Carolina peaked in 2007 at $35,891 and $33,249, respectively (BEA 2012a). **Table 3–16** presents the per capita incomes of the ROI, Georgia, and South Carolina.

Table 3–16 Per Capita Income of the Savannah River Site Region of Influence, Georgia, and South Carolina in 2000 and 2009

	Savannah River Site Region of Influence		*Georgia*		*South Carolina*	
Year	*Nominal*	*Real* [a]	*Nominal*	*Real* [a]	*Nominal*	*Real* [a]
2000	$25,132	$31,311	$28,531	$35,546	$25,081	$31,247
2009	$32,678	$32,678	$34,129	$34,129	$32,505	$32,505

[a] Real per capita income adjusted to 2009 dollars using the Consumer Price Index for All Urban Consumers in U.S. City Average.

Source: BEA 2012a.

In 2009, the government was the largest employer in the ROI, at approximately 21 percent of total employment. Retail trade was the next leading industry at approximately 11 percent of employment, followed by healthcare and social assistance, and administrative and waste management services at approximately 10 percent each. Similar employment distributions were seen in Georgia, where the leading employment sectors were also government, retail trade and healthcare and social assistance at approximately 15 percent, 10 percent, and 9 percent, respectively. South Carolina's leading employment sectors were government, retail trade, and manufacturing at approximately 16 percent, 11 percent, and 9 percent, respectively (BEA 2012b). The major employment sectors in the ROI, Georgia, and South Carolina are presented in **Figure 3–5**.

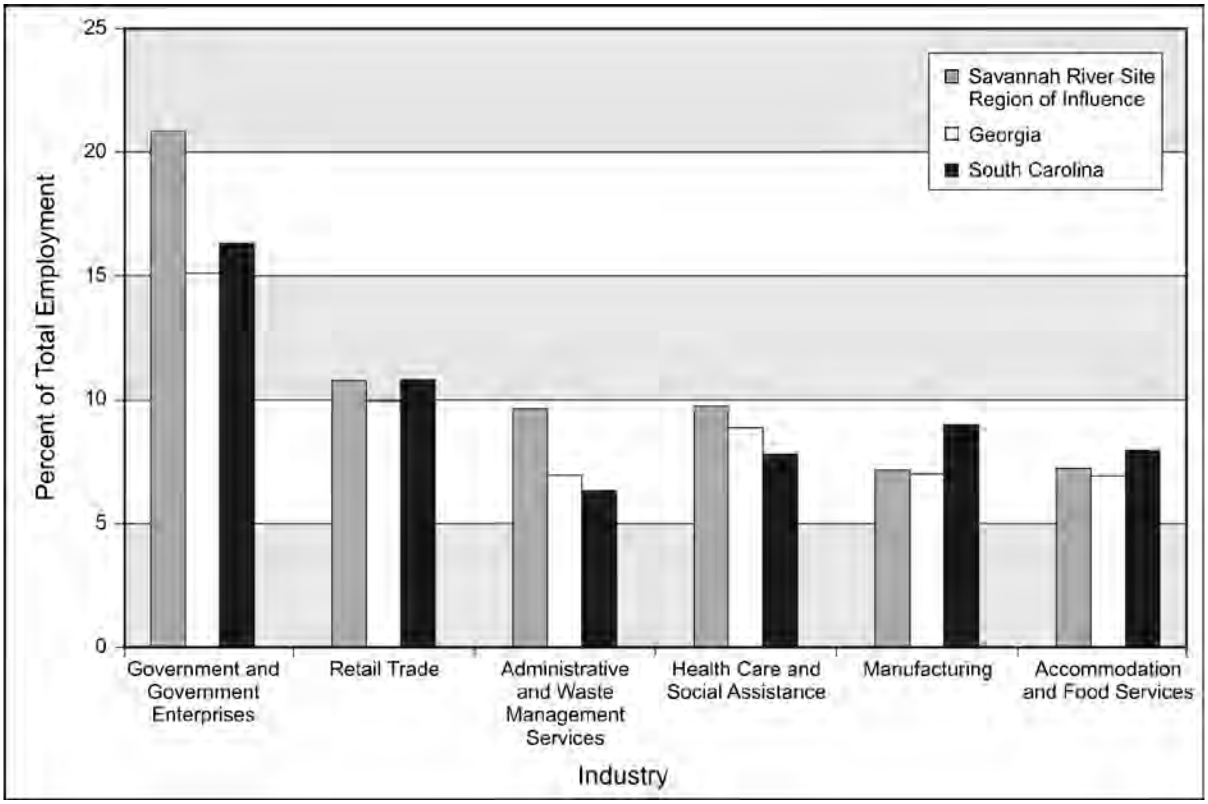


Figure 3–5 Major Employment Sector Distribution for the Savannah River Site Region of Influence, Georgia, and South Carolina in 2009

Population and Housing

In 2010, the population in the ROI was estimated to be 507, 322 (Census 2011a). From 2000 to 2010, the total population in the ROI increased at an average annual rate of approximately 1.1 percent, which was lower than the growth rate in both Georgia and South Carolina. Over the same time period, the total population of Georgia increased at an average annual rate of approximately 1.7 percent, to 9,687,653 people. South Carolina experienced an increase of approximately 1.4 percent annually, to 4,625,364 people in 2010. The populations of the ROI, Georgia, and South Carolina are shown in **Table 3–17**.

Table 3–17 Total Population of the Savannah River Site Region of Influence, Georgia, and South Carolina in 2000 and 2010

Year	*Savannah River Site Region of Influence*	*Georgia*	*South Carolina*
2000	455,096	8,186,653	4,012,023
2010	507,322	9,687,653	4,625,364

Source: Census 2011a.

From 2000 to 2010, the number of housing units in the ROI increased at an average annual rate of 1.5 percent, to 217,690 units (Census 2010, 2011b). The number of housing units in Georgia and South Carolina increased at average annual rates of approximately 2.2 and 2 percent respectively, resulting in a total number of housing units of 4,088,801 and 2,137,683, respectively. **Table 3–18** shows the number of housing units in the ROI, Georgia, and South Carolina. The average homeowner vacancy rate for the counties that make up the ROI was 2.9 percent in 2010, slightly higher than the statewide rate for South Carolina of 2.8 percent, but lower than the homeowner vacancy rate for Georgia of 3.4 percent. The average renter vacancy rate for the ROI in 2010 was 9.2 percent, compared with the statewide renter vacancy rates of 12.4 percent for Georgia and 14.4 percent for South Carolina (Census 2011c, 2011d).

Table 3–18 Total Housing Units in the Savannah River Site Region of Influence, Georgia, and South Carolina in 2000 and 2010

Year	*Savannah River Site Region of Influence*	*Georgia*	*South Carolina*
2000	187,811	3,281,737	1,753,670
2010	217,690	4,088,801	2,137,683

Source: Census 2010, 2011b.

3.1.8.2 Local Transportation

In addition to state transportation departments, three major planning agencies collect and maintain data on the efficiency of the transportation system in the region: the Augusta Planning Commission in Georgia, and the North Augusta Planning Commission and the Lower Savannah Council of Governments Planning Department in South Carolina. Road performance is measured using level of service (LOS) ratings. LOS ratings range from "A" to "F," with "A" being the best travel conditions and "F" being the worst. Most planners aim for LOS C. At LOS C, roads are below, but close to, capacity and traffic generally flows at the posted speed.

In the Lower Savannah Council of Governments planning area, the roads with the highest levels of traffic operate at LOS A (LSCOG 2005). This area includes the counties immediately surrounding SRS. In the North Augusta Planning Area, roads operate at LOS C or better (NA 2005). This area includes the northwest part of Aiken County and Edgefield County. In the Augusta–Richmond County Planning Area, there are several street and highway system segments that operate below LOS C, including segments of Interstate 520 (I–520) (Bobby Jones Expressway) and I–20 (Carl Sanders Highway), as well as segments of principal arterial roads, including Deans Bridge Road, Doug Barnard Parkway, Mike Padgett Highway, Peach Orchard Road, Washington Road, and Wrightsboro Road. Most of the congested segments are located in the urbanized part of the county (ARC 2008). Roads in Columbia County operating below LOS C also include segments of I–520, I–20, Belair Road, Lewiston Road, Horizon South Parkway, Old Evans Road, and Washington Road (TEI 2004). Most SRS employees live in the Augusta area and the city of Aiken and would use roads in these planning areas to commute to SRS (DOC 2008).

3.1.9 Infrastructure

Site infrastructure includes those basic resources and services required to support planned construction and operations activities and the continued operations of existing facilities. For the purposes of this *SPD Supplemental EIS*, infrastructure is defined as transportation, electricity, fuel, water, and sewage. **Table 3–19** describes the SRS infrastructure.

Table 3–19 Savannah River Site Sitewide Infrastructure

Resource	*Estimated Use*	*Capacity*	*Available Capacity*
Transportation [a]			
Primary and secondary roads (miles)	1,230	1,230	N/A
Railroads (miles)	32	32	N/A
Electricity			
Power consumption (megawatt-hours per year)	310,000	4,400,000 [a]	4,100,000
Peak load (megawatts) [a]	60	500	440
Fuel [b]			
Oil (gallons per year)	410,000	N/A [c]	N/A
Coal (tons per year)	150,000	N/A [c]	N/A
Domestic Water (gallons per year)	320,000,000	2,950,000,000	2,630,000,000
Sewage (gallons per year)	250,000,000	383,000,000 [d]	133,000,000

N/A = not applicable or not available.

[a] WSRC 2008a.

[b] Oil use is for A-, D-, and K-Areas.

[c] Capacity is generally not limited, as delivery frequency can be increased to meet demand.

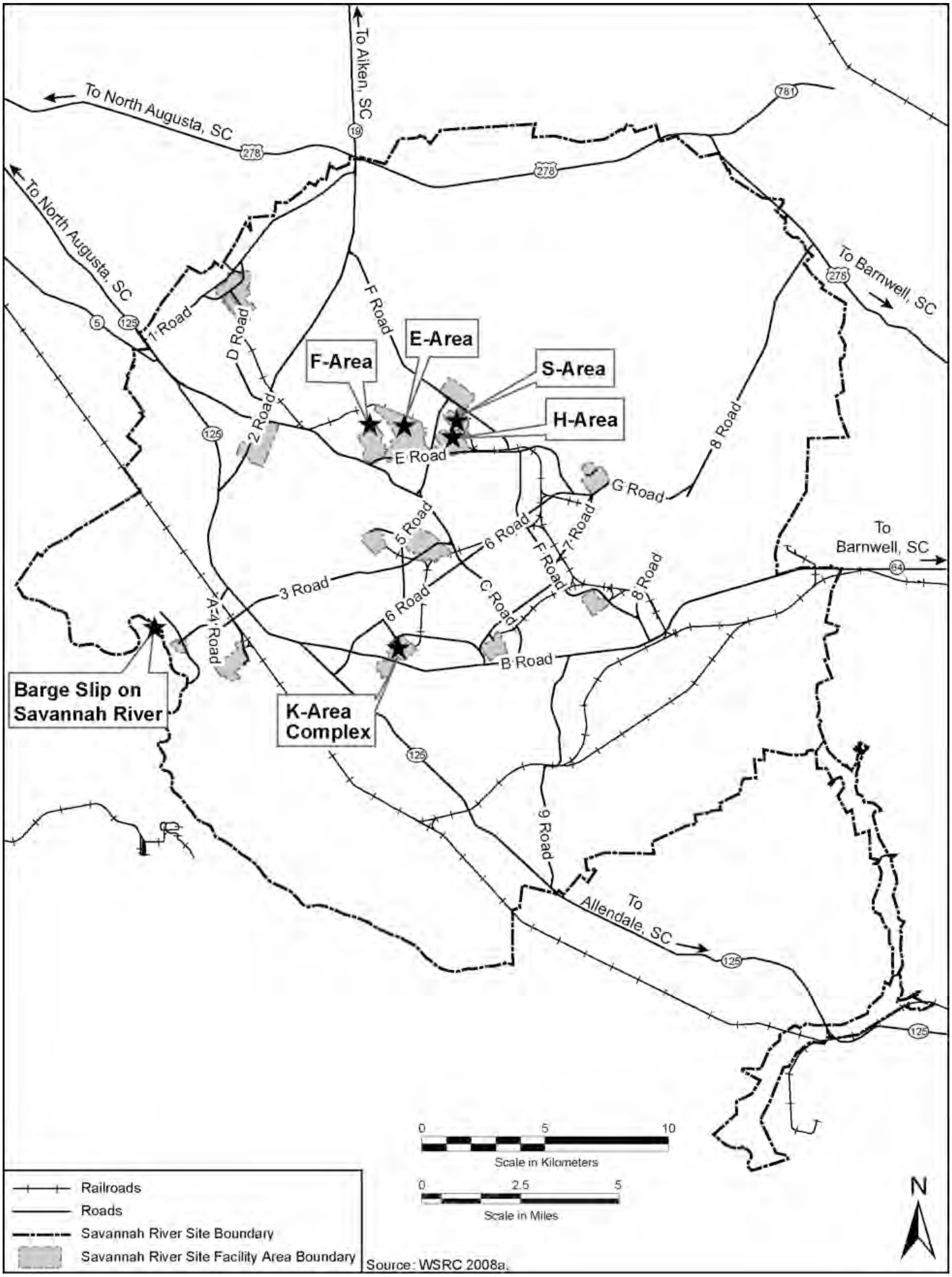
[d] Capacity includes the Central Sanitary Wastewater Treatment Facility and smaller treatment units in D-, K-, and L-Areas.

Note: To convert gallons to liters, multiply by 3.7854; miles to kilometers, multiply by 1.6093; tons (short) to metric tons, multiply by 0.90718. Totals are rounded to two significant figures from information included in SRS Infrastructure PQCD Report D7257000, FY2010 (SRNS 2012).

Transportation – SRS is managed as a controlled area with limited public access. In addition to the vehicular roadways, rail track is dedicated to SRS for transporting large volumes or oversized loads of materials or supplies (SRS 2005:3.1.4-3). As shown in **Figure 3–6**, travel between facilities in E-, F-, H-, K-, and S-Areas evaluated in this *SPD Supplemental EIS* can be accomplished by both surface roads and railroads.

Vehicular access to SRS is provided from South Carolina State Highways 19, 64, 125, 781, and U.S. Highway 278. State Highway 19 runs north from the site through New Ellenton toward Aiken; State Highway 64 runs in an easterly direction from the site toward Barnwell; State Highway 125 runs through the site itself in a southeasterly direction between North Augusta and Allendale, passing through Beech Island and Jackson. U.S. Highway 278 also runs through the site, in a southeasterly direction between North Augusta and Barnwell. State Highway 781 connects U.S. Highway 278 with Williston to the northeast of the site. The northern perimeter of the site is about 10 miles (16 kilometers) from downtown Aiken. Within SRS, there are approximately 130 miles (209 kilometers) of primary and 1,100 miles (1,770 kilometers) of secondary roads (SRS 2005:3.1.4-3). Commuter traffic between SRS and Georgia crosses the Savannah River primarily on I–20 and I–520 and primary arteries Routes 28 and 1 and Business Route 25 to the north of SRS. Another primary artery, U.S. Highway 301, crosses the Savannah River to the south of SRS.

Several major road improvement projects in the area were recently completed. In North Augusta, Phase II of the I–520 (Palmetto Parkway) was completed in 2009. The I–520 project extended the Palmetto Parkway approximately 6.5 miles (10.5 kilometers) from Route 1 to I–20, connecting the two interstates and completing the Augusta–North Augusta loop. The project included the construction of a four-lane interstate with three interchanges and 13 bridges (SCDOT 2008). In Augusta, Georgia, significant improvements to I–20 and I–520 were completed in 2009. The improvements to I–20 and I–520 in Georgia included widening 6.25 miles (10 kilometers) of I–20, the addition of collector-distributor lanes along parts of I–520 and I–20, and reconstruction of the I–20/I–520 interchange. A major project planned to start in the near future is the expansion of the I–20 bridge over the Savannah River from four lanes to six lanes (City of Augusta 2010). This bridge is in the center of the main transportation route between Augusta, Georgia, and Aiken, South Carolina.



Source: WSRC 2008a.

Figure 3–6 Savannah River Site Transportation Infrastructure

Rail service in the region is provided by the Norfolk Southern Corporation and CSX Transportation. Rail access is provided by the Robbins Station on the CSX Transportation line (DOE 1999b:3-144). Within SRS, there are approximately 32 miles (51 kilometers) of track (SRNS 2012). The railroads support delivery of foreign and domestic research reactor fuel shipments, movement of nuclear material and equipment on site, and delivery of construction materials for new mission projects (SRS 2005:3.1.4-3).

Barge transportation is available using the Savannah River. Currently, the Savannah River is used primarily for recreation. SRS has no commercial docking facilities, but has a boat ramp in the former T-Area that has accepted large transport barge shipments (DOE 1999b:3-144).

Columbia Metropolitan Airport in Columbia, South Carolina, and Augusta Regional Bush Field Airport in Augusta, Georgia, receive jet air passenger and cargo service from both national and local carriers. Numerous small private airports are located in the region.

Electricity – Most of the electrical power consumed by SRS is generated by offsite coal-fired and nuclear power plants, and is supplied by the South Carolina Electric and Gas Company. Approximately 310,000 megawatt-hours per year of electricity is used at SRS, with an available capacity of 4,400,000 megawatt-hours per year (SRNS 2012). The peak load use is estimated to be 60 megawatts, with a peak load capacity of 500 megawatts.

Fuel – Coal and fuel oil are used primarily at SRS to produce steam in boiler plants. Fuel oil is also used to power emergency generators. Fuel oil is delivered by tanker truck and used in two boilers located in K-Area. Coal is delivered by rail and is stockpiled for use in D- and H-Areas. The steam plant in A-Area, which burned coal, is no longer used and was replaced with a biomass plant with fuel oil backup. The coal-powered steam boilers in H-Area are currently in standby. Natural gas is not used at SRS (SRS 2005:3.1.4). An estimated 410,000 gallons (1.6 million liters) of fuel oil and 150,000 tons (136,000 metric tons) of coal per year are burned at SRS (SRNS 2012). Replenishment of onsite fuel oil supplies can be delivered by truck or rail as needed. Furthermore, temporary storage tanks can be installed to supplement fuel consumption needs during construction activities. Thus, the capacity for fuel oil or coal utilization is generally not considered to be limited.

Water – Three large domestic water supply systems at SRS deliver the vast majority of the site's requirements. These water treatment facilities are located in A-, D-, and K-Areas. A smaller system located in B-Area is a backup to the A-Area facility. Raw water is drawn from subsurface aquifers through 20-inch- (51-centimeter-) diameter production wells using vertical turbine pumps. Once treated, the potable water is stored in five elevated storage tanks and distributed to the various facilities through a network of piping (SRS 2005:3.1.4).

Approximately 320 million gallons (1.2 billion liters) of domestic water are used at SRS annually, with a capacity to supply up to 2,950 million gallons (11.2 billion liters) per year (SRNS 2012). Process water for individual areas is supplied through separate deep groundwater wells or river intake systems (SRS 2005).

Sewage – The Central Sanitary Wastewater Treatment Facility (CSWTF), located on Burma Road and installed in 1995, collects and treats 97 percent of sanitary wastewater generated at SRS. Also constructed in 1995, 18 miles (29 kilometers) of pressurized sewer line and 12 lift stations are used to transport sanitary waste to the CSWTF. The balance of the sanitary waste is treated at 3 smaller, and older, independent facilities located in D-, K-, and L-Areas. The original treatment facilities, lift stations, and 40 miles (64 kilometers) of gravity pipe were installed in the 1950s. Collectively, the sanitary systems include the CSWTF, 3 smaller treatment facilities, 46 lift stations, and 58 miles (93 kilometers) of sewer pipe. The CSWTF and the smaller treatment units in D-, K-, and L-Areas are estimated to collect and treat approximately 250 million gallons (950 million liters) of sewage per year with a capacity to treat up to 383 million gallons (1.5 billion liters) per year of sewage (SRNS 2012).

Proposed Facility Locations

Proposed activities analyzed in this *SPD Supplemental EIS* would be located in E-, F-, H-, K-, and S-Areas. **Table 3–20** compares estimated current consumption of resources in these areas.

The construction and operation of MFFF in F-Area was analyzed in an EIS prepared by the U.S. Nuclear Regulatory Commission (NRC) (NRC 2005a). However, because this facility is not yet operational, the estimated use of resources presented in Table 3–20 does not include data for MFFF. Chapter 4, Section 4.1.7.7, discusses the infrastructure burden for operating MFFF and any additional modifications that may be required for implementing the alternatives analyzed in this *SPD Supplemental EIS* for F-Area.

Table 3–20 Current Use of Resources

Resource	*E-Area*	*F-Area*	*H-Area*	*K-Area*	*S-Area*
Electricity					
Power consumption (megawatt-hours per year)	2,900	46,000	99,000	9,200	45,000
Peak load (megawatts)	1 [a]	10	24.7	5.8	6
Diesel/Fuel Oil (gallons per year) [b]	N/A	N/A	N/A	170,000	N/A
Domestic Water (gallons per year)	20,000,000	61,000,000	140,000,000	3,600,000	12,000,000

N/A = not applicable.

[a] WSRC 2008a; estimated for E-Area based on requirements for other areas.

[b] Fuel oil is not used in E-, F-, H-, or S-Areas.

Note: To convert gallons to liters, multiply by 3.7854. Totals are rounded to two significant figures from information included in SRS Infrastructure PQCD Report D7257000, FY2010 (SRNS 2012).

Electricity – Step-down transformers are used to reduce the electrical power from the 115-kilovolt transmission loop to medium voltage levels, typically 4.16 or 13.8 kilovolts, in individual areas. There are two 30-megavolt-amp transformers for K-Area, two 44-megavolt-amp transformers for H-Area, and two 24/32-megavolt-amp transformers for each of F- and S-Areas.

The current estimated power consumption for the five areas that would be affected by the proposed activities totals approximately 202,000 megawatt-hours, which accounts for approximately 65 percent of current sitewide electrical usage and represents about 5 percent of the sitewide available capacity. The theoretical maximum peak load that could be experienced by the five areas given current estimated peak loads for each area totals approximately 48 megawatts, compared to a sitewide peak load of 60 megawatts. SRS has the capacity to deliver a peak load of up to 500 megawatts.

Fuel – In K-Area, fuel oil is used only to power two package boilers and the K-Area Interim Surveillance Backup Generator. Fuel oil is also used as the backup for the A-Area biomass steam plant. Another biomass plant is under construction to replace the D-Area powerhouse. The estimated 170,000 gallons (640,000 liters) of fuel oil used annually represents about 41 percent of the current sitewide consumption of fuel oil.

Water – The estimated current annual consumption of domestic water for all five areas of approximately 240 million gallons (910 million liters) represents 75 percent of the sitewide use and about 8 percent of sitewide capacity. Over 63 percent of the domestic water used at SRS is currently consumed in F- and H-Areas.

3.1.10 Waste Management

Waste management includes minimization, characterization, treatment, storage, and disposal of solid and liquid waste generated from ongoing DOE activities. The waste is managed according to appropriate treatment, storage, and disposal technologies and in compliance with applicable Federal and state statutes and DOE orders. Sitewide remediation activities are conducted under a 1989 Federal Facility Agreement, a tri-party agreement between EPA, SCDHEC, and DOE. The Federal Facility Agreement directs the comprehensive remediation of the site and integrates cleanup requirements under the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (WSRC 2008d:1-3). Additional information about regulatory requirements for waste treatment, storage, and disposal is provided in Chapter 5 of this *SPD Supplemental EIS*.

3.1.10.1 Waste Generation

The following waste types are managed at SRS: high-level radioactive waste (HLW), TRU waste and mixed TRU waste, solid and liquid LLW, MLLW, hazardous waste, and nonhazardous solid and liquid sanitary waste. The volume of each of these waste types currently managed by SRS would be affected by the activities proposed in this *SPD Supplemental EIS*. Solid waste generation rates from activities at SRS are provided in **Table 3–21**. Waste generation rates from activities at SRS for HLW, liquid LLW, and liquid sanitary waste are not included in Table 3–21, but are discussed in subsections that follow.

As shown in Table 3–21, sitewide 2010 generation rates for TRU waste, LLW, MLLW, and hazardous waste were considerably below the 5-year average. However, generation rates increased for solid sanitary and construction and demolition debris. These changes can be primarily attributed to fewer decontamination and decommissioning (D&D) and environmental restoration activities occurring in 2010 than in previous years. The reduction of LLW generated in K-Area can be attributed to a reduction in the area's LLW backlog, enhanced waste minimization and pollution prevention practices, and a shift in the K-Area mission to storage of special nuclear material (WSRC 2008a). It is expected that sitewide generation rates will increase over the next few years as activities funded by the *American Reinvestment and Recovery Act* are conducted.

Tables 3–22, 3–23, and **3–24** provide a summary and status of current and planned treatment, storage, and disposal facilities at SRS.

Table 3–21 Solid Waste Generation Rates at the Savannah River Site (cubic meters)

	Savannah River Site – Total		*K-Area*		*H-Canyon in H-Area*		*HB-Line in H-Area*		*DWPF in S-Area*		*E-Area and Hazardous/Mixed Waste Storage*		*F-Area (F-Canyon and FB-Line)*	
Waste Type	***5-Year Average***	***FY2010***	***5-Year Average***	***FY2010***	***5-Year Average***	***FY2010***	***5-Year Average***	***FY2010***	***5-Year Average***	***FY2010***	***5-Year Average***	***FY2010***	***5-Year Average***	***FY2010***
TRU [a]	120	67	0.5	0.6	1.5	0	27	22	0.1	0	0	0	39	27
LLW	13,000	7,700	86	64	650	830	97	130	250	190	5	5	730	950
MLLW	86	30	2.5	8.7	0.3	0	0.2	0	1.3	0.4	0	0	6.1	6.6
Hazardous	84	12	0.2	0	0	0	0	0	0	0	0	0	1.8	0
Sanitary [b]	2,400	2,600	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C&D debris [c]	83,000	130,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

C&D = construction and demolition; DWPF = Defense Waste Processing Facility; FY = fiscal year; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; N/A = not available; TRU = transuranic.

[a] Includes mixed TRU wastes.

[b] Sanitary waste is provided for all of the Savannah River Site (information by individual area is not available). Waste sent to the recycle facility and Three Rivers Landfill is measured by weight with volume estimated at 1 metric ton per cubic meter (1,690 pounds per cubic yard).

[c] C&D landfill waste volume is based on truck volumes received. Note that about 36 percent of the waste mass/estimated volume reported is sent to the recycling facility and not disposed of in the C&D landfill. Waste generation does not include waste-like materials recovered through salvage and excess property operations, or materials recovered through construction services.

Source: SRNS 2012.

Table 3–22 Waste Treatment Capabilities at the Savannah River Site

			Waste Type				
Facility Name	***Capacity***	***Status***	***High-Level Radioactive***	***Low-Level Radioactive***	***Mixed Low-Level Radioactive***	***Hazardous***	***Nonhazardous***
Treatment Facility							
Defense Waste Processing Facility	200 canisters per year nominal [a]	Operating	X				
Tank Farm Evaporators	2H Evaporator: 810,000 liters per week; [b] 2F and 3H Evaporators: 2.1 million liters per week total	Operating		X			
Salt Waste Processing Facility	21 million liters per year average	Planned for 2014	X [c]				
Interim processing of salt waste	15 liters per minute	Operating	X [c]				
F- and H-Areas Effluent Treatment Project	594 million liters per year	Operating		X	X		
Savannah River Technology Center Ion Exchange Treatment Probe	11,200 cubic meters per year	Operating			X		
Z-Area Saltstone Facility	28,400 cubic meters per year	Operating		X			
Central Sanitary Wastewater Treatment Facility	1.5 billion liters per year	Operating					X

[a] The nominal rate accounts for outages and downtime. Process enhancements are currently underway or planned that would increase the average production rate to about 400 canisters per year.

[b] Expected average annual rate of treatment of the Defense Waste Processing Facility recycle. The 2H Evaporator only treats the Defense Waste Processing Facility recycle. All evaporators are assumed to operate at 50 percent utility.

[c] The interim processing facility, which will ultimately be replaced by the Salt Waste Processing Facility, processes salt waste from the high-level radioactive waste tanks to separate the higher activity fraction of the waste (to be sent to the Defense Waste Processing Facility for vitrification) from the lower activity fraction of the waste (to be sent to Z-Area Saltstone Facility for disposal).

Note: There are no dedicated treatment facilities for transuranic/mixed transuranic waste. To convert cubic meters to cubic feet, multiply by 35.315; to convert liters to gallons, multiply by 0.26417.

Source: DOE 1999b:3-10; SRNS 2012; WSRC 2006a, 2007l, 2007m.

Table 3–23 Waste Storage Capabilities at the Savannah River Site

Facility Name	*Capacity*	*Status*	*Waste Type*					
			High-Level Radioactive	***Transuranic***	***Mixed Transuranic***	***Low-Level Radioactive***	***Mixed Low-Level Radioactive***	***Hazardous***
Storage Facility								
High-Level Liquid Radioactive Waste Tank Farms	6.1 million liters [a]	Operating	X					
Glass Waste Storage Buildings	4,590 canisters in two existing buildings	Operating	X					
Failed Equipment Storage Vaults (Defense Waste Processing Facility)	2 exist, space allocated for 12 more vaults	Operating	X					
Transuranic Waste Storage Pads [b]	13,200 cubic meters	Operating		X	X		X	X
Defense Waste Processing Facility Organic Waste Storage Tank	568 cubic meters	De-inventoried and decommissioned					X	
Solvent Storage Tanks at the Consolidated Incinerator Facility, S33–S36 [c]	105,000 liters per tank [d]	Operating				X	X	

[a] Working capacity remaining in the F- and H-Area tank farms that does not include two tanks in F-Area that have been closed or tank space in other tanks that may not be viable for storage. Currently, 36 million gallons (136 million liters) of high level waste is stored in 49 underground storage tanks.

[b] TRU Pad 26-E has been permitted to accept hazardous waste and mixed low-level radioactive waste for storage and has a maximum capacity of 296 cubic meters.

[c] These tanks were originally to be used for solvent storage; however, they were subsequently used to store other waste streams.

[d] Operating capacity.

Note: There are no dedicated low-level radioactive waste storage facilities. To convert cubic meters to cubic feet, multiply by 35.315; to convert liters to gallons, multiply by 0.26417.

Source: DOE 1999b:3-10; WSRC 2007a, 2007l, 2008a.

Table 3–24 Waste Disposal Capabilities at the Savannah River Site

			Waste Type	
Facility Name	***Capacity***	***Status***	***Low-Level Radioactive***	***Nonhazardous***
Disposal Facility				
Intermediate-Level Waste Vaults	5,300 cubic meters per vault	Operating	X	
Low-Activity Waste Vaults [a]	30,500 cubic meters per vault	Limited Operations	X	
Low-level radioactive waste disposal facility slit trenches [a]	182,000 cubic meters	Operating	X	
Low-level radioactive waste disposal facility engineered trenches [a]	70,800 cubic meters	Operating	X	
Z-Area Saltstone Vaults	80,000 cubic meters per vault; up to 40 vaults planned	Operating	X	
Three Rivers Landfill [b]	4.2 million cubic meters per year (permitted)	Operating		X
Burma Road Cellulosic and Construction Waste Landfill	Not applicable	Closed		X
Construction and demolition debris landfill	2.47 million cubic yards total permitted capacity	Operating		X
288-F industrial solid waste landfill for ash from the A-Area power generating facility	105,776 cubic meters	Operating		X
488-4D industrial solid waste landfill for ash from the D-Area power generating facility	94,091 cubic meters	Operating		X

[a] As of February 2012, the estimated unused disposal capacity remaining is approximately 22,000 cubic meters for the Low-Activity Waste Vaults; 23,000 cubic meters for the slit trenches; and 14,000 cubic meters for the engineered trenches. The Low Activity Waste Vaults are generally used for waste staging; disposal of low-level radioactive waste is limited based on isotopic composition.

[b] Three Rivers Landfill is permitted to take up to 500,000 metric tons of compacted solid waste per year. Assuming a pre-compaction density of 200 pounds per cubic yard, this equates to approximately 4.2 million cubic meters per year of pre-compacted waste that can be disposed of at the landfill.

Note: Only low-level radioactive waste and nonhazardous waste are disposed of at SRS. To convert cubic meters to cubic feet, multiply by 35.315.

Source: DOE 1999b:3-10; SRNS 2012; WSRC 2007l, 2008a.

3.1.10.2 High-Level Radioactive Waste

The F- and H-Area tank farms have received over 140 million gallons (530 million liters) of waste from SRS operations. While DOE no longer produces nuclear materials or the used nuclear fuel (commonly referred to as “spent nuclear fuel”) that generated the original waste, additional HLW is generated as part of stabilization of used nuclear fuel, plutonium, and other nuclear material. DWPF operations also generate liquids (called DWPF recycle) with low radionuclide concentrations that, after evaporation, are stored in the liquid radioactive waste tanks (DOE 2006a:2-3). Currently, approximately 36 million gallons (136 million liters) of waste containing about 400 million curies of radioactivity are stored in 49 underground tanks of the tank farms (SRR 2009). Approximately 1.6 million gallons (6.1 million liters) of working capacity remains in the F- and H-Area tank farms. Two other tanks were closed in 1997. Chemicals such as sodium hydroxide are added to adjust the waste to an alkaline state to prevent corrosion of the carbon steel tanks. This chemical adjustment results in the precipitation of radioactive metals, including strontium and actinides, which settle to the bottom of the tanks and form a layer commonly referred to as “sludge.” The supernate, or salt solution, above this sludge layer is decanted to another tank. Evaporators are used to reduce the volume of the supernate and thus concentrate it. The evaporation process creates two distinct phases, concentrated supernatant solution and solid saltcake (collectively called salt waste). Because the majority of the waste has undergone evaporation and been concentrated as much as possible, meaningful additional reduction by evaporation of the total waste volume currently stored is not possible (DOE 2006a:3-2, 3-3). DOE carefully manages the limited storage space in the tank farms because, among other considerations, DWPF operation generates recycle that is returned to the tank farm for further treatment and storage (WSRC 2007l).

DOE is using a process involving deliquification, dissolution, and adjustment to treat certain salt waste, with additional processing of salt waste using the Actinide Removal Process and Modular Caustic Side Solvent Extraction Unit (SRNS 2009a:6). After completion of the Salt Waste Processing Facility, expected to become operational in 2014 (SRNS 2012), additional salt waste treatment capacity will be available. After treatment operations are completed, approximately 223 megacuries of salt waste will have been removed from the F- and H-Area tank farms (71 FR 3834; WSRC 2007l).

DWPF was constructed to solidify HLW stored in the F- and H-Area tank farms into a vitrified form for eventual geologic disposal, which would then allow the HLW tanks in the tank farms to be closed.

DWPF began operating in March 1996, and is projected to complete vitrification of the HLW in the F- and H-Area tank farms by 2024. Operations consist of mixing a sand-like borosilicate glass (called “frit”) with the waste, melting the mixture, and pouring it into stainless steel canisters to cool and harden. Each canister is 10 feet (3 meters) tall and 2 feet (0.6 meters) in diameter and has a filled weight of about 5,000 pounds (2,268 kilograms). Filled canisters are taken from DWPF to one of two adjacent Glass Waste Storage Buildings. Canisters are lowered into underground storage positions (SRNS 2012). The estimated storage capacity for the two storage buildings is approximately 4,590 canisters (SRR 2009). Construction of a third storage building is planned. The canisters will remain in safe, secure storage in these storage buildings pending decisions on a long-term solution for management of HLW and used nuclear fuel[8]. As of August 2010, more than 2,950 canisters had been poured at DWPF (SRNS 2012).

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[8] *DOE has terminated the program for a geologic repository for used nuclear fuel and HLW at Yucca Mountain, in Nevada. Notwithstanding the decision to terminate the Yucca Mountain program, DOE remains committed to meeting its obligations to manage and ultimately dispose of spent nuclear fuel and HLW. DOE established the Blue Ribbon Commission on America’s Nuclear Future to conduct a comprehensive review and evaluate alternative approaches for meeting these obligations. The Commission issued its report in January 2012.*

3.1.10.3 Transuranic and Mixed Transuranic Waste

Packaged TRU waste materials are transported to E-Area via closed-body trucks from the generating site and are stored on covered storage pads. The transuranic storage pads in E-Area can store up to approximately 470,000 cubic feet (13,200 cubic meters) of transuranic and mixed transuranic waste. Periodically, the DOE Carlsbad Field Office schedules a characterization campaign at SRS. Characterization activities include nondestructive examination, nondestructive assay, and headspace gas analysis. The certified waste containers are subsequently loaded into Type B shipping casks and then transported to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, for disposal (SRNS 2012).

SRS made its first TRU waste shipment to WIPP in May 2001, and 1,299 shipments have been made through January 2012 (WIPP 2012; WSRC 2007n). Over 26,000 containers, or 193,000 cubic feet (5,460 cubic meters), of the original TRU waste inventory had been shipped as of the end of 2008 (SRNS 2009a).

The inventory of non-drummed (or large boxed) TRU waste accounts for approximately 127,000 cubic feet (3,600 cubic meters) stored in large steel boxes, concrete culverts, and other containers. This non-drummed TRU waste is currently being processed and repackaged and will be shipped to WIPP for disposal (SRNS 2012).

3.1.10.4 Low-Level Radioactive Waste

Both liquid and solid LLW are treated at SRS. Most aqueous LLW streams are sent to the F- and H-Area Effluent Treatment Project (formerly called the Effluent Treatment Facility) and treated by pH adjustment, submicron filtration, organic removal, reverse osmosis, and ion exchange to remove chemical and radioactive contaminants other than tritium. This facility is designed to process 100,000 to 250,000 gallons (380,000 to 950,000 liters) of low-level radioactive wastewater daily. The maximum permitted facility capacity is 430,000 gallons (1.6 million liters) per day, or about 160 million gallons (590 million liters) per year. Actual processing is approximately 20 million gallons (76 million liters) of wastewater per year, or 55,000 gallons (210,000 liters) per day (WSRC 2006a, 2006f, 2007m). After treatment, the effluent is discharged to Upper Three Runs through an NPDES-permitted outfall. The treatment residuals are concentrated by evaporation and stored in the H-Area tank farm for eventual treatment in the Z-Area Saltstone Facility, where wastes are immobilized with grout for onsite disposal (DOE 1999b:3-133; WSRC 2007g).

LLW is primarily disposed of in engineered trenches and slit trenches. As of February 2012, approximately 18,000 cubic yards (14,000 cubic meters) of disposal space remains in the engineered trenches and approximately 30,000 cubic yards (23,000 cubic meters) of disposal space remains in two active slit trenches (SRNS 2012). Together, the remaining solid LLW waste disposal capacity at SRS is estimated to be 48,000 cubic yards (37,000 cubic meters). Although some disposal capacity remains in concrete vaults located in E-Area, these are used primarily to stage LLW prior to shipment for off-site disposal and to dispose of the higher radioactive fraction of the LLW generated at SRS. Intermediate-activity waste is packaged according to waste form (DOE 1999b:3-134). While most solid LLW is disposed of on site at SRS, some LLW is shipped off site for disposal at DOE's Nevada National Security Site and commercial facilities (SRNS 2009a).

Saltstone generated in the solidification of LLW salts separated from HLW is disposed of in the Z-Area Saltstone Vaults. Saltstone is solidified grout formed by mixing LLW salt with cement, fly ash, and furnace slag. Saltstone constitutes the highest volume of solid LLW disposed of at SRS (DOE 1999b:3-134).

3.1.10.5 Mixed Low-Level Radioactive Waste

MLLW is radioactive waste that contains material that is regulated as hazardous waste. Storage facilities for MLLW are located in several different SRS areas. These facilities are regulated under RCRA or as Clean Water Act-permitted tank systems (DOE 2002b:3-43). MLLW is sent off site to RCRA-regulated treatment, storage, and disposal facilities, including commercial facilities and the Nevada National Security Site, for disposal. A section of the TRU storage pads (e.g., TRU Pad 26-E) has been permitted to store MLLW and hazardous waste and has a storage capacity of 390 cubic yards (296 cubic meters).

3.1.10.6 Hazardous Waste

Hazardous waste is nonradioactive waste that SCDHEC regulates under RCRA and corresponding state regulations. Hazardous waste is accumulated at the generating location as permitted by regulation or stored in U.S. Department of Transportation-approved containers in E-Area. A section of the transuranic storage pads (e.g., TRU Pad 26-E) has been permitted to store MLLW and hazardous waste and has a storage capacity of 390 cubic yards (296 cubic meters). Most of the waste is shipped off site to commercial RCRA-permitted treatment and disposal facilities using Department of Transportation-certified transporters (DOE 1999b:3-134, 3-135). DOE also plans to continue to recycle, reuse, or recover certain hazardous wastes, including metals, excess chemicals, solvents, and chlorofluorocarbons (DOE 2002b:3-47).

Polychlorinated biphenyls (PCBs) are present at SRS in various forms, including in K-Area. The majority of the PCBs in K-Area facilities are in special purpose coatings and paints. PCBs are also known to be present in fluorescent light ballasts and old capacitors, and may be present in caulking materials and non-liquid cable insulation. Wastes containing PCBs are managed in accordance with Toxic Substances Control Act regulations (40 CFR Part 761) and applicable EPA approval documents issued to SRS. Some nonradioactive and non-liquid PCBs can be disposed of in the Three Rivers Landfill. None of the PCB wastes from the K-Area reactor building can be disposed of in the onsite construction and demolition waste landfill. PCB wastes that are not eligible for disposal at SRS must be disposed of at an offsite Toxic Substances Control Act-permitted facility (SRNS 2012).

3.1.10.7 Nonhazardous Waste

Solid sanitary waste is sent to the Three Rivers Regional Landfill, which is located within the SRS site boundary (DOE 2002b:3-46) and serves as a regional municipal landfill for Aiken, Allendale, Bamberg, Calhoun, Edgefield, McCormick, Orangeburg, and Saluda Counties (LSCOG 2008). The Three Rivers Landfill has a total permitted capacity of 30 million metric tons and can receive up to 500,000 metric tons per year. In 2008, approximately 2.4 million metric tons of solid waste had been disposed of in the landfill. Assuming a pre-compaction density of 200 pounds per cubic meter, Three Rivers Landfill is permitted to receive up to approximately 4,200,000 cubic meters of non-hazardous solid waste annually (SRNS 2012). Construction and demolition debris is disposed of in a landfill near N-Area (WSRC 2008a).

Asbestos is commonly found throughout SRS in building materials (e.g., floor and ceiling tile, building insulation, window and door caulking, and lighting parts), packing and gaskets, wire and pipe insulation, and machine parts. To eliminate health risks to workers by unintended exposure to asbestos, SCDHEC and EPA require asbestos inspections before maintenance activities are conducted; or buildings or structures are renovated, repaired, moved, or demolished. Asbestos waste is managed as "special waste" and regulatory approval must be obtained prior to generation or disposal. While not considered a "hazardous waste" by state or Federal regulations, asbestos waste is managed by a "cradle-to-grave" process of special waste manifests and notification of waste disposal activities. Asbestos waste can only be disposed of in approved landfills (SRNS 2012). Asbestos waste is disposed of in the Three Rivers Regional Landfill and the N-Area construction and demolition debris landfill, both of which are SCDHEC-approved asbestos waste landfills (WSRC 2008d:3-13).

Sanitary wastewater is collected and treated at the Central Sanitary Wastewater Treatment Facility prior to discharge to NPDES-permitted outfalls. The Central Sanitary Wastewater Treatment Facility has a design capacity to treat up to 383 million gallons (1.5 billion liters) per year (SRNS 2012).

3.1.11 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. The potentially affected area for SRS includes parts of 28 counties throughout Georgia and South Carolina that make up an area within a 50-mile (80-kilometer) radius of the SRS site. To be consistent with the human health analysis, the population distributions of the potentially affected area are calculated using data at the block-group level of spatial resolution from the 2010 census (Census 2011f), and have been projected to the year 2020 using data from the 1990 census, the 2000 census, and the 2010 census for each of the affected counties within a 50-mile (80-kilometer) radius of SRS (Census 1990, 2001, 2011f).

In accordance with CEQ guidance, meaningfully greater minority populations are identified where either the minority population of the affected area exceeds 50 percent, or 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 (CEQ 1997). Meaningfully greater is defined here as 20 percentage points above the population percentage in the general population. The average minority population percentage of South Carolina and Georgia for the projected 2020 population is approximately 44.6 percent and the average minority population percentage of the counties surrounding SRS is approximately 42.6 percent. Comparatively, a meaningfully greater minority population percentage relative to the general population of the state and the surrounding counties would exceed the 50 percent threshold defined by CEQ. Therefore, the lower threshold of 50 percent is used to identify areas with meaningfully greater minority populations surrounding SRS. In order to evaluate the potential impacts on populations in closer proximity to the proposed sites at SRS, additional radial distances of 5, 10, and 20 miles (8, 16, and 32 kilometers) are also analyzed. **Table 3–25** shows the composition of the ROI surrounding the proposed SRS facilities at each of these distances. No populations reside within the 5-mile (8-kilometer) radius of the facilities analyzed.

The total projected population residing in the SRS ROI in 2020 would be approximately 886,276, of which 47 percent would be considered members of a minority population. Of the 580 block groups in the potentially affected area, approximately 265 (46 percent) were identified as containing meaningfully greater minority populations.

Table 3–25 Projected Populations in the Potentially Affected Area Surrounding the Savannah River Site in 2020

	10 Miles		*20 Miles*		*50 Miles*	
Population Group	***Population***	***Percent of Total***	***Population***	***Percent of Total***	***Population***	***Percent of Total***
Nonminority	4,216	60	73,173	64	472,377	53
Black or African American [a]	2,179	31	32,262	28	332,231	37
Total Hispanic [b]	413	6	5,429	5	46,107	5
American Indian or Alaska Native [a]	29	0	641	1	3,870	0
Other Minority [a]	634	9	9,034	8	77,789	9
Total Minority [a]	2,842	40	41,937	36	413,890	47
Total Population	7,058	100	115,110	100	886,267	100
Low-Income	1,347	19	20,433	18	162,157	18

[a] Includes Hispanic persons.

[b] Includes all Hispanic persons regardless of race.

Note: To convert miles to kilometers, multiply by 1.609. Totals may not equal the sum of subcategories due to rounding. The potentially affected area comprises the area within a 50-mile (80-kilometer) radius of the site.

The overall composition of the projected populations within every radial distance is predominantly nonminority. The concentration of minority populations is greatest within the 50-mile (80-kilometer) radius. The Black or African American population is the largest minority group within every radial distance, constituting approximately 37 percent of the total population within 50 miles (80 kilometers). The Hispanic or Latino population constitutes about 5 to 6 percent of the total population at each radial distance. **Figure 3–7** displays the block groups identified as having meaningfully greater minority and low-income populations surrounding SRS.

The projected low-income population (those living below the poverty threshold) living within 50 miles (80 kilometers) of SRS in 2020 is estimated to be 162,157 people (18.3 percent). Meaningfully greater low-income populations are identified using the same methodology described above for identification of minority populations. The 2010 census does not contain any data relative to income. The U.S. Census Bureau’s American Community Survey (ACS) 5-year estimates are the only data set that publishes current data relative to income at the block group level of geography. Therefore, the 2006–2010 ACS 5-year estimates were used to identify low-income populations in the potentially affected area. These populations were then scaled up to be directly comparable to the projected 2020 potentially affected population. The 2006–2010 ACS 5-year estimates show the average low-income population percentage of South Carolina and Georgia is 15.9 percent (Census 2011e). Comparatively, a meaningfully greater low-income population percentage using these statistics would be 35.9 percent. Therefore, the lower threshold of 35.9 percent is used to identify areas with meaningfully greater low-income populations surrounding SRS. Of the 580 block groups that surround SRS, 80 (14 percent) contain meaningfully greater low-income populations.

Figures 3–8 and **3–9** show cumulative total and minority and low-income populations projected to live within the potentially affected area in 2020 as a function of distance from the facilities at SRS. Values along the vertical axis show populations residing within a given distance from these facilities.

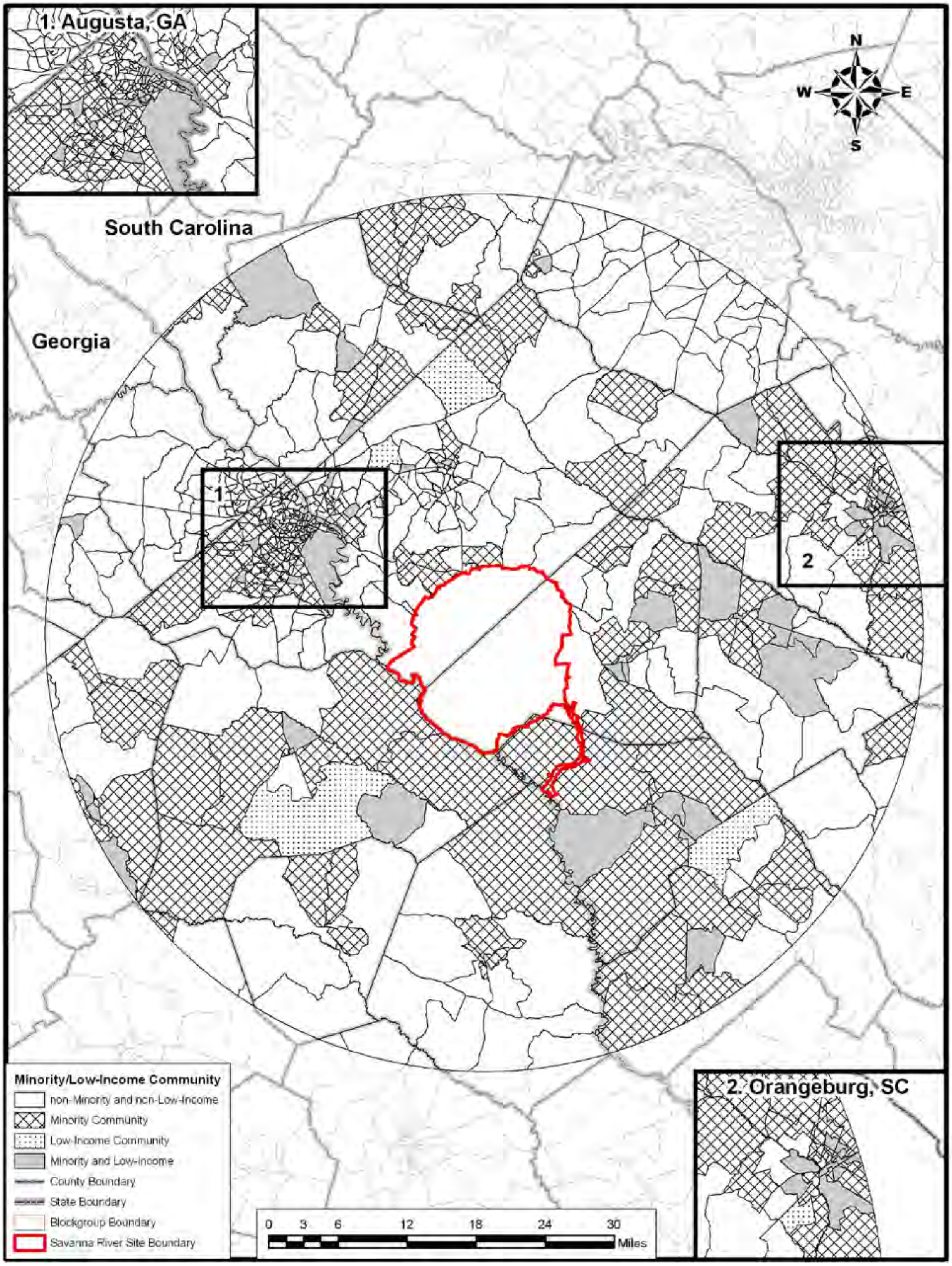


Figure 3–7 Meaningfully Greater Minority and Low-Income Populations Surrounding the Savannah River Site

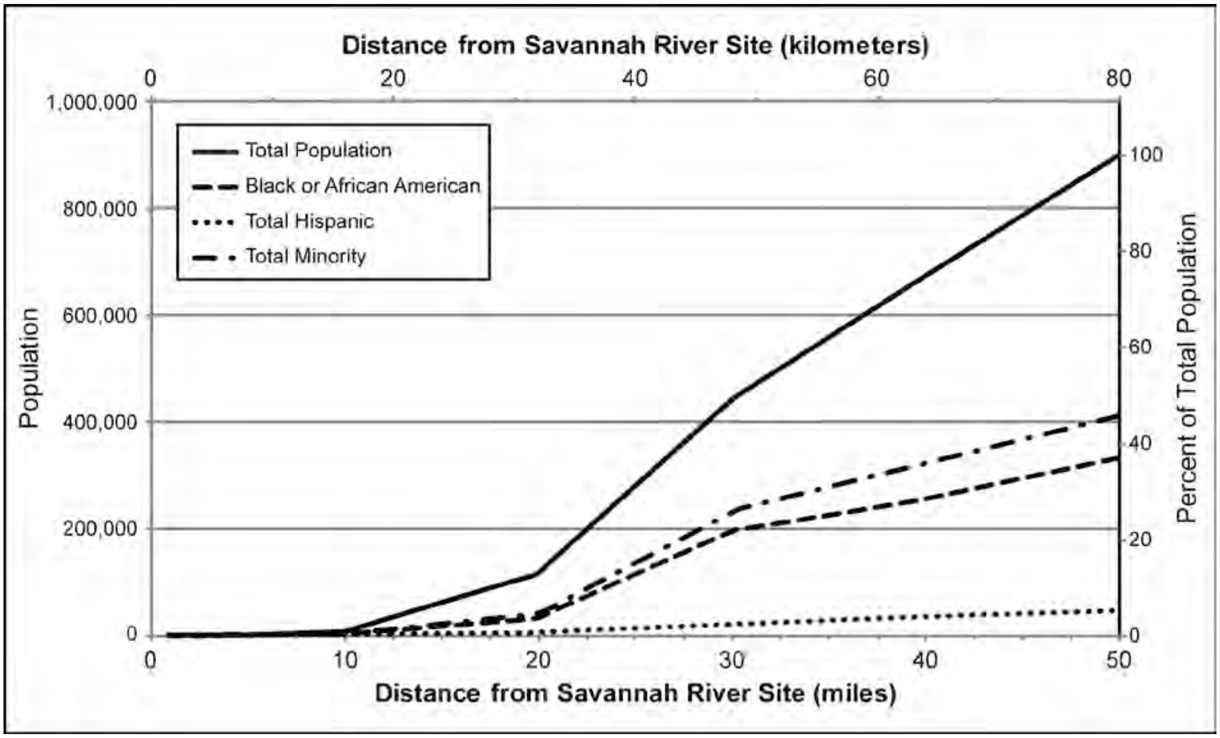


Figure 3–8 Cumulative Minority Populations as a Function of Distance from Savannah River Site

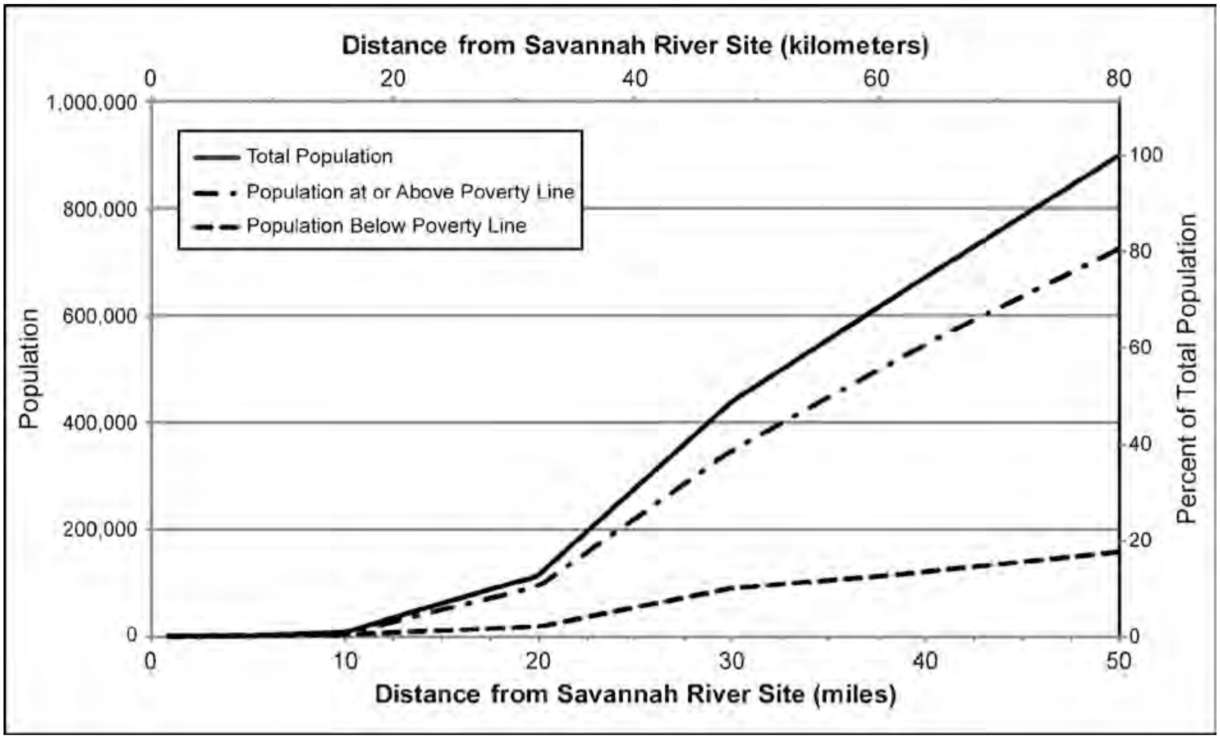


Figure 3–9 Cumulative Low-Income Populations as a Function of Distance from Savannah River Site

3.2 Los Alamos National Laboratory

This section describes the LANL environment in general and TA-55, the technical area in which activities described in Chapter 2 have been proposed.

3.2.1 Land Resources

3.2.1.1 Land Use

LANL is located on 23,040 acres (9,324 hectares) of land in north-central New Mexico. The site is located 60 miles (97 kilometers) north-northeast of Albuquerque, 35 miles (56 kilometers) northeast of Santa Fe, and 20 miles (32 kilometers) southwest of Española. The site is owned by DOE. Portions of LANL are located in Los Alamos and Santa Fe Counties. LANL is divided into 47 contiguous technical areas with location and spacing that reflect the site's historical development patterns, regional topography, and functional relationships. Chapter 1, Figure 1–3, shows LANL's location and technical areas. In total, about 20 percent of the site is developed (DOE 2011g:3-2; LANL 2012b:2-1).

Land use in the LANL region is linked to the economy of northern New Mexico, which depends heavily on tourism, recreation, agriculture, and the state and Federal governments. Area communities are generally small, including the Los Alamos townsite and White Rock, which are home to about 11,000 and 7,000 residents, respectively, and primarily support urban uses, including residential, commercial, light industrial, and recreational. The region also includes American Indian communities; lands of the Pueblo de San Ildefonso share a border with LANL on its east side, while the Santa Clara and Pojoaque Pueblos are located approximately 20 miles (32 kilometers) to the northeast and east, respectively. Numerous other pueblos are also located in the Los Alamos area. Major governmental bodies that serve as land stewards and determine land uses within Los Alamos and Santa Fe Counties include county governments, DOE, the U.S. Department of Agriculture (U.S. Forest Service, Santa Fe National Forest), the U.S. Department of the Interior (National Park Service, Bureau of Indian Affairs, and the Bureau of Land Management [BLM]), the State of New Mexico, and several American Indian pueblos. Bandelier National Monument and Santa Fe National Forest border LANL primarily to the southwest and northwest, respectively; however, small portions of each also border the site to the northeast (DOE 2011g:3-5).

Land use within Los Alamos and Santa Fe Counties is controlled by the counties' comprehensive plans. LANL is designated as "Federal" in the Los Alamos County Plan. The Santa Fe County Plan designates LANL as "Agricultural and Residential"; there are no agricultural activities on the site, nor are there any residential uses on LANL property. However, the privately owned Royal Crest Trailer Park, located along East Jemez Road, is entirely within the site boundaries. Although county governments have no jurisdiction over Federal lands, they seek Federal cooperation to achieve the goals set forth in their comprehensive plans (DOE 2011g:3-5).

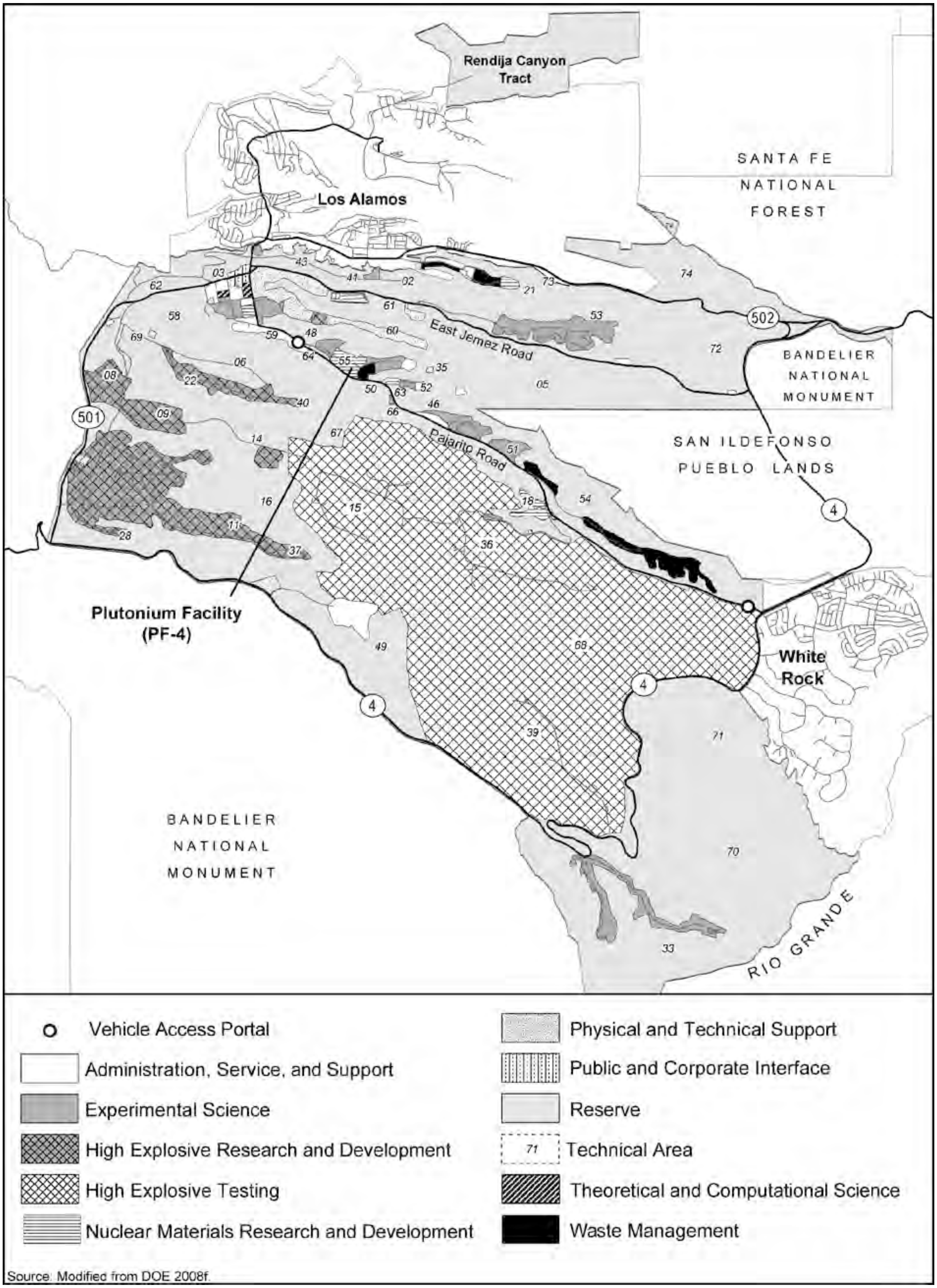
The *Los Alamos National Laboratory Comprehensive Site Plan 2000: Los Alamos National Laboratory Project Management and Planning* (LANL 2000) identifies 10 land use categories. These categories are depicted in **Figure 3–10** and defined as follows:

- *Administration, Service, and Support*—Administrative functions, nonprogrammatic technical expertise, support, and services for LANL management and employees.
- *Experimental Science*—Applied research and development activities tied to major programs.
- *High-Explosives Research and Development*—Research and development of new explosive materials. This land is isolated for security and safety.

- *High-Explosives Testing*—Large, isolated, exclusive-use areas required to maintain safety and environmental compliance during testing of newly developed explosive materials and new uses for existing materials. This land also includes buffer areas.
- *Nuclear Materials Research and Development*—Isolated, secured areas for conducting research and development involving nuclear materials. This land use includes security and radiation hazard buffer zones. It does not include waste disposal sites.
- *Physical and Technical Support*—Includes roads, parking lots, and associated maintenance facilities; infrastructure such as communications and utilities; facility maintenance shops; and maintenance equipment storage. This land use generally is free from chemical, radiological, or explosives hazards.
- *Public and Corporate Interface*—Provides link with the general public and other outside entities conducting business at LANL, including technology transfer activities.
- *Reserve*—Areas that are not otherwise included in one of the other categories. It may include environmental core and buffer areas, vacant land, and proposed land transfer areas.
- *Theoretical and Computational Science*—Interdisciplinary activities involving mathematical and computational research and related support activities.
- *Waste Management*—Provides for activities related to the handling, treatment, and disposal of all generated waste products, including solid, liquid, and hazardous materials (chemical, radiological, and explosive).

In 1977, LANL was designated as a National Environmental Research Park for use by the national scientific community as an outdoor laboratory to study the impacts of human activities on pinyon-juniper woodland ecosystems. In 1999, the 1,000-acre (405-hectare) White Rock Canyon Reserve, located on the southeast perimeter of LANL, was dedicated to preserve its significant ecological and cultural resources. In 2000, land on and to the north and west of the site was affected by the Cerro Grande Fire. The fire burned a total of 43,150 acres (17,462 hectares), of which 7,684 acres (3,110 hectares) were within the boundaries of LANL. On June 26, 2011, the Las Conchas Fire began as a result of a wind-thrown tree striking and shorting out a power line. This fire burned 156,590 acres (63,370 hectares), including 133 acres (53.8 hectares) of LANL and DOE/NNSA property. Approximately 131acres (53 hectares) were intentionally back-burned to help limit the spread of the wildfire, and only 1 acre (0.40 hectare) of land burned as a result of the wildfire (LANL 2012c:Appendix II, page 5). There are no agricultural activities on the LANL site, nor are there any prime or unique farmlands, as defined in the Farmland Protection Policy Act of 1981, located within the Incorporated County of Los Alamos (DOE 2011g:3-4).

As a result of the passage of Public Law 105-119, Section 632, 10 tracts on LANL were designated for possible conveyance from DOE to the Incorporated County of Los Alamos or to the Department of the Interior by 2007 to be held in trust for the Pueblo de San Ildefonso. This program was analyzed in the *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at the Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico* (DOE 1999c). Due to changes in the program, the total acreage designated for conveyance or transfer is now estimated to be 4,309 acres (1,744 hectares) and the completion date is 2022. By mid-2011, 2,441 acres (988 hectares) had been conveyed or transferred (DOE 2011g:3-5).



Source: Modified from DOE 2008f.

Figure 3–10 Los Alamos National Laboratory Sitewide Land Use

Proposed Facility Location

Land use within Technical Area 55 (TA-55) is designated Nuclear Materials Research and Development, and Reserve. TA-55, which is 40 acres (16 hectares) in size, is largely developed, with only the south wall of an extension of Mortandad Canyon having significant vegetative cover. This area is designated Reserve while the rest of the technical area is designated Nuclear Materials Research and Development. Facilities within TA-55, including the Plutonium Facility (PF-4), support research of, and applications for, the chemical and metallurgical processes of recovering, purifying, and converting plutonium and other actinides into many compounds and forms, as well as research into material properties and fabrication of parts for research and stockpile applications (DOE 2011g:3-5).

3.2.1.2 Visual Resources

The topography of northern New Mexico is rugged, especially in the vicinity of LANL. Mesa tops are cut by deep canyons, creating sharp angles in the landform. Often, little vegetation grows on these steep slopes, exposing the geology, with contrasting horizontal planes varying from fairly bright reddish orange to almost white in color. A variety of vegetation occurs in the region, the density and height of which may change over time and can affect the visibility of an area within the LANL viewshed. Views of the site have changed over the last decade as a result of wildfires and thinning operations that were undertaken to remove wildfire fuels. While in the past motorists may have viewed more-mature woodlands, views are currently more open (DOE 2011g:3-5). Undeveloped lands within LANL have BLM Visual Resource Contrast ratings of Class II or III. Management activities within these classes may be seen, but should not dominate the view. The contrast rating system was developed by BLM as a guide for evaluating the visual impacts of a project (BLM 1986).

For security reasons, much of the development within LANL, which is generally austere and utilitarian, has occurred out of the view of the public. Passing motorists or nearby residents can see only a small portion of what is actually on the site. The most visible developments at LANL are a limited number of very tall structures; facilities at relatively high, exposed locations; or those beside well-traveled, publicly accessible roads. For example, the National Security Sciences Building in TA-3 is eight stories high and is visible from most locations throughout the Los Alamos townsite. At night, the lights of LANL, the Los Alamos townsite, and the community of White Rock are directly visible from various locations across the viewshed and as far away as the towns of Española and Santa Fe (DOE 2011g:3-7). Developed areas within LANL are consistent with a BLM Class IV Visual Resource Contrast rating, in which management activities dominate the view and are the focus of viewer attention (BLM 1986:6,7).

Proposed Facility Location

As previously noted, most of TA-55 is developed, with only the south wall of an extension of Mortandad Canyon having significant vegetative cover. PF-4, a two story building, is the largest facility in TA-55. The newest building within TA-55 is the three-story Radiological Laboratory/Utility/Office Building (RLUOB). RLUOB is visible from a number of locations throughout LANL and is the key visible structure along Pajarito Road. However, views from Pajarito Road are limited to LANL workers, as the road is closed to the public (DOE 2011g:3-7). The visual resources along the road generally are consistent with BLM Visual Contrast Ratings of Class III and IV. Under a Class III rating, development may attract attention, but the natural landscape dominates; however, under a Class IV rating, development dominates the view and is the major focus of the landscape (BLM 1986:6,7). When seen from higher elevations to the west, development within TA-55 blends with that within TA-35, -48, -50, and -63.

3.2.2 Geology and Soils

The majority of the information in this section was adapted from the *Final Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (CMRR-NF SEIS)* (DOE 2011g). A detailed description of the geology at LANL is included in the *Geology and Structure of the Chemistry and Metallurgy Research Facility Replacement Site, Los Alamos National Laboratory, New Mexico* (Gardner et al. 2008). A detailed description of soils at LANL is included in the *Soil Survey of Sandoval County Area, New Mexico, Parts of Los Alamos, Sandoval, and Rio Arriba Counties* (NRCS 2008).

3.2.2.1 Geology

General Site Description

LANL is located on the Pajarito Plateau, within the Southern Rocky Mountains Physiographic Province. The Pajarito Plateau lies between the Sierra de los Valles, located in the Jemez Mountains, to the west, and the Rio Grande River to the east. The gently sloping surface of the Pajarito Plateau is divided into multiple narrow east-southeast-trending mesas, dissected by deep parallel canyons (DOE 2003d:3-20). Rocks in the LANL region are volcanic and sedimentary (Reneau et al. 1996:8). Bedrock outcrops occur on more than 50 percent of the surface at LANL (DOE 2003d:3-21). In the LANL area, the youngest surficial geologic units consist of sediment deposited by flowing water (alluvium) and rock debris accumulated at the bases of slopes along stream channels and in canyons (colluvium). Artificial fill is also present as a result of development (DOE 2003d:3-20).

Volcanic activity began forming the Jemez Mountains approximately 16.5 million years ago (DOE 2003d:3-20) and has continued sporadically to the most recent eruptions that produced the El Cajete pumice fall, about 50,000 to 60,000 years ago (Reneau et al. 1996:20, 40). Two main types of Quaternary volcanic activity have occurred close to LANL, including explosive and effusive rhyolitic (i.e., silicic) eruptions in the Valles caldera, located approximately 6 miles (10 kilometers) west of LANL, and explosive and effusive basalt (mafic) eruptions in the Cerros del Rio volcanic field, located in the nearby Rio Grande valley (to the east) and partially underlying the eastern portions of LANL (DOE 2011g:3-29).

The Sierra de los Valles form the eastern rim of the Valles caldera, which is a cauldron-like volcanic feature, formed by the collapse of land following a volcanic eruption. The first of two major caldera-forming eruptions occurred 1.61 million years ago, forming the Toledo caldera and producing the lower, or Otowi Member, of the Bandelier Tuff (Spell et al. 1996:263). The second major caldera-forming eruption occurred 1.256 million years ago (DOE 2011g:3-19), forming the Valles caldera and depositing the upper, or Tshirege Member, of the Bandelier Tuff (Spell et al. 1996:263).

The 1.2- to 1.6-million-year-old Bandelier Tuff is a variably consolidated ash-flow unit and forms the bedrock on which nearly all LANL facilities are constructed. These rock layers dip gently southeastward and thin away from the volcanic source to the west (DOE 2003d:3-21, 2008f:4-20). As previously described, the Bandelier Tuff was formed in two eruptive pulses from the nearby Valles caldera, located approximately 10 miles (16 kilometers) west of LANL. The younger member, or Tshirege Member, of the Bandelier Tuff is widely exposed as the mesa-forming unit around LANL (DOE 2011g:3-21).

Beneath the Bandelier Tuff is approximately 18 feet (5.5 meters) of fine sand and silt, which may be a fine-grained interval of the older alluvial Puye Formation. Underlying the Puye Formation is several hundred feet of the Cerro del Rio basalt and Tschicoma Formation dacitic lava (Kleinfelder 2007:39). The complex interfingering and interlaying of strata beneath LANL results in variable properties that affect canyon wall formation, slope stability, subsurface flows, seismic stability, and the engineering properties of the rock (DOE 2003d:3-12, 2008f:4-17-4-20).

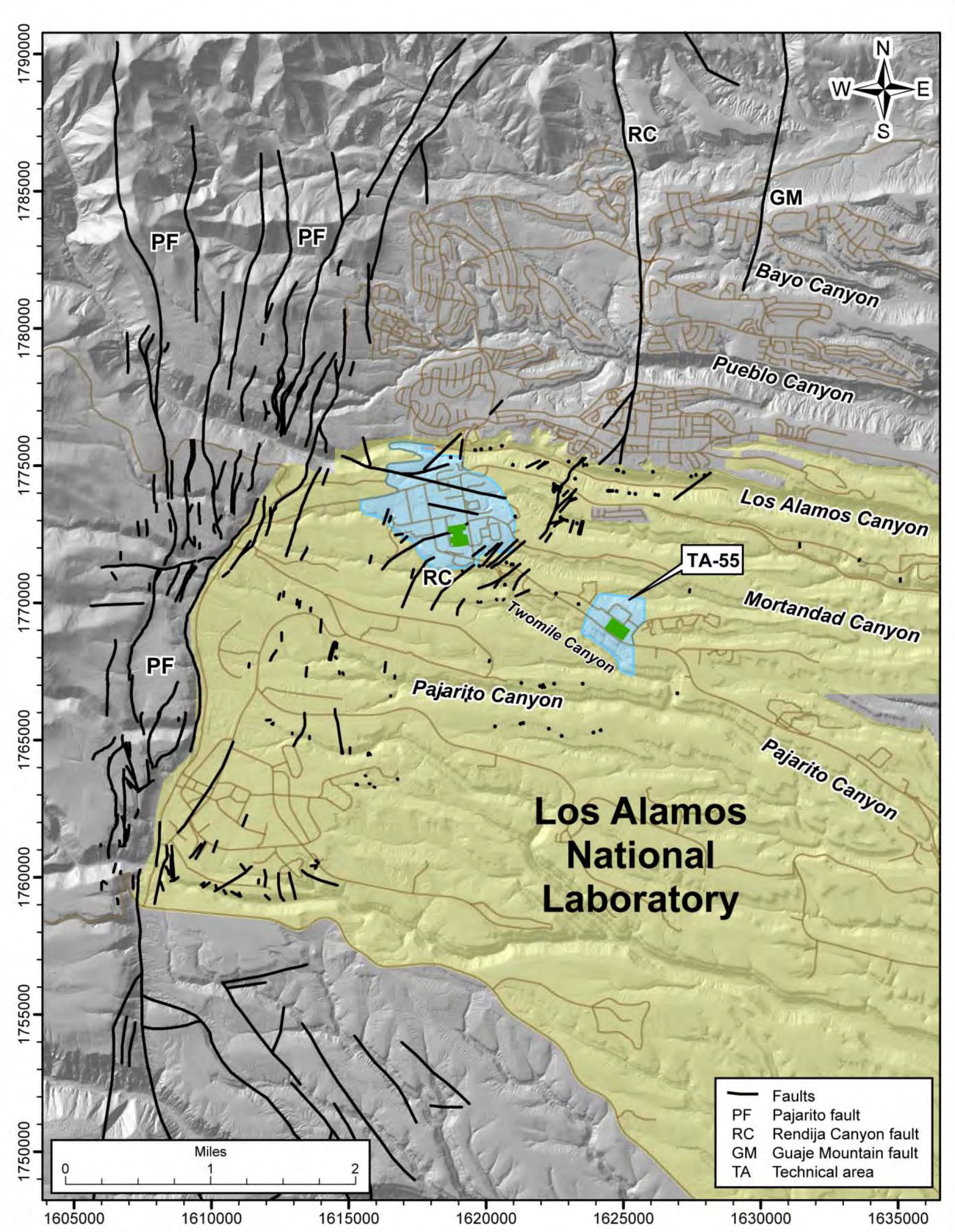
The major tectonic feature in the region is the Rio Grande rift, which begins in central Colorado, trends southward through central New Mexico, and extends into northern Mexico. This rift comprises a complex system of north-trending basins, formed from down-faulted blocks of the Earth's crust. The Jemez Mountains and associated Pajarito fault system form the western margin of the rift. In the LANL area, the rift is approximately 35 miles (56 kilometers) wide and contains the Española Basin; the Sangre de Cristo Mountains border the rift on the east (DOE 2003d:3-20).

The Pajarito fault system is a complex zone of deformation, consisting of many laterally discontinuous faults and associated folds and fractures. The Pajarito fault system extends for about 31 miles (50 kilometers) along the western margin of LANL and consists of the Pajarito, Santa Clara, Rendija Canyon, Guaje Mountain, and Sawyer Canyon faults. As shown in **Figure 3–11**, these are all roughly north–south striking, nearly parallel, and interconnected normal slip faults that were produced by extension in the Earth's crust (DOE 2011g:3-23).

The Pajarito, Santa Clara, and Sawyer Canyon are east-dipping faults, whereas the Rendija Canyon and Guaje Mountain are west-dipping faults. Of these faults, the Pajarito is the longest, has the largest Quaternary displacement (during the past 1.8 million years), and together with the Santa Clara, delineates the boundary between the Pajarito Plateau and Jemez Mountains. The Rendija Canyon, Guaje Mountain, and Sawyer Canyon faults constitute a broad zone of smaller faults within the downthrown block of the main Pajarito and Santa Clara faults (DOE 2011g:3-23). The main trace of the Rendija Canyon fault dies out near the latitude of Los Alamos Canyon, although a complex distribution of associated, smaller, discontinuous faults continue approximately 2 miles (3 kilometers) southward, curving southwest toward the Pajarito fault (DOE 2011g:3-23) (Figure 3–11).

Although large historical earthquakes have not occurred on the Pajarito fault system, geologic evidence indicates that it is seismically active and capable of producing large surface-faulting earthquakes of 6.5 to 7.3 moment magnitude (M) (LANL 2007a:ES-2; 3-9). Early Quaternary deposits have been displaced down to the east by as much as 650 feet (200 meters) along this fault zone, which also shows compelling evidence for repeated, late Quaternary faulting (LANL 2007a:5-7, 5-8; Lewis et al. 2009:252, 254). Numerous paleoseismic trench studies (Gardner et al. 1990; Olig et al. 1996; Kelson et al. 1996; Reneau et al. 2002; Gardner et al. 2003; McCalpin 2005) have been conducted on several different traces of the fault system, revealing evidence of at least two, possibly three, large surface-faulting earthquakes that occurred during the last 11,000 years and as many as nine large earthquakes that occurred during the last 110,000 years (LANL 2007a:5-14, 5-15, 5-38; Lewis et al. 2009:252, 268).

Previous geologic studies postulated that the southern ends of the Rendija Canyon and Guaje Mountain faults may continue as surface faults south of the Los Alamos townsite and trend through sensitive LANL sites (Dransfield and Gardner 1985; Vaniman and Wohletz 1990; Wohletz 1995, 2004). Ensuing studies used geologic field investigative techniques to recognize and map small fault displacements (Reneau et al. 1995; Gardner et al. 1998, 1999, 2008; Lavine et al. 2005). This procedure allowed the identification of fault locations in real time, with data precision better than 0.05 feet (0.02 meters) in the horizontal directions and better than 0.02 feet (0.01 meters) in the vertical direction, relative to the position of known and established benchmarks.



Source: Modified from Gardner et al. 2008.

Figure 3–11 Mapped Faults in the Los Alamos National Laboratory Area

A comprehensive update to the LANL seismic hazard analysis was completed in June 2007 (LANL 2007a). The updated study used more-recent field data, most notably from the CMRR Project site, and the application of the most current analysis methods, in order to update the seismic source model, ground motion attenuation relationships, dynamic properties of the subsurface (primarily the Bandelier Tuff) beneath LANL, as well as the probabilistic seismic hazard and design/evaluation-basis earthquake ground motions for LANL. The approach used in the 2007 analysis follows the Senior Seismic Hazard Analysis Committee's guidelines for a Level 2 analysis, as described in NRC's *Recommendations for Probabilistic Seismic Hazard Analysis – Guidance on Uncertainty and Use of Experts* (NRC 1997). Based on this analysis, the dominant contributor to seismic hazard at LANL is the Pajarito fault system, due to its proximity and rate of activity (LANL 2007a:ES-1).

In 2009, the probabilistic seismic hazard analysis was updated again to incorporate a new set of ground motion attenuation relationships and to examine potential conservatisms in the 2007 study (LANL 2009c). The results of the 2009 updated analysis were reviewed and accepted by an external review panel, DOE, and the Defense Nuclear Facilities Safety Board (DNFSB). These ground accelerations were based on the latest geologic data, including that published in Lewis et al. (2009). Expected maximum magnitudes for the various rupture scenarios of the Pajarito fault system range from M 6.5 to 7.3. The 2009 updated study refined the estimate for the dominant earthquake, determining that a range in magnitude of M 6.0 to M 7.0 was appropriate at close distances (LANL 2009c:3-8).

During earthquakes, facilities near a cliff edge or in a canyon bottom are potentially susceptible to slope instability, rock falls, and landslides. Slope stability studies have been performed at LANL facilities where a hazard has been identified. The potential for seismically induced land subsidence at LANL is considered low and, for soil liquefaction, negligible (DOE 2003d:3-25).

The unusually low amount of seismic activity in the Jemez Mountains has been interpreted to indicate that seismic signals are partially absorbed deep in the subsurface, due to elevated temperatures and high heat flow (LANL 2004:4-27). The significance of this to LANL is that it indicates that the Jemez Mountains continue to be a zone of potential volcanic activity. The U.S. Geological Survey recently rated the Valles caldera a "moderate threat" and recommended enhanced monitoring of the Jemez Mountains Volcanic Field (DOE 2011g:3-29).

Potential future silicic volcanic eruptions within the Jemez Mountains Volcanic Field would likely be similar to the most recent, 35,000-to 60,000-year-old rhyolitic eruptive cycle, which consisted of relatively small rhyolite domes and flow eruptions. Potential future silicic eruptions could consist of explosive eruptions that produce proximal and downwind tephra fallout and pyroclastic flows in topographic lows. In addition, rhyolite lava flows and domes could fill topographic low areas near the vent, up to a distance of several kilometers. Eruptive activity may continue for days to months for explosive eruptions and several years to tens of years for a single eruption cycle. The total period for a phase of eruption could last thousands of years (DOE 2011g:3-29; LANL 2010b:19).

If silicic volcanism occurred within the Valles caldera topographic rim, the Pajarito Plateau would likely be impacted by centimeter-to-meter thicknesses of tephra fallout. Tephra deposits on the slopes of the Sierra de los Valles, west of LANL, could result in the production of volcanic mudflows in the canyons as rainfall and snowmelt mobilized the loose tephra. Tephra fallout may deposit greater than 4 inches (10 centimeters) of ash within about 12 to 25 miles (20 to 40 kilometers) downwind, which would encompass LANL technical areas. Volcanic blast effects, pyroclastic flows, and lava flows would be unlikely to directly affect LANL due to distance and topographic barriers (LANL 2010b:19, 20).

In addition to silicic volcanism, basaltic (mafic) volcanism has occurred over the past 30 million years. Evidence of basaltic volcanism includes the approximately 1-million-year-old Cerros del Rio volcanic field beneath LANL and stretches tens of kilometers to the east and south. While the main activity in the

Cerros del Rio volcanic field occurred more than 1 million years ago, magmatic activity has more recently occurred in the Rio Grande rift and along the Jemez Lineament, including eruptions near Carrizozo and Grants, New Mexico, located approximately 200 miles (320 kilometers) and 175 miles (280 kilometers), respectively, from LANL. These eruptions occurred 1,100 to 5,200 years ago, albeit farther from LANL than the most recent eruptions within the Jemez Mountains Volcanic Field. Therefore, the potential for new basaltic volcanism in the Española Basin cannot be ruled out (DOE 2011g:3-30, LANL 2010b:21-22).

Based on observed deposits of past eruptions, two main types of future basaltic eruption are possible, including a Strombolian eruption, which may produce a cinder cone, tephra fallout, and lava flows via fountaining and low ash column, and hydro-magmatic eruption, in which rising magma and surface water combine explosively to form maar craters, surges, ash flows, and tephra fallout. New basaltic activity is most likely within the area of existing Cerros de Rio basalts. Such explosions, surges, and magma effusion may affect areas within several hundred meters of the vent. Lava flows may affect areas within several kilometers of the vent. As described for silicic fallout hazards, tephra fall may produce significant impacts on buildings, roads, and utility infrastructure. A recurrence of volcanic activity could impact the area near the eruption for an extended period of time (months to years), until volcanic activity stopped (DOE 2011g:3-30, LANL 2010b:21-22).

Volcanism in the vicinity of LANL is very unlikely over the next 50 to 100 years, but cannot be completely ruled out. Based on consideration of available information on the volcanic history of the region surrounding LANL, the preliminary calculation of the recurrence rate for silicic eruptions is about 1×10^{-5} per year in the Valles caldera study region. Although the eruption record shows significant clustering of events, this simple calculation assumes a homogenous (Poisson) distribution of events. Similarly, the preliminary calculation of the recurrence rate for basaltic eruptions along the Rio Grande rift floor is 2×10^{-5} per year. The recurrence rate for an eruption that could produce major impacts at LANL would be less than the rates listed above for the expected recurrence of volcanic activity across the entire study area. In any event, the recurrence rate for a volcanic eruption occurring somewhere in the study region is an order of magnitude less than the performance goal of 1×10^{-4} per year (DOE-STD-1023-95) for facilities such as PF-4 at LANL (DOE 2011g:3-30, LANL 2010b:vii, 21).

Potential mineral resources at LANL consist of rock and soil for use as backfill or borrow material, or for construction of waste unit covers. Rock and mineral resources, including sand, gravel, and volcanic pumice, are mined throughout the surrounding counties. Sand and gravel are primarily used at LANL for road building; pumice for landscaping. The welded (a term that refers to depositional heat consolidation and compaction) and harder units of the Bandelier Tuff are suitable as foundation aggregate, structural and ornamental stone, and insulating material. Volcanic tuff has also been used successfully as aggregate in soil-cement sub-base for roads (DOE 2003d:3-25, 2008f:4-33).

The only borrow pit currently in use at LANL is the East Jemez Road Borrow Pit in TA-61, which is used for soil and rubble storage and retrieval. This borrow pit is cut into the upper Bandelier Tuff. There are numerous commercial offsite borrow pits and quarries in the vicinity of LANL, which primary produce sand and gravel. Eleven pits or quarries are located within 30 miles (48 kilometers) of LANL, which is the distance considered the upper economically viable limit for hauling borrow material to LANL (DOE 2008f:4-33).

Facility Location

The Valles caldera, the source of volcanic eruptions that produced the Bandelier Tuff, is located approximately 10 miles (16 kilometers) west of TA-55. Tshirege Member bedrock subunits of the Bandelier Tuff exposed at TA-55 includes Unit 2 (Qbt2), Unit 3 (Qbt3), and Unit 4 (Qbt4) (limited exposure) (Lewis et al. 2009:254). Seismic ground response, as determined by seismic characterization borings, is affected by the relatively high seismic wave velocity of the denser basement rocks, consisting of the Cerros del Rio basalt and Tschicoma Formation dacite, and the much lower seismic wave velocities of the overlying, softer Bandelier Tuff (Kleinfelder 2007:38).

Geotechnical borings were drilled at TA-55 to characterize the complete geologic column down to the basement bedrock level. Borehole DSC-1B was drilled to a depth of 741 feet (226 meters) below ground surface penetrating the Tschicoma Formation dacite, while borehole DSC-2A reached a total depth of 550 feet (168 meters) below ground surface (Kleinfelder 2007:29, 39). Based on these borings, approximately 700 feet (213 meters) of Bandelier Tuff is present beneath TA-55. The upper portion of this geologic unit comprises Units 3 (Qbt3) and 4 (Qbt4) of the Tshirege Member. The upper unit, Qbt4, is composed of soft volcanic tuff, with slight to moderate welding and substantial random fracturing. Some fractures are deeply weathered and clay-filled. The upper part of underlying Unit 3 ($Qbt3_U$) is similar to Qbt4, but less fractured and weathered (Kleinfelder 2007:38-41, 50, 51; 2010:1, 2).

The lower part of Unit 3 ($Qbt3_L$) is nonwelded to slightly welded, is weak and friable, does not sustain fractures, and exhibits more soil-like properties. This unit is, on average, approximately 56 feet (17 meters) thick across LANL, from a depth of approximately 75 feet (23 meters) to approximately 125 to 131 feet (38 to 40 meters) below ground surface, with upper and lower transition zones composed of slightly stiffer and slightly more dense material. Compared to the units above and below it, $Qbt3_L$ has lower bearing capacity, higher porosity, and less cohesion, and is more compressible. This unit also has a slight to moderate potential for hydro-collapse, due to wetting. $Qbt3_L$ displays properties more typical of slightly cemented, nonplastic, medium to dense silty sand. The apparent cementation is actually weak welding caused by vapor-phase minerals that form fragile connections between the volcanic ash particles that constitute the matrix of this unit. This weak welding is easily broken by even slight disturbance. The properties of $Qbt3_L$ that are most problematic to nuclear facility construction are those that affect the seismic response of the unit, specifically, the estimated seismic wave velocities (the speed at which seismic waves travel) associated with this rock type (DOE 2011g:3-21).

At TA-67 (south of TA-55, see Chapter 1, Figure 1–3), investigations found small, complex faults with activity older than 50,000 to 60,000 years (the age of the El Cajete pumice), but no correlation between increased fracture density and surficial faulting (DOE 2011g:3-27). At TA-3, a fault with approximately 8 feet (2.4 meters) of displacement was identified (LANL 1998:30). In contrast, around TA-55 no evidence was found for laterally continuous surface-rupturing faults (Gardner et al. 2008:1, 2).

There appear to be no active surface displacing faults at TA-55; the closest mapped surface trace of faults associated with the Pajarito fault system lies about 3,300 feet (1,000 meters) to the east (Figure 3–11). Investigations at and near TA-55 used intensive geologic field techniques to recognize and map vertical fault displacements, which may have been unmapped using standard geologic mapping techniques (Reneau et al. 1995; Gardner et al. 1998, 1999, 2008; Lavine et al. 2005). Near TA-55 the stratigraphic markers in the Bandelier Tuff are continuous and show no evidence for laterally continuous surface-rupturing faults. This is consistent with findings of subsurface excavation at the CMRR Project site in TA-55 that also used high-precision mapping techniques (Gardner et al. 2008). Although Gardner et al. (2008:1, 23) did observe some fractures and small faults confined within units of the tuff, they concluded that the exposed fractures and faults formed very shortly after emplacement of the tuff at 1.256 million years, as a result of cooling and compaction, and the identified geologic structures pose no surface rupture hazard.

Based on the 2009 study (LANL 2009c), the TA-55 horizontal and vertical peak ground acceleration values for a 2,500-year return period are 0.47 *g* and 0.51 *g*, respectively.

3.2.2.2 Soils

General Site Description

Soils in Los Alamos County have developed from decomposition of volcanic and sedimentary rocks within a semiarid climate and range in texture from clay and clay loam to gravel. Soils that formed on mesa tops of the Pajarito Plateau include the Carjo, Frijoles, Hackroy, Nyjack, Pogna, Prieta, Seaby, and Tocal soils series. All of these soils are well-drained and range from very shallow (0 to 10 inches [0 to 25 centimeters]) to moderately deep (20 to 40 inches [51 to 102 centimeters]), with the greatest depth to the underlying Bandelier Tuff being 40 inches (102 centimeters) (DOE 1999a:4-34).

Soils that develop in canyon settings can be locally much thicker. Soil erosion rates vary considerably at LANL, due to the mesa and canyon topography. The highest erosion rates occur in drainage channels and on steep slopes. Roads, structures, and paved parking lots concentrate runoff. High erosion rates are also caused by past area logging practices, livestock grazing, and loss of vegetative cover. The lowest erosion rates occur at the gently sloping central portions of the mesas, away from the drainage channels. Soils at LANL are acceptable for standard construction techniques (DOE 2003d:3-25, 3-26). No prime farmland soils have been designated in Los Alamos County. The closest areas of prime farmland are located approximately 7.5 miles (12 kilometers) east and 10 miles (16 kilometers) south of LANL, adjacent to the Rio Grande (NRCS 2011).

Biological (cryptogrammic) soil crusts are surface carpets of soil bound by a mosaic of cyanobacteria, lichens, mosses, fungi, and other soil biota and their byproducts that can be up to 4 inches (10 centimeters) thick. Filaments and exudates produced by these highly specialized organisms glue loose soils together and if left undisturbed stabilize bare ground and protect soils from erosion. These communities primarily occur in semi-arid and arid regions and may constitute up to 70 percent of some plant communities (BLM 2001:1-2). In addition to protecting otherwise bare areas against erosion, soil crusts improve soil fertility by fixing atmospheric nitrogen and carbon and producing organic biomass, and influence surface runoff and water infiltration, soil moisture regimes, and soil-water-plant interactions (BLM 2001:29-40, Wilcox et al. 2003:2, 7). Crusts are adapted to severe growing conditions but are highly vulnerable to compressional disturbances. Intensive disturbances such as trampling by humans, livestock, or vehicles frequently result in the loss of living soil cover and creation of unprotected, bare soil (BLM 2001:19-22). A study by Wilcox et al. (2003:7) of hydraulic conductivity between vegetative types of Pinon-Juniper woodlands on the Mesita del Buey area of the LANL Pajarito Plateau identified areas of biological soil crusts, which were found to have limited effect on soil hydrology.

In 2000, the Cerro Grande Fire wildfire burned over 50,000 acres (20,240 hectares); approximately 7,700 acres (3,120 hectares) of LANL. The fire increased the vulnerability of the affected area to soil erosion from fire-induced habitat damage and groundcover loss. As a preventative measure to reduce on- and off-site erosion impacts, the Army Corps of Engineers installed erosion structures to control sediment generation and delivery from burned areas on LANL. In addition, soil, surface water and groundwater, and biota monitoring mitigation measures were implemented to identify any increases in area contaminant concentrations (LANL 2011d:1-5, 8-18). Also, the 2011 Las Conchas fire affected water sheds above LANL and contributed to soil erosion (LANL 2012c:36-39).

Facility Location

TA-55 is underlain by the Rock outcrop-Frijoles-Hackroy general soil map unit that includes approximately 52 percent rock outcrop, 14 percent Frijoles soils, 14 percent Hackroy soils, and 20 percent minor component soils. The bedrock outcrop component of the Rock outcrop-Hackroy Complex (60 percent rock outcrop and 25 percent Hackroy and similar soils) consists of barren to nearly barren areas on benches, ledges, and escarpment features typically located on the margins and sideslopes of mesas (NRCS 2008:27).

The Frijoles soil series consists of very fine sandy loam that occurs on 1 to 8 percent sideslope summits of narrow mesas that developed from pumice derived eolian deposits over alluvium materials. The depth to pumice generally ranges from 15 to 30 inches (38 to 76 centimeters). These soils generally are deep, well drained, and are characterized by moderately slow permeability, very low available water capacity, low shrink-swell potential, and medium runoff (NRCS 2008:27, 155-156).

The Hackroy soils of the Rock outcrop-Hackroy Complex consist of very shallow to shallow, sandy loam soils that developed from residuum weathered from tuff and primarily occur on 1 to 8 percent slopes of plateau nose slope summits. The depth to bedrock tuff typically ranges from 8 to 20 inches (20 to 51 centimeters). These well-drained soils are generally characterized by slow permeability, very low available water capacity, high shrink-swell potential, and very high runoff (NRCS 2008:27, 56-57).

3.2.3 Water Resources

Water resources encompass the surface and groundwater sources of water suitable for American Indian traditional and ceremonial purposes, plants and wildlife propagation, and human endeavors and enterprise. The ROI includes on- and offsite water resource systems that could be affected by effluent discharges and releases or stormwater runoff associated with the proposed alternatives. Changes in the environment can potentially affect hydrologic equilibrium, water quality, and the availability of usable water.

3.2.3.1 Surface Water

General Site Description

LANL is located on the New Mexico Pajarito Plateau, which is bounded by the Jemez Mountains on the west and the Rio Grande on the east. The plateau consists of narrow mesas separated by deep east-west canyons (LANL 2006b:3). The LANL Pajarito Plateau drainage system is grouped into seven watersheds that primarily consist of one or more mesa drainage areas and deep, narrow canyons that collect, convey, and discharge surface runoff and groundwater seepage. The watershed drainage systems are categorized by a primary canyon (main drainage stem) and two or more mesa aggregate (tributary drainage reaches) canyons. The watersheds that encompass LANL include the Los Alamos/Pueblo, Sandia, Mortandad, Pajarito, Water Canyon/Cañon de Valle, Ancho, and Chaquehui Watersheds (LANL 2006b:13) (**Figure 3–12**). The only primary canyon wholly within LANL is the Ancho Canyon of the Ancho Watershed (DOE 2011g:3-31). LANL surface drainage and groundwater discharges flow into the Rio Grande, the largest river in New Mexico (LANL 2006b:3). The New Mexico Water Quality Control Commission (NMWQCC) has designated most surface water on the Pajarito Plateau for livestock watering, wildlife habitat, and secondary contact[9] (DOE 2011g:3-32).

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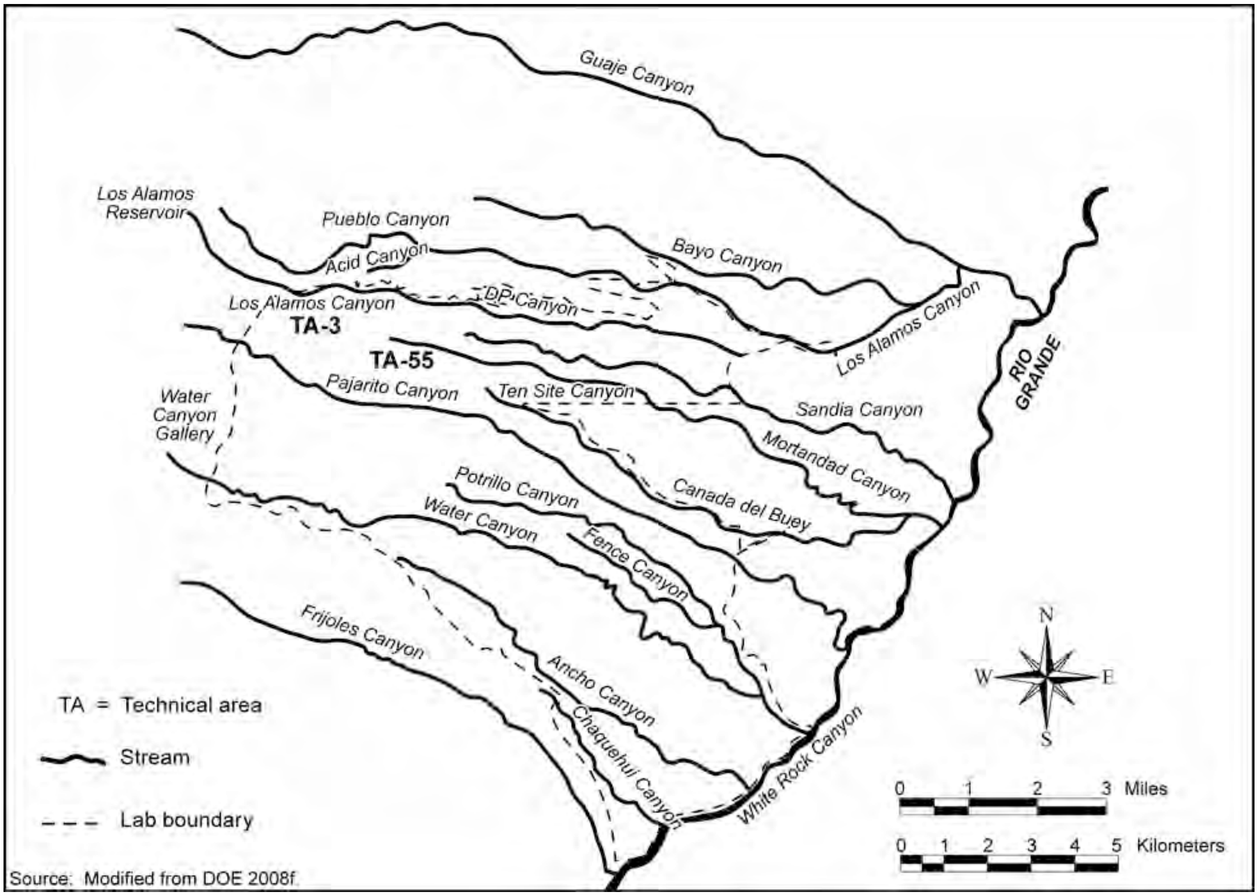
[9] *Secondary contact means any recreational or other water use in which human contact with the water may occur and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, wading, commercial and recreational boating and any limited seasonal contact (NMWQCC 2005:4).*



Source: Modified from DOE 2008f.

Figure 3–12 Major Watersheds in the Los Alamos National Laboratory Region

Streams within LANL are generally classified as alluvial streams, which are waterways composed of sandy clays and clayey-silty sands that originate in upland areas. Primary sources of stream flow include base flow,[10] snowmelt runoff, and stormwater runoff, and permitted anthropogenic discharges. Snowmelt during the spring can last from days to weeks and produces low discharge rates and sediment loads. In contrast, periodic runoff from thunderstorms occurs over hours and produces high discharge rates and sediment loads. LANL stream flow regimes are generally classified as perennial, intermittent, and ephemeral (DOE 2011g:3-31).

Streams in the LANL canyons are dry most of the year; perennial flows[11] do not extend the full length of any primary watershed canyon (DOE 2011g:3-31). Most canyon stream flow regimes are short-lived intermittent and/or ephemeral flows (LANL 2011d:1-2). Permitted discharges of treated LANL wastewater can be a significant source of stream flow in some canyons, such as Los Alamos Canyon. Outfall discharges can occasionally transition the naturally dry flow regimes of some small canyons to wet canyon flow regimes. Wet canyons such as Pueblo, Los Alamos, Sandia, Pajarito, Chaquehui, Cañon de Valle, Water, Mortandad, and Guaje promote conditions that result in relatively fast, unsaturated flow and transport (LANL 2005:2-77, 2-90, 4-A-3–4-A-7). In contrast, dry canyons such as Ancho, Potrillo, Canada del Buey, Fence, Rendija, Bayo, Barrancas, Twomile, and Threemile are generally characterized

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[10] *Base flow is persistent but not necessarily perennial stream flow that originates from springs, effluent discharge, or streambed alluvial groundwater.*

[11] *Perennial flow is continuous during both wet and dry periods; baseflow is primarily generated by groundwater discharge and its upper surface is typically lower than the adjoining area water table. Intermittent flows only occur during certain times of the year resulting from springs, melting snow, or localized precipitation inputs; seasonal flows typically last longer than 30 days per year. Ephemeral flows only occur during or immediately after periods of precipitation or snowmelt; the streambed is above the adjoining area water table (NMWQCC 2010:16).*

by smaller catchments, shallower drains, infrequent surface flows, slower infiltration, and little or no saturated alluvium in the canyon bottoms. In dry canyons, contaminants tend to remain relatively close to their original source locations (LANL 2005:2-91, 4-A-3–4-A-7).

Of the approximately 80 miles (129 kilometers) of LANL waterways, approximately 3 miles (5 kilometers) exhibit natural spring-fed perennial flow (Pajarito and Water Canyons and Cañon de Valle), 4 miles (6 kilometers) of Sandia Canyon produce perennial water flow from LANL effluent discharges from wastewater treatment plants, and the remaining 71 miles (114 kilometers) are dry most of the year, but seasonally exhibit intermittent or ephemeral flow regimes (LANL 2010a:ES-14).

LANL streams all average less than 1 cubic foot per second of flow annually, with combined average daily flows of greater than 10 cubic feet (0.28 cubic meters) per second occurring infrequently. No LANL streams average over 1 cubic foot (0.03 cubic meters) per second of flow annually and combined mean daily flow is normally less than 10 cubic feet per second (0.28 cubic meters per second) (LANL 2011d:6-4). For 2010, the largest flow of 25 cubic feet (0.7 cubic meters) per second was recorded for Los Alamos Canyon at its discharge into the Rio Grande. The average daily flow in the Rio Grande at Otowi Bridge during 2010 ranged from 407 to 4,580 cubic feet (11.5 to 129 cubic meters) per second (LANL 2011d:6-46). The flux of LANL-contaminated sediments in the Rio Grande is small (LANL 2011d:ES-16).

No federally designated Wild and Scenic Rivers occur within, are in the vicinity, or are in the drainage region of influence of LANL. New Mexico-designated river segments in the region include the Jemez, Rio Chama, Rio Grande (segment at the New Mexico and Colorado border), and Pecos Rivers (Wild and Scenic Rivers 2009).

Canyon flash flooding during summer thunderstorms can extend beyond the LANL boundary. In particular, Pueblo Canyon storm flows occasionally flood Pueblo de San Ildefonso lands, potentially exposing area water resources to treated sanitary effluent discharged from the Los Alamos County Wastewater Treatment Plant. (DOE 2011g:3-32–3-33). The largest recorded flood in 2009 occurred in Ancho Canyon and had an estimated peak discharge of 414 cubic feet (11.7 cubic meters) per second. No significant new sediment deposits resulted from the flood (LANL 2010a:15).

No lakes or reservoirs have been identified within the LANL boundary. The Cochiti Reservoir, approximately 10 miles (16 kilometers) south of LANL, is a Rio Grande impoundment that traps sediments, some of which are contaminated by discharges from upstream municipal centers and LANL (LANL 2006b:3). Other regional reservoirs include Los Alamos, Abiquiu, and Guaje reservoirs (LANL 2002:2-3).

Monitoring of the Rio Grande at Otowi Bridge in 2010 showed no measurable evidence of LANL contributions to PCBs (LANL 2011d:ES-16). Nine radionuclides and gross alpha and beta alpha radiation were detected in water samples; no screening levels were exceeded. Two results were slightly above screening levels for ammonia and copper; however, average values were below chronic standards. Overall, the data indicated good river water quality (LANL 2011d:6-46).

The Clean Water Act (33 U.S.C. 1251 et seq.) was enacted to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The Clean Water Act established the NPDES permit requirements for point-source effluent discharges into the nation's waters. NPDES permits specify the chemical, physical, and biological criteria for LANL effluent discharges through permitted outfalls (LANL 2010a:62).

Within the New Mexico Environment Department (NMED), NMWQCC is the state agency that regulates surface and subsurface liquid discharges to protect all New Mexico surface-water and groundwater resources. As required, a facility must submit a discharge plan and obtain a permit from NMED (or approval from the New Mexico Oil Conservation Division for energy/mineral-extraction activities). In 2010, LANL had one discharge permit and two discharge plans pending NMED approval (LANL 2011d:ES-11).

The NPDES Industrial Stormwater Permit Program at LANL, covered under the EPA 2008 NPDES Stormwater Multi-Sector General Permit for Industrial Activities (MSGP-2008), regulates stormwater discharges from regulated industrial activities and their associated facilities (such as metal fabrication; hazardous waste treatment, storage, and disposal; landfill operations; vehicle and equipment maintenance; recycling activities; electricity generation; warehousing activities; and asphalt manufacturing). MSGP-2008 requires the development and implementation of site-specific Storm Water Pollution Prevention Plans (SWPPPs). To achieve compliance, LANL operated 29 stormwater monitoring stations at 19 different locations (LANL 2011b:3-6).

On February 13, 2009, an NPDES Individual Permit (NM0030759) was issued by EPA, Region 6, to Los Alamos National Security, LLC (LANS), and DOE as co-permittees authorizing stormwater discharges from LANL solid waste management units and area of concern sites associated with historical LANL 1940s era Manhattan Project operations. The permit lists 405 sites to be managed to prevent stormwater runoff-induced offsite transport of contaminants and contaminated sediments, and requires monitoring at 250 Site Management Areas. Potential contaminants include metals, organics, high explosives, and radionuclides that have been identified as occurring in near-surface soils susceptible to erosion. The permit was issued on September 30, 2010, and became effective November 1, 2010 (LANL 2011d:2-23, LANL 2011b:3-6).

Since 2008, LANL has operated entirely under the current NPDES permit (Permit No. NM0028355, effective date August 2007) for industrial and sanitary wastewater discharges (EPA 2007a). The NPDES outfall permit establishes specific chemical, physical, and biological criteria that effluent from LANL must meet before it is discharged (LANL 2010a:49). The total number of permitted outfalls was reduced from 55 identified in 1999 to 15 that were renewed in the August 2007 permit. As a consequence, there has been a significant decrease in discharge flows (LANL 2011b:4-2). **Table 3–26** identifies the NPDES permitted outfalls for point sources at LANL. There were 15 permitted outfalls in 2009: 1 sanitary outfall and 14 industrial outfalls. LANL continues to meet requirements under the Clean Water Act (LANL 2010a:49).

LANL has three principal wastewater treatment facilities located in three technical areas: the TA-46 Sanitary Wastewater Systems (SWWS) Plant, the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF); and the TA-16 High Explosives Wastewater Treatment Facility. Treated effluents from the SWWS Plant have been routed to Sandia Canyon since 1992. Released treated wastewater from NPDES-permitted outfalls at LANL rarely leaves the site (LANL 2011b:3-4). Past discharges have included accidental releases from experimental reactors and laboratories at TA-46. Historically, LANL also released wastewater into Water Canyon and Cañon de Valle from several high-explosives processing sites in TA-16 and TA-9 (DOE 2011g:3-36).

In 2009, a total of approximately 133 million gallons (503 million liters) of effluent was discharged from LANL into Los Alamos, Mortandad, Sandia, and Water Canyons. The majority of discharges came from support facilities, not facilities tied directly to operations (such as research or production). Over 85 million gallons (322 million liters) of treated sanitary wastewater were discharged from the TA-46 Sanitary Waste Treatment Plant into Sandia Canyon. This discharge accounted for approximately 64 percent of the total outfall discharge for that year.

Table 3–26 Los Alamos National Laboratory NPDES Permitted Outfalls for 2009

Outfall	*TA-Bldg*	*Description*	*Watershed Canyon Discharge*	*Discharge (gallons)*
02A129	21-357	Steam Plant	Los Alamos	0
03A048	53-963/978	LANSCE Cooling Tower		18,000
051	50-1	Radioactive Liquid Waste Treatment Facility	Mortandad	1,000,000
03A021	3029	CMR Building Air Washers		0
03A022	3-2238	Sigma Cooling Tower		600,000
03A160	35-124	National High Magnetic Field Laboratory Cooling Tower		100,000
03A181	55-6	Plutonium Facility Cooling Tower		1,200,000
13S	46-347	Sanitary Wastewater Treatment Plant	Sandia	85,000,000
001	3-22	Power Plant		63,000
03A027	3-2327	Strategic Computing Complex Cooling Tower		16,000,000
03A113	53-293/952	LANSCE Cooling Tower		340,000
03A199	3-1837	Laboratory Data Communications Center		10,000,000
03A130	11-30	TA-11 Cooling Tower	Water	3,000
03A185	15-312	DARHT Cooling Tower		880,000
05A055	16-1508	High Explosives Wastewater Treatment Facility		0
			Total	133,000,000

CMR = Chemistry and Metallurgy Research; DARHT = Dual-Axis Radiographic Hydrodynamic Test; LANSCE = Los Alamos Neutron Science Center; NPDES = National Pollutant Discharge Elimination System; TA = technical area.
Note: Values rounded to two significant figures. To convert from gallons to liters, multiply by 3.7854.
Source: LANL 2010a:63.

During 2009, none of the 76 samples collected from the SWWS outfall exceeded Clean Water Act effluent limits. Only 7 of the 1,361 samples collected from LANL's industrial outfalls exceeded effluent limits: 3 chlorine exceedances, 2 pH exceedances, 1 total suspended solids exceedance, and 1 PCB exceedance (LANL 2010a:49). LANL surface water is not a source of municipal, industrial, or irrigation water (LANL 2010a:ES-14).

The State of New Mexico's Integrated List of Category 5 waters constitute the Clean Water Act Section §303(d) List of Impaired Waters. The list identifies whether a particular surface water of the state is or is not meeting its designated uses as defined by the standards for the Interstate and Intrastate Surface Waters (20.6.4 NMAC) by applying the state's assessment protocols (NMED 2008:i-v). Under the Clean Water Act §303(d) list, NMWQCC lists parts of one or more canyons within or near LANL as impaired for aluminum, arsenic, cadmium, copper, gross alpha, mercury, PCB, radium-226, radium-228, selenium, vanadium, and zinc (**Table 3–27**).

Compliance activities performed through the LANL Water Stewardship Program in 2009 to manage and protect surface water resources focused on monitoring surface-water quality and stream sediment in northern New Mexico. Samples are collected at more than 290 sites when sufficient water is present during stormwater runoff events. LANL workers analyze these samples for radionuclides, high explosives, metals, a wide range of organic compounds, and general chemistry (LANL 2010a:42-43).

Table 3–27 State of New Mexico Integrated Clean Water Act §303(d)/§305(b) List of Integrated Report Category 5/5C Impaired Waters Within the Region of Influence of LANL [a]

Impaired Waterway	*HUC* [b]	*Probable Causes of Impairment*	*Designated Uses Not Supporting* [c]
Los Alamos Canyon (within LANL)	13020101	Aluminum, Gross Alpha, Mercury, PCB in water column, Selenium	Limited aquatic life, livestock watering, wildlife habitat
Pueblo Canyon (NM 502 to headwaters)		Aluminum, Gross Alpha, Mercury, PCB in water column, Radium-226 and -228, Selenium	
Mortandad Canyon (within LANL)	13020201	Aluminum, Gross Alpha, Selenium	Aquatic life, livestock watering, wildlife habitat
Pajarito Canyon (within LANL above Starmers Gulch)		Aluminum, Gross Alpha, Radium-226 and -228, Selenium	Limited aquatic life, livestock watering, wildlife habitat
Pajarito Canyon (within LANL below Arroyo de La Delfe)			
Rio Grande (Cochiti Reservoir to San Ildefonso boundary)		PCB in fish tissue, Turbidity	Marginal coldwater aquatic life, primary contact
Sandia Canyon (Sigma Canyon to NPDES Outfall 001)		Aluminum, Gross Alpha, Mercury, PCB in water column	Coldwater aquatic life, livestock watering, wildlife habitat
Sandia Canyon (within LANL below Sigma Canyon)		Aluminum, Gross Alpha, Selenium	Limited aquatic life, livestock watering, wildlife habitat
Water Canyon (LANL boundary to headwaters)		Aluminum	
Water Canyon (within LANL below Area-A Canyon)		Aluminum, Arsenic, Cadmium, Copper, Gross Alpha, Selenium, Vanadium, Zinc	

HUC = Hydrologic Unit Code; LANL = Los Alamos National Laboratory; NM = New Mexico; NPDES = National Pollutant Discharge Elimination System; PCB = polychlorinated biphenyl.

[a] Integrated Report Category 5/5C: Impaired for one or more designated or existing uses; additional data will be collected before a TMDL is scheduled. TMDLs must be developed for all waters that do not meet their designated uses (such as drinking water, recreation, and fish harvesting) and are thus defined as impaired. Assessment units are listed in this category if there are not enough data to determine the pollutant of concern.

[b] HUC: U.S. Geological Survey Hydrologic Unit Code used to identify watersheds.

[c] Any designated uses specified in the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC) that apply to the given assessment unit and/or any documented existing uses that apply to the given assessment unit.

Source: NMED 2008.

The overall quality of surface water in the area of LANL is good (LANL 2011d:ES-14). In more than 100 surface water and sediment samples taken in 2009, most analytes were at concentrations far below regulatory standards and risk-based advisory levels. LANL operations have affected major watersheds in the area, resulting in sediment contamination in several canyons (mainly due to past industrial effluent discharges). However, radionuclide levels are well below applicable regulatory standards and measured sediment contamination levels are well below screening levels for recreational uses (LANL 2010a:15). Detailed information on surface-water quality monitoring, including analytical results, is presented in the *Los Alamos National Laboratory Environmental Report 2010* (LANL 2011d). LANL surface-water monitoring results are summarized in **Table 3–28**.

Proposed Facility Location

The TA-55 facility is located on the narrow Mesita del Buey Mesa within the Pajarito Watershed adjacent to Twomile Canyon Aggregate. The 12.8 square mile (33 square kilometer) Pajarito Watershed originates on the eastern boundary of the Valles Caldera National Preserve, extends across the central portion of LANL to the community of White Rock, and joins the Rio Grande at an elevation of 5,422 feet (1,653 meters) above sea level. The drainage is approximately 15.4 miles (24.8 kilometers) long from the headwaters to the confluence with the Rio Grande (LANL 2006b:50). Primary historical uses of the watershed have been for the TA-18 Los Alamos Critical Experiments Facility at the canyon bottom and surface and subsurface materials disposal operations on the mesa. TA-15 and TA-36 were also used for munitions firing (LANL 2005:3-A-34). The watershed consists of three canyons: the primary Pajarito Canyon and aggregate Twomile and Threemile Canyons (LANL 2006b:52).

Table 3–28 Summary of LANL 2010 Surface Water Monitoring [a]

Chemical	*Onsite*	*Offsite*	*Significance*	*Trends*
Plutonium-239/240, Strontium-90, and Cesium-137 radionuclides	No	No	No LANL-derived radionuclides exceed DOE biota concentration guides or derived concentration guidelines in 2010	Steady
Gross alpha radioactivity	Pajarito, Pueblo, Los Alamos, Sandia, Mortandad, and Water Canyons	Yes, including canyons not affected by LANL	56 percent of stormwater results from 2010 were greater than NMWQCC standards. Major source is naturally occurring radioactivity in sediments, except in Mortandad, Pueblo, and Los Alamos Canyons where there are LANL contributors.	
Chromium	Mortandad Canyon	No	Single result above standard	
Copper	Mortandad and Sandia Canyons		Elevated in 2010 at a few sites that receive runoff from developed areas, including TA-3 and the Los Alamos townsite	
Mercury	Los Alamos Canyon		Two results above standard	
Zinc	Los Alamos and Sandia Canyons		Above standards at two locations with small drainage areas receiving runoff from paved roads and other developed areas	
PCBs	Los Alamos, Mortandad, and Sandia Canyons	Yes, including canyons not affected by LANL	Above standards; PCBs have been released by historical LANL discharges from runoff from developed areas, including the Los Alamos town-site. PCBs are also found in background areas of the Santa Fe National Forest, resulting from region atmospheric fallout	

LANL = Los Alamos National Laboratory; NMWQCC = New Mexico Water Quality Control Commission; PCB = polychlorinated biphenyl; TA = technical area.

[a] Impacts resulted in values near or above regulatory standards, screening levels, or risk levels

Source: LANL 2011d:ES-15.

Pajarito Canyon is predominantly intermittent and/or ephemeral and discontinuously perennial in its upper and lower reaches (LANL 2006b:51). Short reaches of perennial flows occur downstream of springs at Starmers Gulch between Twomile and Threemile Canyons and below springs 4A and 4C in White Rock Canyon near the Rio Grande. Discharge from these springs comes from intermediate perched groundwater and the regional aquifer (LANL 2005:3-A-31). Saturated alluvial occurs in the lower portion of Pajarito Canyon. Historically, small amounts of wastewater have been released into Pajarito Canyon tributaries (LANL 2011d:5-55). During 2010, no runoff was recorded at stream gage E250 in Pajarito Canyon above NM-4 (LANL 2011d:6-42). Twomile and Threemile Canyon surface-water flows are primarily ephemeral with possible short-reach intermittent flows (LANL 2005:3-A-31).

Sampling by The Radioactivist Campaign at spring 4A in 2003 reported the detection of cesium-137 (radioactive isotope of cesium) in water and bryophytes (aquatic moss), identifying the spring as a potential source of LANL radioactivity into the Rio Grande from groundwater discharge. Sampling by NMED in 2004 of springs 4A, 4C, and Big and Hemingway Springs identified elevated levels of tritium, chloride, nitrate, and perchlorate. Uranium isotopes 234 and 238 were detected in all bryophytes and water samples. Plutonium isotopes 239 and 240 were detected in all bryophyte samples and plutonium-238 may have been detected in spring 4A water samples. Concentrations of gamma emitters in bryophytes were near detection limits. The NMED study did not confirm detections of cesium-137 in spring 4A water and bryophytes identified by the The Radioactivist Campaign study (Ford-Schmid et al. 2005:10).

Drainage from TA-55 primarily occurs as sheet flow runoff from impervious surfaces within the complex (DOE 2011g:3-32). No LANL NPDES-permitted outfalls discharge into Pajarito, Twomile, or Threemile Canyons (LANL 2006b:51-52). Metal and high explosives have been detected during surface-water sampling in the upper and middle Pajarito Canyon. Non-filtered water samples for a small Twomile

Canyon tributary showed elevated levels of arsenic and mercury. Cyclotrimethylenetrinitramine, or research department explosive (known as "RDX"), semivolatile organic compounds, and pesticides have been detected in Threemile Canyon water samples (LANL 2005:3-A-31**).** Portions of Pajarito Canyon are listed by the NMWQCC under the Clean Water Act §303(d) list as impaired (Table 3–27).

3.2.3.2 Groundwater

General Site Description

The LANL Pajarito Plateau groundwater hydrologic system includes alluvial groundwater, perched intermediate groundwater, and the regional aquifer (LANL 2005:1-7). Groundwater recharge occurs from snowmelt, stormwater runoff, and LANL permitted outfall discharges (LANL 2005:2-78). If not impeded by less permeable layers, infiltrating surface water eventually reaches the regional aquifer (DOE 2011g:3-35).

Alluvial groundwater occurs when water infiltrates and saturates the soil and forms shallow, perched groundwater systems. These systems are confined to the canyon bottoms generally within deposits that are layered with alluvial fans, colluvium, and rock fall deposits from adjacent slopes. In parts of some canyons, streams have filled the bottoms with alluvium up to 100 feet (25 meters) thick (LANL 2011d:5-2). Dry canyons and mesas do not have alluvial groundwater (LANL 2005:1-9, 2-77). Alluvial groundwater is not a source of municipal drinking water for the Los Alamos area (LANL 2005:2-77; DOE 2011g:3-35).

Intermediate-depth perched groundwater forms within the vadose zone by recharge from overlying alluvial groundwater. The vadose zone beneath the Pajarito Plateau ranges in thickness from 600 feet (183 meters) to over 1,200 feet (366 meters) (LANL 2005:2-85). Contributing factors to perched groundwater are local high infiltration rates and low-permeability barriers to vertical flow created by subsurface stratigraphic structures. Perched water is typically discontinuous laterally, occurring as vertical, finger-like waterbodies (LANL 2005:2-97, 2-99). Perched water depth varies from approximately 120, 450, and 500 to 750 feet (37, 137, and 152 to 229 meters) for Pueblo, Sandia, and Mortandad Canyons, respectively. Some perched water discharges at mesa edges or along canyon flanks, forming perennial and intermediate springs (LANL 2011d:5-2–5-3). These subsurface pathways are important to the movement of contaminated fluids from the surface to the regional aquifer (LANL 2005:1-2). Perched water is not a municipal water source in the Los Alamos area (LANL 2005:2-95; DOE 2011g:3-35).

The regional aquifer (water-bearing rock capable of yielding significant quantities of water to wells and springs) is a major source of drinking water and agricultural use in northern New Mexico and extends throughout the Española Basin (approximately 2,317 square miles [6,000 square kilometers]) (LANL 2005:2-103). The area of saturation that forms the regional groundwater aquifer serves as the only regional aquifer in the area that is capable of providing the public water supply for various customers, including LANL, Los Alamos County, Bandelier National Monument, and other consumers located in portions of Santa Fe and Rio Arriba Counties (DOE 2011g:3-35).

On the Pajarito Plateau, the aquifer is separated from alluvium and intermediate perched groundwater by approximately 350 to 600 feet (107 to 183 meters) of unsaturated tuff, basalt, and sediments with an average moisture content of less than 10 percent. The aquifer water table occurs at depths of approximately 1,200 feet (370 meters) along the western edge of the Pajarito Plateau, 600 feet (180 meters) along the eastern edge of the plateau, and 1,000 feet (300 meters) in the central portion of the plateau (DOE 2011g:3-35). Along the western portion of the plateau, the aquifer exists under unconfined (not under pressure) water table conditions; along the eastern margins of the plateau and Rio Grande confined (under pressure) artesian conditions tend to exist (LANL 2005:2-72, 2011b:1-2). Water generally flows east to southeast toward the Rio Grande. The primary recharge source is infiltration of precipitation that falls on the Jemez Mountains (LANL 2011b:1-2). Throughout much of the basin the upper source of the aquifer intersects the Rio Grande (LANL 2005:2-103). The approximate 11.5-mile (19-kilometer) reach of the Rio Grande between White Canyon and the mouth of the Rito de los Frijoles receives an estimated 4,300 to 5,500 acre-feet (5.3 million to 6.8 million cubic meters) of aquifer discharge water (LANL 2011d:1-4).

The LANL potable water supply is provided by the Los Alamos Water Supply System, owned and operated by Los Alamos County. Potable water for LANL and surrounding communities is drawn from the regional aquifer by 14 deep wells located in the Guaje, Otowi, and Pajarito well fields. The county is responsible for compliance with the Safe Drinking Water Act (42 U.S.C. 300f et seq.) and the New Mexico Drinking Water Regulations (LANL 2011d:2-24–2-25). Water consumption at LANL for 2009 was approximately 384 million gallons (1.454 billion liters) (LANL 2011b:ES-4). The Los Alamos County water supply infrastructure is discussed in Section 3.2.9.

With one exception, the Los Alamos County water supply system contains no detected LANL-derived contaminants (LANL 2010a:42). During 2009, perchlorate was found in Pueblo Canyon Well Otowi-1 at concentrations up to 58 percent of the 2005 Consent Order[12] screening level of 4 micrograms per liter and 16 percent of EPA's interim health advisory for perchlorate in drinking water of 15 micrograms per liter. This well is no longer used by Los Alamos County for public water supply. Radioactive analyte concentration values in water well samples did not exceed regulatory standards (DOE 2011g:3-36; LANL 2010a:14).

Groundwater monitoring beyond LANL boundaries is conducted in locations affected by LANL operations in the past, as well as in areas unaffected by LANL for the purpose of providing baseline data. Groundwater monitoring and characterization is performed in compliance with the requirements of Federal and State of New Mexico laws and regulations and DOE orders (LANL 2010a:42). The NMWQCC regulates liquid discharges onto or below the ground surface to protect New Mexico's groundwater resources (LANL 2010a:68). Liquid effluent discharges since the 1940s have affected the water quality of shallow alluvial groundwater, intermediate perched groundwater, and the regional aquifer. Contaminants identified are generally associated with canyon bottom alluvial groundwater or mesa-top liquid effluent discharge outfalls such as Mortandad and upper Sandia Canyons (LANL 2011d:ES-11). The limited extent of alluvium and intermediate perched groundwater and hundreds of feet of underlying dry bedrock restricts the volumetric recharge contribution to the regional aquifer. Water movement from the surface to the aquifer water table may take several decades or longer (DOE 2011g:3-35; LANL 2011d:5-4). Based on historical monitoring data, contaminants are more likely to be detected in the shallow alluvial and intermediate perched groundwater, whereas their detection in the regional aquifer system should be less common because of its depth.

In 2010, 153,000 analyses were performed for groundwater monitoring samples (LANL 2011d:ES-11). A summary of contaminants detected in the LANL groundwater system in 2010 is shown in **Table 3–29**.

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[12] *A Consent Order was entered into by the DOE, NMED, and LANL in March 2005 to: (1) define the nature and extent of releases of contaminants at, or from, LANL; (2) identify and evaluate, where needed, alternatives for corrective measures to clean up contaminants in the environmental and prevent migration of contaminants at, or from, LANL; and (3) implement such corrective measures (DOE 2011g:3-36).*

Table 3–29 Summary of LANL 2010 Groundwater Monitoring [a]

Chemical	Onsite	Offsite	Significance	Trends
Chromium	Mortandad Canyon regional aquifer and Mortandad and Sandia Canyons intermediate groundwater	No	In aquifer above groundwater standards; not affecting drinking water supplies; source eliminated in 1972	Increasing in Mortandad Canyon intermediate groundwater; fairly steady over 5 years at one location in Mortandad and Sandia Canyons' intermediate and regional groundwater
Nitrate	Pueblo and Mortandad Canyons intermediate groundwater and Sandia and Mortandad Canyon regional groundwater	Pueblo and Los Alamos Canyons	Pueblo Canyon sources include Los Alamos Canyon's Sewage Treatment Plant or past effluent discharges.	Generally variable in Pueblo Canyon, steady in Sandia Canyon, and increasing in Mortandad Canyon
Perchlorate	Mortandad Canyon alluvial, intermediate, and regional groundwater; Los Alamos Canyon intermediate groundwater; Pueblo Canyon regional aquifer	Pueblo Canyon	Source was historical outfall discharges that were terminated	Decreasing in Mortandad Canyon alluvial groundwater and increasing in a Mortandad Canyon regional aquifer location
Dioxane[1,4-]	Pajarito, Los Alamos, and Mortandad Canyons intermediate groundwater	No	Limited in extent; not used as a source of drinking water	Over 5 years, concentrations have remained steady or decreased in Los Alamos and Mortandad Canyons; varied seasonally in Pajarito Canyon
Trichloroethane [1,1,1-]; dichloroethene[1,1-]	Intermediate groundwater near main warehouse			Seasonally variable; undergoing corrective action
RDX	Cañon de Valle alluvial and intermediate groundwater and Pajarito Canyon intermediate groundwater			Generally stable with seasonal fluctuations; Pajarito Canyon regional aquifer values are below standards but are increasing at one location
Barium	Pajarito and Mortandad Canyons and Cañon de Valle alluvial and intermediate groundwater			Generally stable in Cañon de Valle; other canyons likely due to cation exchange caused by road salt
Boron	Cañon de Valle intermediate groundwater			Generally stable with seasonal fluctuations
Tetrachloroethene, trichloroethene	Cañon de Valle alluvial and intermediate groundwater			
Strontium-90	Los Alamos and Mortandad Canyons alluvial groundwater		Not used as a source of drinking water and has not penetrated to deeper groundwater.	Mainly fixed in location; some decrease due to effluent quality improvement
Fluoride	Los Alamos and Mortandad Canyons alluvial groundwater, Pueblo and Los Alamos Canyons intermediate groundwater, and Pueblo Canyon regional aquifer	Pueblo Canyon	Source was historical effluent releases; not used as a source of drinking water	Slow decrease in concentration in alluvium due to effluent quality improvement
Chloride, total dissolved solids	Pajarito, Pueblo, Los Alamos, Sandia, and Mortandad Canyons; intermediate groundwater near Technical Area 3		Source was road salt in snowmelt	Values are generally highest in winter and spring samples
Fluoride, uranium, nitrate, total dissolved solids	No	Pine Rock Spring and Pueblo de San Ildefonso	Water quality affected by irrigation with sanitary effluent at Overlook Park	Steady over the years

LANL = Los Alamos National Laboratory; RDX = Research Department Explosive.

[a] Impacts resulted in values near or above regulatory standards, screening levels, or risk levels.

Source: LANL 2011d:ES-12–ES-13.

Proposed Facility Location

The TA-55 facility is located in the Pajarito Watershed. For Pajarito Canyon, surface-water infiltration creates a continuous saturated zone of alluvium that extends from the Pajarito fault zone to White Rock. Alluvial groundwater occurs in the lower portion of Threemile Canyon. Pajarito Canyon groundwater sampling identified the presence of radionuclides, metals, high explosives, volatile organic compounds, and anions (LANL 2005:3-A-32). In 2009, alluvial groundwater sampling of several wells along Pajarito Road indicated high chloride and total dissolved solids concentrations. Runoff related to winter road salting (resulting in an increase in chloride, sodium, and total dissolved solids levels) is the apparent cause (DOE 2011g:3-36). On the Pajarito Canyon mesa south of Threemile Canyon, deep perched groundwater was located at a depth of 894 feet (272 meters) with a saturated thickness of 18 feet (5.5 meters). In 2005, four rounds of water sampling characterization showed no regional aquifer impacts from LANL-related operations. Tritium was detected above background during the initial round of sampling, but was at background levels during subsequent sampling (LANL 2005:3-A-34).

Pajarito Canyon springs, fed by perched groundwater above alluvium, in the western portion of the canyon include Homestead, Josie, Bryan, Garvey, Perkins, Charlie's, Upper Starmer, Kieling, Bulldog, and Starmer Springs. Twomile Canyon Aggregate contains five springs (SM-30, SM-30A, Anderson, Hanlon, and TW-1.72) and the Threemile Canyon Aggregate contains two springs (Threemile Spring and TA-18). Discharge rates are typically 1 to 15 gallons (3.8 to 57 liters) per minute. (LANL 2005:3-A-31, 2006a:1).

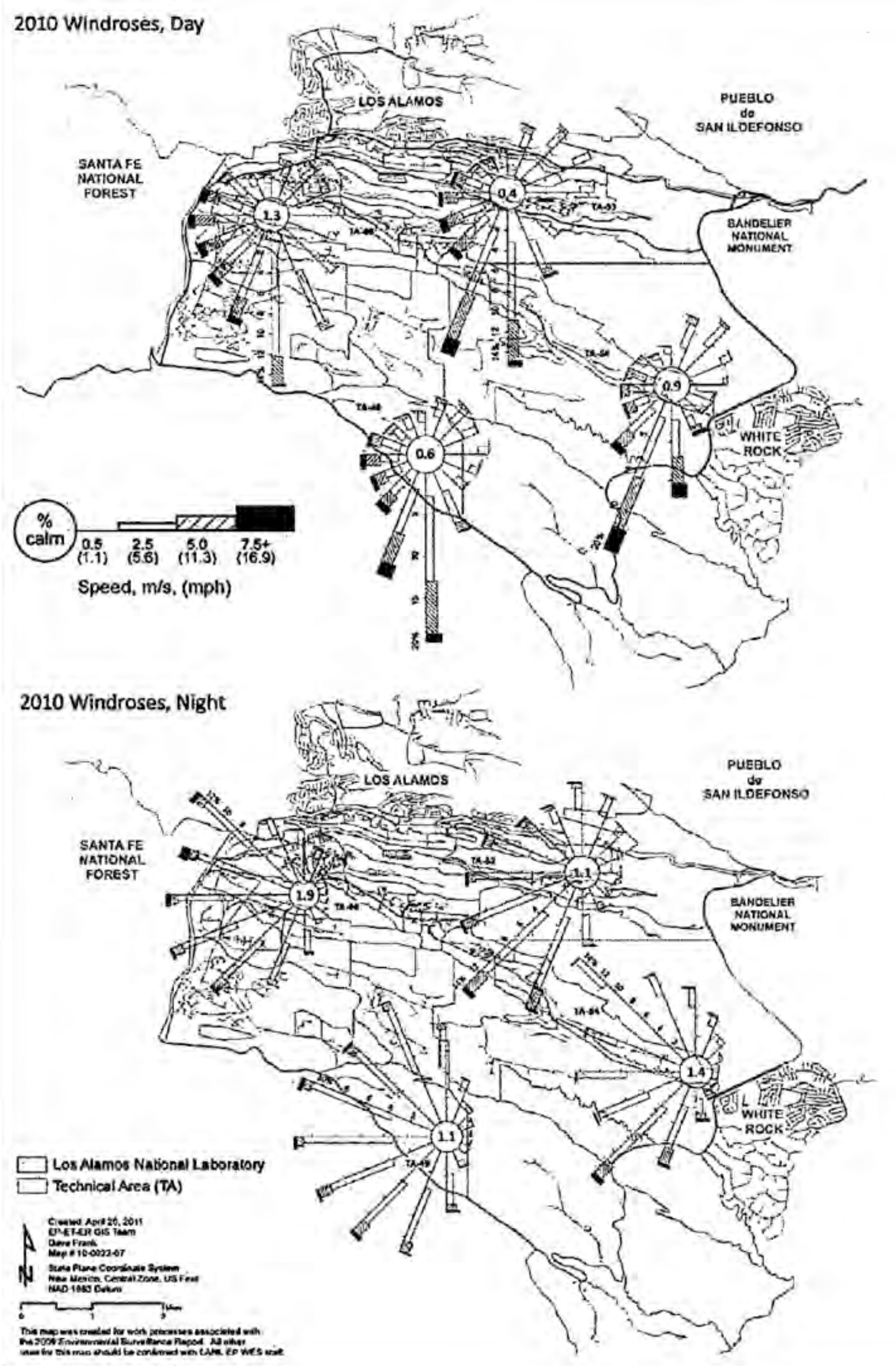
3.2.4 Meteorology, Air Quality, and Noise

3.2.4.1 Meteorology

Climate information for an area does not change drastically over time; thus, the information presented in the *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2003d:3-13–-3-14) and the *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (LANL SWEIS)* (DOE 2008f:4-75–4-82) is still applicable. Los Alamos County is a semiarid, temperate mountain climate characterized by seasonable, variable rainfall. Precipitation ranges from 10 to 20 inches (25 to 51 centimeters) per year and precipitation rates within the county decline toward the Rio Grande Valley. The town of Los Alamos is less arid (dry) than the area near the Rio Grande, which is arid continental. Mean temperatures range from 17.4 °F (-8.1 °C) in January to 80.6 °F (27 °C) in July, with an extreme low temperature of -18 °F (-28 °C) and an extreme high temperature of 95 °F (35 °C). Normal temperatures (30-year mean) in the town of White Rock range from 14.6 °F (-9.7 °C) in January to 85.6 °F (29.8 °C) in July. Temperatures in Los Alamos County vary with altitude, averaging 5 °F (3 °C) higher in and near the Rio Grande Valley, which is 6,500 feet (1,981 meters) above sea level, and 5 to 10 °F (3 to 5.5 °C) lower in the Jemez Mountains, which are 8,500 to 10,000 feet (2,590 to 3,050 meters) above sea level (DOE 2003d: 3-13–3-14).

Precipitation in Los Alamos County during July and August is 36 percent of the annual average value due to thunderstorms. Los Alamos County averages 60 thunderstorms per year, with intense and frequent lightning that has caused fires. Local lightning density is estimated at 15 strikes per square mile (5.6 strikes per square kilometer) per year, commonly observed between May and September (LANL 2010a:30). Flash flooding from heavy thunderstorms in canyons and low-lying areas does occur. Winter precipitation falls as snow, with an average snowfall of 59 inches (150 centimeters). Snowfall levels vary year to year, ranging from 9 inches (23 centimeters) to 153 inches (389 centimeters). Los Alamos County experienced drought conditions from 1998 through 2003, the longest and most severe drought experienced by this area during the last 80 years. Above-average precipitation in 2004 and 2005 helped to restore normal conditions. Precipitation levels were slightly below normal in 2009 (18.6 inches [47.2 centimeters]) (LANL 2010a:1-19–1-23).

Windspeed averages 7 miles per hour (3 meters per second) in Los Alamos County. Wind speeds vary seasonally, with lowest wind speeds in December and January. The highest winds occur March through June due to intense storms and cold fronts. Due to the complex terrain surface, winds vary dramatically with time of day, location, and elevation. Generally, an upslope airflow occurs in the morning, with winds shifting from the south over the entire plateau by noon. During the night, winds come from the west-southwest to the northwest over the western portion of the plateau due to cold air drainage off the Jemez Mountains and the Pajarito Plateau (DOE 2008f:4-77–4-78). Wind roses for LANL for 2010 are presented in **Figure 3–13**.



Source: LANL 2011d:4-29

Figure 3–13 Daytime and Nighttime Wind Roses for 2010

3.2.4.2 Air Quality

Air pollution refers to any substance in the air that could harm humans, animals, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

General Site Description

LANL is located within the Upper Rio Grande Valley Intrastate Air Quality Control Region (#157). The area encompassing LANL and Los Alamos County is classified as an attainment area for all six criteria pollutants (40 CFR 81.332).

Operations at LANL emit criteria pollutants primarily from combustion sources, such as boilers, emergency generators, and motor vehicles. Emissions at LANL are provided in **Table 3–30**.

Table 3–30 Air Pollutant Emissions at Los Alamos National Laboratory

Pollutants	*2010 Emissions(tons per year)*
Carbon Monoxide	36.5
Nitrogen Oxides	51
Particulate Matter	3.7
Sulfur Oxides	1
Volatile Organic Compounds	10
Hazardous air pollutants	4.7

Note: To convert tons to metric tons, multiply by 0.90718.
Source: LANL 2011d:2-18

The Bandelier Wilderness Area is designated as a Class I Prevention of Significant Deterioration area (an area that exceeds 10,000 acres [4,047 hectares]) in accordance with the Clean Air Act, as amended, and New Mexico regulations. This means that facilities located within a 62-mile (100-kilometer) radius of the area must not cause appreciable deterioration in air quality. NMED monitored levels of air pollutants of interest (sulfur dioxide, nitrogen dioxide, ozone, and particulate matter with an aerodynamic diameter less than or equal to 10 microns [PM_{10}]) at a station adjacent to Bandelier National Monument between 1990 and 1994. Operation of the station was discontinued in 1995 because the recorded values were well below applicable standards. Visibility is considered to be an important value (40 CFR Part 81; 20 *New Mexico Administrative Code* [NMAC 20.2.74]) and requires protection. Visibility has been officially monitored by the National Park Service at Bandelier National Monument since 1988. The visual range has not deteriorated during the period for which data are available (DOE 2003d:3-16–3-17).

The State of New Mexico has established ambient air quality standards for the criteria pollutants and total suspended particulates, hydrogen sulfide, and total reduced sulfur. The criteria pollutant standards and concentrations attributable to LANL are shown in **Table 3–31**. These concentrations are in compliance with the applicable ambient air quality standards.

Air quality permits have been obtained from the NMED Air Quality Bureau for various activities at LANL, including beryllium operations; open burning of high-explosives waste; and operation of an air curtain destructor, an asphalt plant, a rock crusher, the TA-3 power plant, and the TA-33 generator. Each of these operations was modified or constructed after August 31, 1972. In accordance with Title V of the Clean Air Act and *New Mexico Administrative Code* 20.2.70, a sitewide operating permit application was submitted to NMED in December 1995. A modified application was submitted in 2005; a renewal application was submitted in 2008. The current approved operating permit was issued in August 2009. In 2010, LANL requested a revision to the operating permit to incorporate the CMRR-RLUOB (LANL 2011d:2-18–2-19). The LANL sitewide operating permit has voluntary facility-wide emission limits to ensure that LANL remains a minor stationary source for the purposes of the Prevention of Significant Deterioration Construction Permit Program and the Clean Air Act Title III requirements for hazardous air pollutants. Prior to construction, NMED requires air permits for new sources of emissions depending on the design and operation (DOE 2011g:3-13).

Table 3–31 Comparison of Ambient Air Concentrations from Los Alamos National Laboratory Sources with Most Stringent Applicable Ambient Air Quality Standards

Air Pollutant	*Averaging Time*	*Most Stringent Standard* [a]	*Maximum Facility-Wide Concentration*
Carbon Monoxide	8-hour 1-hour	8.7 ppm [c] 13.1 ppm [c]	0.22 ppm 1.2 ppm
Nitrogen Dioxide	Annual 24-hour	0.05 ppm [c] 0.1 ppm [c]	0 ppm NR
Sulfur Dioxide	Annual 24-hour 3-hour	0.02 ppm [c] 0.1 ppm [c] 0.5 ppm [b]	0 ppm 0.04 ppm 0.2 ppm
Particulate Matter (PM_{10}) [d]	24-hour	150 $\mu g/m^3$ [b]	102 $\mu g/m^3$
Particulate Matter ($PM_{2.5}$)	Annual 24-hour	15 $\mu g/m^3$ [b] 35 $\mu g/m^3$ [b]	N/R N/R
Ozone	8-hour	0.08 ppm [b]	N/R
Lead	Rolling 3-month average	0.15 $\mu g/m^3$ [b]	N/R

N/R = Not reported in the *LANL SWEIS*; PM_n = particulate matter less than or equal to *n* microns in aerodynamic diameter; ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. Methods of determining whether standards are attained depend on pollutant and averaging time. The National Ambient Air Quality Standards (40 CFR 50), 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 8-hour ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average concentration is less than or equal to the standard. The 24-hour PM_{10} standard is attained when the expected number of days with a 24-hour average concentration above the standard is less than or equal to 1. The 24-hour $PM_{2.5}$ standard is met when the 3-year average of the 98th percentile 24-hour averages is less than or equal to the standard. The annual $PM_{2.5}$ standard is met when the 3-year average of the annual means is less than or equal to the standard.

[b] Federal standard.

[c] State standard.

[d] EPA revoked the annual PM_{10} standard in 2006.

Note: Emissions of other air pollutants not listed here have been identified at LANL, but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the *LANL SWEIS* (DOE 2008f:4-82–4-88). Values may differ from those of the source document due to rounding. EPA recently promulgated 1-hour ambient standards for nitrogen dioxide and sulfur dioxide. The 1-hour standard for nitrogen dioxide is 188 micrograms per cubic meter and the 1-hour standard for sulfur dioxide is 197 micrograms per cubic meter. EPA recently promulgated a lead standard of 0.15 micrograms per cubic meter based on a 3-month rolling average (40 CFR 50). No modeling results were available for comparison to these standards.

Source: DOE 2008f:5-49, 2011g:4-115; NMAC 20.2.3. 2006; 40 CFR 50.

Recent data from nearby ambient air monitors in Los Alamos are presented in **Table 3–32**. The data indicate that the NAAQS for particulate matter are not exceeded in the area around LANL (LANL 2012b:3-2, 2011d:4-21).

The "natural greenhouse effect" is the process by which part of the terrestrial radiation is absorbed by gases in the atmosphere, thereby warming the Earth's surface and atmosphere. This greenhouse effect and the Earth's radiative balance are affected largely by water vapor, carbon dioxide, and trace gases, all absorbers of infrared radiation and commonly referred to as "greenhouse gases." Trace gases include nitrous oxide, chlorofluorocarbons, and methane.

Table 3–32 Ambient Air Quality Standards and Monitored Levels in the Vicinity of Los Alamos National Laboratory

Pollutant	*Averaging Time*	*Ambient Standard (micrograms per cubic meter)*	*Concentration (micrograms per cubic meter)*	*Locations*
PM_{10}	24 hours	150	60 58	White Rock Fire Station Los Alamos Medical Center
$PM_{2.5}$	Annual	15	6 6	White Rock Fire Station Los Alamos Medical Center
	24 hours	35	19 12	White Rock Fire Station Los Alamos Medical Center

PM_n = particulate matter less than or equal to *n* microns in aerodynamic diameter.
Source: LANL 2011d:4-21, 40 CFR Part 50.

LANL carbon-dioxide-equivalent emissions of carbon dioxide and methane from combustion of fossil fuels in calendar year 2010 were estimated to be 66,650 tons (60,460 metric tons) (LANL 2011d:2-17), which is less than 0.001 percent of the total U.S. emissions of 6.08 billion metric tons per year (EPA 2012:ES-4-ES-6).

Proposed Facility Locations

The meteorological conditions described previously for LANL are considered to be representative of TA-55. Information on air pollutant emissions from this area is included in the overall site emissions discussed previously.

The air pollutant sources of significance for permitting include machining and foundry operations, boilers and heaters, and degreasers (DOE 2008f:4-84–4-85).

3.2.4.3 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities, diminish the quality of the environment, or if loud enough, cause discomfort and even hearing loss.

General Site Description

Existing noise related to LANL facilities that is detectable by the public comes from a variety of sources, including construction, truck and automobile movements to and from the LANL technical areas, high-explosives testing, and firearms practice by security guards. Non-LANL noise occurring within Los Alamos County is dominated by traffic movement and, to a much lesser degree, other residential-, commercial-, and industrial-related activities. Measurements of nonspecific background ambient noise in the LANL area have been taken at a couple of locations near LANL boundaries next to public roadways. Background noise levels were found to range from 31 to 35 decibels A-weighted (dBA) at the vicinity of the entrance to Bandelier National Monument and New Mexico State Route (SR) 4. In White Rock, background noise levels range from 38 to 51 dBA (1-hour equivalent sound level); the slight increase compared to Bandelier National Monument is probably due to higher levels of traffic and the presence of a residential neighborhood, as well as the different physical setting (DOE 2003d:3-17–3-18).

Peak noise levels from LANL operations are represented by the detonation of high explosives. The higher-frequency, audible air pressure waves that accompany detonation of explosives can be heard by both workers and the area public. The lower-frequency air pressure waves are not audible, but may cause secondary and audible noises within a testing structure that may be heard by personnel (DOE 2011g:3-18).

Noise attenuation (reduction) is affected by vegetation, topography, and meteorology. Much of LANL is forested, particularly where explosives test sites are located, and varied elevations and rock formations influence and channel noise and vibrations away from receptors. Booming noises from explosives are similar to thunder and startle receptors and LANL workers alike. The Cerro Grande Fire reduced vegetative cover, thereby decreasing the ability of the surrounding environment to absorb noise (DOE 2008f:4-93).

LANL operational noise (both audible and vibration) is regulated by worker protection standards (29 CFR 1910.95) that are consistent with the Los Alamos County Code. Los Alamos County promulgated a local noise ordinance that establishes noise level limits for residential land uses. Noise levels that affect residential receptors are limited to a maximum of 65 dBA during daytime hours (between 7 A.M. and 9 P.M.) and 53 dBA during nighttime hours (between 9 P.M. and 7 A.M.). During daytime hours, the permissible noise level can be increased to 75 dBA in residential areas, provided the noise is limited to 10 minutes in any 1 hour. Activities that do not meet the noise ordinance limits require a permit. It was determined by the Los Alamos County Community Development Department that LANL does not need a special permit under the Los Alamos County Code, as explosive test noise is not prolonged. Traffic noise is exempted from the Los Alamos County Code. Wildlife and sensitive, federally protected bird populations are vigorous in the LANL area, suggesting that noise generated at LANL is within the acceptable tolerance range for most wildlife species and sensitive nesting birds (DOE 2011g:3-19).

Proposed Facility Locations

No distinguishing noise characteristics in TA-55 have been identified. Facilities in this area are far enough from the site boundary that noise levels from sources in these areas would not be measurable or would be barely distinguishable from background levels.

3.2.5 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 purpose of this *SPD Supplemental EIS*, ecological resources are differentiated by habitat type (aquatic and wetland versus terrestrial) and sensitivity (threatened, endangered, and other special-status species).

3.2.5.1 Terrestrial Resources

General Site Description

LANL is located in a region of diverse landforms, elevation, and climate. Approximately 20 percent of the land has experienced some degree of disturbance; the remaining habitat contains a high degree of biological diversity represented by approximately 900 species of vascular plants in five distinct vegetative zones. Juniper (*Juniperus monosperma*) savannas, pinyon pine (*Pinus edulis)*-juniper woodlands, grasslands, ponderosa pine (*Pinus ponderosa*) forests, and mixed conifer forests composed of Douglas fir (*Pseudotsuga menziesii)*, ponderosa pine, and white fir (*Abies concolor)* all occur within the 37-square-mile (23,680-acre [9,583-hectare]) LANL boundary. PF-4 is located within TA-55 and falls primarily within the ponderosa pine forest and mixed conifer forest vegetation type (DOE 2011g:3-32).

LANL also contains a diverse population of animals, including 57 species of mammals, 200 species of birds, 28 species of reptiles, 9 species of amphibians, and over 1,200 species of arthropods. Common species found at LANL include the western bluebird (*Sialia mexicana*), elk (*Cervus elaphus*), and raccoon (*Procyon lotor*). Raptors occurring on site include red-tailed hawk (*Buteo jamaicensis*), great-horned owl (*Bubo virginianus*) and the American peregrine falcon (*Falco peregrinus anatum*). Large carnivores include black bear (*Ursus americanus*) and bobcat (*Lynx rufus*) and the predominant game species are elk and mule deer (*Odocoileus hemionus*) (DOE 2011g:3-32).

In addition, several factors, such as the construction of new facilities, fires (including the Cerro Grande and Las Conchas fires), periods of severe drought, and bark beetle outbreaks, have all impacted the landscape at LANL. For example, in 2000, the Cerro Grande Fire burned 43,150 acres (17,460 hectares), which dramatically altered the landscape, specifically forested areas. Since 1997, forests around LANL have been mechanically thinned in an effort to reduce future wildfire potential. In addition, within 2 years of the Cerro Grande Fire, a bark beetle outbreak occurred that contributed to high mortality of pinyon, ponderosa pine, and Douglas fir trees. Bark beetle outbreaks at LANL tend to be associated with extended periods of drought, particularly periods of drought following a major wildfire (DOE 2011g:3-32).

Proposed Facility Locations

Although PF-4 is located within TA-55 and consists mainly of developed land, the area was historically part of the ponderosa pine forest and mixed conifer forest vegetation type (DOE 2011g:3-32).

3.2.5.2 Aquatic Resources

General Site Description

The Rito de Los Frijoles in Bandelier National Monument (located to the south of LANL) and the Rio Grande are the only truly perennial streams in the LANL region; however, several of the canyon floors within LANL contain reaches of perennial surface water. Some perennial streams occur in lower Pajarito and Ancho Canyons, which flow to the Rio Grande. Surface-water flow occurs in canyon bottoms seasonally or intermittently as a result of spring snowmelt and summer rain. A few short sections of riparian vegetation of cottonwood (*Populus deltoides*), willow *(Salix* spp.*)*, and other wetland plants are present in scattered locations at LANL, as well as along the Rio Grande in White Rock Canyon. The springs and streams at LANL do not support fish populations; however, many other animal species utilize these waters. For example, terrestrial wildlife use onsite streams for drinking and associated riparian habitat for nesting and feeding.

Proposed Facility Locations

No ponds or permanent streams are identified in any of the technical areas of concern; therefore, aquatic habitat is minimal and associated with ponding within wetland areas. As explained in Section 3.2.5.3, wetlands are present within TA-55 within Mortandad Canyon (DOE 2011g:3-35).

3.2.5.3 Wetlands

General Site Description

Thirty separate wetlands occupy portions of the 14 technical areas within LANL for a total of approximately 34 acres (14 hectares). Most of wetlands at LANL are associated with canyon stream channels or are present on mountains or mesas as isolated meadows, often in association with springs, seeps, or effluent outfalls. Of these wetlands, 13 acres (5 hectares) were created or enhanced by process effluent wastewater from NPDES-permitted outfalls. This total has most likely been reduced due in part to closure or rerouting of the outfall sources. Dominant wetland plants include reed canarygrass (*Phalaris arundinacea*), narrowleaf cattail (*Typha angustifolia*), coyote willow (*Salix exigua*), Baltic rush (*Juncus balticus*), wooly sedge (*Carex pellita*), American speedwell (*Veronica americana*), common spike rush (*Eleocharis palustris*), and curly dock (*Rumex crispus*).

Proposed Facility Locations

One wetland exists within TA-55 and is within a branch of Mortandad Canyon between TA-55 and TA-48; it covers 1.19 acres (0.48 hectares). This wetland is dominated by cattails (*Typha latifolia*) (DOE 2011g:3-35).

3.2.5.4 Threatened and Endangered Species

General Site Description

Several federally and state-listed species have been recorded at LANL and within the surrounding areas. **Table 3–33** provides a list of these species and their designation and potential to occur on site.

Table 3–33 Threatened and Endangered and Other Sensitive Species of Los Alamos National Laboratory

Common Name	*Scientific Name*	*Federal Status* [a]	*State Status* [b]	*Potential to Occur*
Mammals				
Black-footed Ferret	*Mustela nigripes*	FE	–	Low
New Mexico Meadow Jumping Mouse	*Zapus hudsonius luteus*	C	SE	Moderate
Spotted Bat	*Euderma maculatum*	–	ST	High
Birds				
American Peregrine Falcon	*Falco peregrinus anatum*	D	ST	High
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	D	ST	Moderate
Bald Eagle	*Haliaeetus leucocephalus*	D	ST	High
Broad-billed Hummingbird	*Cyanthus latirostris magicus*	–	ST	Low
Gray Vireo	*Vireo vicinior*	–	ST	Moderate
Mexican Spotted Owl	*Strix occidentalis lucida*	FT	ST	High
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	FE	SE	Moderate
Amphibians				
Jemez Mountains Salamander	*Plethodon neomexicanus*	C	SE	High
Plants				
Greater Yellow Lady's Slipper	*Cypripedium calceolus var. pubescens*	–	SE	Moderate
Wood Lily	*Lilium philadelphicum var. anadinum*	–	SE	High

Low = No known habitat exists on LANL; Moderate = Habitat exists, though the species has not been recorded recently; High = Habitat exists and the species is recorded to occur at LANL.

[a] *Federal Status*

FE = Federally Endangered; in danger of extinction throughout all or a significant portion of its range.

FT = Federally Threatened; likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

C = Candidate; substantial information exists in the U.S. Fish and Wildlife Service files on biological vulnerability to support proposals to list as endangered or threatened.

D = Federally delisted due to recovery, currently monitored.

[b] *State Status*

SE = State Endangered

Animal: any species or subspecies whose prospects of survival or recruitment in New Mexico are in jeopardy.

Plant: a taxon listed as threatened or endangered under provision of the Federal Endangered Species Act, or is considered proposed under the tenets of the act, or is a rare plant across its range within the state, and of such limited distribution and population size that unregulated taking could adversely impact it and jeopardize its survival in New Mexico.

ST = State Threatened

Animal: any species or subspecies that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range in New Mexico.

Plant: New Mexico does not list plants as threatened.

Source: DOE 2011g:3-36.

Proposed Facility Locations

TA-55 is within the core and/or buffer habitat zones of the Sandia–Mortandad Canyon and Pajarito Canyon Mexican Spotted Owl Area of Environmental Interest (DOE 2011g:3-36).

3.2.6 Human Health

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

3.2.6.1 Radiation Exposure and Risk

General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of LANL are shown in **Table 3–34**. Background radiation doses are unrelated to LANL operations. Annual background radiation doses to individuals are expected to remain constant over time.

Table 3–34 Radiation Exposure of Individuals in the Los Alamos National Laboratory Site Vicinity Unrelated to Los Alamos National Laboratory Site Operations

Source	*Effective Dose (millirem per year)*
Natural background radiation	
Cosmic and external terrestrial radiation	170
Internal terrestrial radiation	40
Radon-220 and -222 in homes (inhaled)	270
Other background radiation	
Diagnostic x-rays and nuclear medicine	300
Weapons test fallout	< 1
Consumer and industrial products	10
Total	**790**

Source: LANL 2011d:3-9.

Releases of radionuclides to the environment from LANL operations provide another source of radiation exposure to individuals in the vicinity of LANL. Types and quantities of radionuclides released from LANL operations are listed in the annual LANL environmental reports. The annual doses to the public from recent releases of radioactive materials (2006 through 2010) and the average annual doses over this 5-year period are presented in **Table 3–35**. These doses fall within radiological limits established per DOE Order 458.1 and are much lower than background radiation.

Using a risk estimator of 600 LCFs per 1 million person-rem (or 0.0006 LCFs per rem) (DOE 2004d:22), the annual average LCF risk to the maximally exposed member of the public due to radiological releases from LANL operations from 2006 through 2010 is estimated to be 3×10^{-7}. That is, the estimated probability of this person developing a fatal cancer at some point in the future from radiation exposure associated with 1 year of LANL operations is 1 in 3.3 million. (Note: It takes a number of years from the time of radiation exposure until a cancer manifests.)

Table 3–35 Annual Radiation Doses to the Public from Los Alamos National Laboratory Site Operations in 2006–2010 (effective dose equivalent)

Members of the Public	*Year*	*Atmospheric Releases* [a]	*Liquid Releases* [b]	*Total* [c]
Maximally exposed individual (millirem)	2006	0.42	N/A	0.42
	2007	0.41	N/A	0.41
	2008	0.55	N/A	0.55
	2009	0.55	N/A	0.55
	2010	0.33	N/A	0.33
	2006–2010 Average	0.45	N/A	0.45
Population within 50 miles (person-rem) [d]	2006	0.60	N/A	0.60
	2007	0.36	N/A	0.36
	2008	0.79	N/A	0.79
	2009	0.57	N/A	0.57
	2010	0.22	N/A	0.22
	2006–2010 Average	0.51	N/A	0.51
Average individual within 50 miles (millirem) [e]	2006	0.0021	N/A	0.0021
	2007	0.0013	N/A	0.0013
	2008	0.0028	N/A	0.0028
	2009	0.0020	N/A	0.0020
	2010	0.00079	N/A	0.00079
	2006–2010 Average	0.0018	N/A	0.0018

N/A = not applicable.

[a] DOE Order 458.1 and Clean Air Act regulations in 40 CFR Part 61, Subpart H, establish a compliance limit of 10 millirem per year to the maximally exposed individual.

[b] There are no liquid effluent pathways from normal LANL operations that result in doses to the public.

[c] DOE Order 458.1 establishes an all-pathways dose limit of 100 millirem per year to individual members of the public.

[d] Doses are to a population of 280,000, based on the 2000 census. Based on the 2010 census, the population is estimated to be about 383,000. Assuming that the distribution of the population remained the same, the dose to 2010 population would be 0.30 person-rem.

[e] Obtained by dividing the population dose by the number of people living within 50 miles of LANL.

Note: To convert miles to kilometers, multiply by 1.609.

Source: LANL 2007b:Ch. 3, 2008:Ch. 3, 2009b:Ch. 3, 2010a:Ch. 3, 2011d:Ch. 3.

According to the same risk estimator, no excess fatal cancers are projected in the population living within 50 miles (80 kilometers) of LANL from 1 year of normal operations from 2006 through 2010. This may be compared with the number of fatal cancers expected in the same population from all causes. The average annual mortality rate associated with cancer for the entire U.S. population from 2003 through 2007 (the last 5 years for which final data are available) was 188 per 100,000 (HHS 2006:Table C, 2007:Table C, 2008:Table B, 2009:Table B, 2010:64).[13] Based on this national mortality rate, the number of fatal cancers that were expected to occur in 2010 in the population living within 50 miles (80 kilometers) of LANL is 720.[14]

LANL 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 3–36** presents the annual average individual and collective worker doses from LANL operations from 2006 through 2010, the latest 5-year period for which data are available. These doses fall within the regulatory limits of

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[13] *Preliminary data for 2008 and 2009 indicate mortality rates that are less than 2 percent smaller than this rate (HHS 2010:Table 7, 2011:Table B).*

[14] *The number of fatal cancers is based on an estimated population of 383,000 people living within 50 miles (80 kilometers) of LANL in 2010. This population estimate results from projecting the 2000 population of 280,000 that is given in the LANL Environmental Report for 2010 (LANL 2011d:Ch.3).*

10 CFR Part 835. Using the risk estimator of 600 LCFs per 1 million person-rem, the calculated average annual LCF risk of 0.08 in the workforce indicates a low probability of a single cancer fatality in the worker population.

Table 3–36 Radiation Doses to Los Alamos National Laboratory Workers from Operations from 2006 through 2010 (total effective dose equivalent)

Occupational Personnel	From Onsite Releases and Direct Radiation by Year					
	2006	2007	2008	2009	2010	Average
Average radiation worker (millirem) [a]	83	108	88	83	94	91
Total worker dose (person-rem)	164	150	107	116	125	132
Number of workers receiving a measurable dose	1,985	1,392	1,219	1,392	1,335	1,465

[a] No standard is specified for an "average radiation worker"; however, the maximum dose to a worker is limited as follows: The radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, DOE's goal is to maintain radiological exposure as low as reasonably achievable. DOE has therefore established the Administrative Control Level of 2,000 millirem per year; the site contractor sets facility administrative control levels below the DOE level (DOE 2009a).

Source: DOE 2007a:3-10, 2008b:3-10, 2009c:3-10, 2010b:3-10, 2011d:3-10.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the annual LANL surveillance and environmental reports. The concentrations of radioactivity in various environmental media (including air, water, and soil) in the region (on site and off site) are also presented in those reports. Specific to measurements made in air, the average onsite concentration of plutonium-239 was 3.4×10^{-18} curies per cubic meter for the years 2006 through 2010. For the years 2006 through 2009, the average onsite concentrations in air of gross alpha and gross beta radiation were 8×10^{-16} curies per cubic meter and 1.7×10^{-14} curies per cubic meter, respectively; these measurements were discontinued in 2010. No specific measurements were reported for TA-55.

3.2.6.2 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 with which people may come in contact (such as soil through direct contact or via the food pathway).

Adverse health impacts on the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public could occur during normal operations at LANL via inhalation of air containing hazardous chemicals released to the atmosphere by LANL operations. Other potential pathways that pose risks to public health include ingestion of contaminated drinking water or direct exposure.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 3.2.4. These 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 compared with applicable guidelines and regulations.

Chemical exposure pathways to LANL workers during normal operations could include inhaling the workplace atmosphere, drinking LANL potable water, and possible other contact with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls.

LANL workers are also protected by adherence to the Occupational Safety and Health Administration and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at LANL are substantially better than required by standards.

3.2.6.3 Health Effects Studies

Numerous epidemiological studies have been conducted in the LANL area. For example, a 1993 study found that the incidence of some cancers was greater than that observed in reference populations, while the incidence of other cancers was lower (Athas and Key 1993). The most notable increase was for thyroid cancer incidence observed in the mid-1980s, with increased incidence rates also observed for melanoma of the skin, prostate cancer, non-Hodgkin's lymphoma, ovarian cancer, and female breast cancer. The related epidemiologic investigation did not identify a specific cause for the high number of thyroid cancers observed in Los Alamos County, but indicated that it was likely the result of several causes (Athas 1996).

Using cancer incidence data for the years 1973 to 1997, a study identified a statistically significant cluster of childhood cancers in Los Alamos County and six counties to the south and west of Los Alamos County (Bernalillo, Cibola, McKinley, Sandoval, San Juan, and Valencia Counties), when all cancers were considered (Zhan 2001:5,31-48). The same study identified a statistically significant cluster of childhood acute lymphoblastic leukemia in a nine-county area south and southwest of Los Alamos County (Bernalillo, Catron, Cibola, Dona Ana, Lincoln, Sierra, Socorro, Torrance, and Valencia Counties). Over the same years, another study identified a statistically significant cluster of female breast cancer within the four-county area of Los Alamos, Sandoval, Santa Fe, and Bernalillo Counties (Zhan 2002:25,1-8).

In 2003, a study compared annual age-adjusted cancer incidence and mortality rates for the years 1970 to 1996 for 24 types of cancer in Los Alamos County, with rates calculated for a New Mexico state reference population (Richards 2003). Cancer incidence rates considered elevated or significantly elevated compared with the New Mexico state reference population included those for the brain, breast, colon/rectum, esophagus, Hodgkin's lymphoma, leukemia, melanoma of the skin, non-Hodgkin's lymphoma, ovary, prostate, testis, and thyroid. Cancer mortality rates considered elevated or significantly elevated compared with the New Mexico state reference population included those for breast, colon/rectum, kidney, liver, melanoma of the skin, non-Hodgkin's lymphoma, ovary, and pancreas. Incidence and/or mortality rates for other analyzed cancers were not considered elevated in Los Alamos County.

The National Cancer Institute publishes national, state, and county incidence rates for various types of cancer (NCI 2011). However, the published information does not provide an association of these rates with their causes, e.g., specific facility operations and human lifestyles. **Table 3–37** presents a summary of cancer incidence rates for the United States, New Mexico, and the four counties adjacent to LANL. Additional information about cancer profiles in the vicinity of LANL is presented in *State Cancer Profiles, Incidence Rates Report* (NCI 2011).

In a study entitled *Public Health Assessment, Final, Los Alamos National Laboratory,* ATSDR reported on its review of possible public exposures to radioactive materials and other toxic substances in the environment near LANL (ATSDR 2006). The study also examined the results of the Athas and Key (1993) and Athas (1996) studies and determined that there were no data to link environmental factors, other than naturally occurring ultraviolet light from the sun, with the observed incidence of any cancer in Los Alamos County. ATSDR concluded that, "[o]verall, cancer rates in the Los Alamos area are similar to cancer rates found in other communities. In some time periods, some cancers will occur more frequently and others less frequently than seen in reference populations. Often, the elevated rates are not statistically significant."

In 1999, the Centers for Disease Control and Prevention began a dose reconstruction project to estimate the possible exposures of populations from releases of radioactive and chemical materials from LANL since 1943. A final report addressing the first phase of the project – the Los Alamos Historical Document Retrieval and Assessment project – has been published (ChemRisk et al. 2010).

Table 3–37 Cancer Incidence Rates for the United States, New Mexico, and Los Alamos Region, 2004 through 2008 [a]

Cancer type	*United States*	*New Mexico*	*Los Alamos County [b]*	*Santa Fe County [b]*	*Sandoval County*	*Rio Arriba County*
All cancers	465	402.2	435.1	418.1	437.6	331.8
Breast	121.1	109.6	145.5	133.7	125.2	78.9
Colon and Rectum	47.6	40.2	33.9	38.8	45.2	43.9
Leukemia	12.4	12.6	(c)	12.6	15.8	9
Lung and Bronchus	67.9	46	28.3	35.5	44.6	23.9
Prostate	152.7	136.3	199.2	162.9	143.9	140.7
Thyroid	11	12.4	31	14.2	14.5	13.3

[a] Age-adjusted incidence rates per 100,000 persons per year, all races, and both sexes (as appropriate).

[b] Portions of LANL are located in Los Alamos and Santa Fe Counties.

[c] Data have been suppressed by the National Cancer Institute to ensure confidentiality and stability of rate estimates when the annual average count is three or fewer cases.

Source: NCI 2011.

3.2.6.4 Accident History

LANL annual environmental reports were reviewed to determine if there were any unplanned releases of radioactivity to the environment around the LANL site during the most recent 5 years for which data are available (2006–2010). These are the same years for which annual radiation doses to the public from LANL operations are given in Section 3.2.6.1. With the exception of an opacity exceedance that was slightly above the permit limit (25 percent versus 20 percent) and lasted less than 10 minutes in 2007, there were no unplanned radiological or nonradiological airborne, or liquid radiological releases from LANL during this time (LANL 2007b:70, 2008:76, 2009b:74, 2010a:74-75, 2011d:2-31).

LANL did experience unplanned releases of radioactivity to the environment during earlier operations. A discussion of these earlier releases and their impacts is presented in the *LANL SWEIS* (DOE 2008f:4-119, 4-120, 4-121).

3.2.6.5 Emergency Preparedness

Each site in the DOE complex has an established emergency management program that is activated in the event of an accident. These programs have been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. Emergency management programs address emergency planning, training, preparedness, and response for both onsite and offsite personnel.

These programs involve providing specialized training and equipment for local fire departments and hospitals, state public safety organizations, and other government entities that may participate in response actions, as well as specialized assistance teams (DOE Order 151.1C, *Comprehensive Emergency Management System*). These programs also provide for notification of local governments whose constituencies could be threatened in the event of an accident. Broad ranges of exercises are run to ensure the systems are working properly, from facility-specific exercises to regional responses. In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at the Hanford Site in Richland, Washington, in May 1997.

Emergency response facilities and equipment, trained staff, and effective interface and integration with offsite emergency response authorities and organizations are integral components of the emergency management system at LANL. LANL personnel maintain the necessary apparatus, equipment, and a state-of-the-art Emergency Operations Center to respond effectively to virtually any type of emergency, not only at LANL, but throughout the local community as well.

The Emergency Operations Center serves as the command center for emergency responders in the event of an emergency and has space and resources to house up to 120 personnel, including representatives from neighboring pueblos, the Federal Bureau of Investigation, the Federal Emergency Management Agency (FEMA), DOE, the U.S. Forest Service, the National Park Service, the National Guard, New Mexico State Police, Los Alamos County police and firefighters, Emergency Managers, the Red Cross, and others.

The Emergency Response and Management Program at LANL effectively combines Federal and local emergency response capabilities. A coordinated effort to share emergency information with Los Alamos County is a cornerstone of the Emergency Response and Management Program. LANL emergency response and management staff and Los Alamos County police, fire, emergency medical, and 911 dispatch personnel operate out of the LANL Emergency Operations Center. It is the United States' first Emergency Operations Center that combines Federal and local operations. A computer-aided dispatch system provides a centralized dispatch capability for the Los Alamos police and fire departments. First responders from different agencies can share real-time information in the same Emergency Operations Center, resulting in a more coordinated emergency response.

3.2.7 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal and state laws, regulations, and guidelines. *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico,* an institutional, comprehensive plan known as the Cultural Resources Management Plan, defines the responsibilities, requirements, and methods for managing cultural resources at LANL. It provides procedures for effective compliance with Federal historic preservation laws and regulations such as the National Historic Preservation Act, Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act, and American Indian Religious Act, as well as DOE policies and directives aimed to protect cultural resources (LANL 2006c). Implementation of the Cultural Resources Management Plan is governed by a Programmatic Agreement between the DOE Los Alamos Site Office, New Mexico SHPO, and Advisory Council for Historic Preservation (DOE 2006b).

Approximately 88 percent of DOE-administered land in Los Alamos County has been surveyed for prehistoric and historic cultural resources (LANL 2012b:3-32). The great majority of these sites represent the villages, farmsteads, resource exploitation areas, rock art panels, trails, and shrines of more than 10,000 years of American Indian use of the Pajarito Plateau, knowledge of which is still actively preserved in the living memory of modern Pueblo neighbors and other nearby tribes. The Ancestral Pueblo remains are themselves of such cultural richness and significance that in the early 1900s the lands now occupied by LANL were included in the then-proposed "Pajarito Park," which was eventually scaled back to the present-day Bandelier National Monument. The other archaeological sites at LANL represent the remains of homes, wagon roads, trails, trash scatters, fences, and fields of early 20th century Hispanic and Anglo homesteaders. In addition, there are hundreds of historic buildings and structures that represent locations where significant research and development activities took place, beginning with the Manhattan Project in 1943 (LANL 2006c:1).

3.2.7.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records (DOE 1999b:3-160).

General Site Description

As of fiscal year 2009, 1,745 prehistoric cultural resource sites have been recorded on LANL, 1,642 of which are eligible or potentially eligible for listing on the NRHP (LANL 2011b:3-29). Nearly 80 percent of the resources are Ancestral Pueblo and date from the 13th, 14th, and 15th centuries. Most of the sites are found in the pinyon-juniper vegetation zone, with close to 70 percent located between 5,800 and 7,100 feet (1,800 and 2,200 meters) in elevation. Over 60 percent of all cultural resources are found on mesa tops (LANL 2011d:1-5).

Proposed Facility Locations

The proposed capabilities would be installed in the existing PF-4 in TA-55. A rock shelter in TA-55 has been identified as eligible or potentially eligible for listing on the NRHP (DOE 2011g:3-44).

3.2.7.2 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 (DOE 1999b:3-161).

General Site Description

LANL has identified 759 historic properties as of fiscal year 2009; 617 of these are Manhattan Project and Early Cold War period buildings. LANL has recorded 142 historic sites, some of which are experimental areas and artifacts dating from the Manhattan Project and Early Cold War periods. The majority of these sites (118) are structures or artifact scatters associated with the Early Historic Pajarito Plateau or Homestead periods; 99 are eligible for listing on the NRHP (LANL 2011b:3-29, 3-30).

Proposed Facility Locations

The proposed capabilities would be installed in the existing PF-4 in TA-55. While PF-4 is not eligible, an historic structure in TA-55 has been identified as eligible or potentially eligible for listing on the NRHP (DOE 2011g:3-44; LANL 2001).

3.2.7.3 American Indian Resources

American Indian resources are sites, areas, and materials important to American Indians for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various American Indian groups. Of primary concern are concepts of sacred space that create the potential for land use conflicts (DOE 1999b:3-162).

General Site Description

LANL contains ancestral villages, shrines, petroglyphs (carvings or line drawings on rocks), sacred springs, trails, and traditional use areas that could be identified by Pueblo and Hispanic communities as traditional cultural properties. In addition to physical cultural entities, concern has been expressed that "spiritual," "unseen," "undocumentable," or "beingness" aspects may be present at LANL that are an important part of American Indian culture (DOE 2011g:3-45).

LANL completed its long-term monitoring program in 2006 to assess the impact of LANL mission activities on cultural resources at the ancestral pueblo of Nake'muu as part of the *Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility Mitigation Action Plan*. Nake'muu is the only pueblo at LANL with standing walls. The site was occupied from around AD 1200 to 1325 and contains 55 rooms with walls standing up to 6 feet (1.8 meters) high. The site is revisited annually; in 2008, the site experienced an unusually high percentage of new displaced masonry blocks. LANL is in the process of evaluating possible mitigation efforts (LANL 2011b:3-31).

During fiscal year 2009, LANL continued to assist DOE/NNSA in implementing the *Traditional Cultural Properties Comprehensive Plan*. This included informal meetings with the Pueblos of San Ildefonso and Santa Clara. A Memorandum of Agreement was completed and signed (LANL 2011b:3-31).

LANL continued the Land Conveyance and Transfer Project in 2010. DOE/NNSA is in the process of conveying and transferring approximately 2,000 acres (809 hectares) of DOE lands to Los Alamos County and to the Bureau of Indian Affairs to be held in trust for the Pueblo de San Ildefonso. Thirty-nine archaeological sites were excavated during the 2002 to 2005 field seasons, with more than 200,000 artifacts and 2,000 samples collected. During 2010, the artifacts and records from the Land Conveyance and Transfer Project were transferred for curation to the Museum of Indian Arts and Culture in Santa Fe, New Mexico. Data collected from these sites provide new insights into past activities on the Pajarito Plateau from 5000 BC to AD 1943 (LANL 2011d:2-31). This work was conducted under a Programmatic Agreement among DOE/NNSA, the Advisory Council on Historic Preservation, the New Mexico SHPO, and the Incorporated County of Los Alamos concerning the conveyance of certain parcels of land to the county for economic development (LANL 2011b:3-31).

During 2010, LANL continued to monitor 18 archeological and 2 traditional cultural property fences in support of the *Mitigation Action Plan for the Special Environmental Analysis for the Cerro Grande Rehabilitation Project* (LANL 2011b:3-31).

Proposed Facility Locations

There are no identified American Indian resources in TA-55 (DOE 2011g:3-44).

3.2.7.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age (DOE 1999b:3-162).

General Site Description

A single paleontological artifact was discovered at a site formerly within LANL boundaries that has since been conveyed to Los Alamos County; however, in general, the near-surface stratigraphy is not conducive to preserving plant and animal remains. The near-surface materials at LANL are volcanic ash and pumice that were extremely hot when deposited; most carbon-based materials (such as bones or plant remains) would likely have been vaporized or burned if present (DOE 2011g:3-45).

Proposed Facility Locations

No paleontological resources have been identified in TA-55 (DOE 2011g:3-45).

3.2.8 Socioeconomics

Statistics for the local economy, population, and housing are presented for the ROI, a four-county area in New Mexico made up of Los Alamos, Santa Fe, Sandoval, and Rio Arriba Counties. In 2010, there were 13,474 people employed at LANL. The majority of all LANL employees reside in this four-county area. It is estimated that approximately half of the LANL workforce resides in Los Alamos County (DOE 2011g:3-46). The total direct employment at LANL accounts for approximately 8.9 percent of the employment in the ROI.

Indirect employment generated from LANL operations has been calculated using a weighted average of RIMS II direct effect employment multipliers from the U.S. Bureau of Economic Analysis for select industries that most accurately reflect the major activities at the site. The detailed industries included in the RIMS II models that were used to develop the LANL site-specific multiplier include scientific research and development services; environmental and other technical consulting services; facilities support services; investigation and security services; and construction. This method resulted in an estimated LANL direct-effect operations employment multiplier of 2. Therefore, the direct employment of 13,474 would generate indirect employment of 13,649 within the ROI, resulting in a total employment of 27,123, or 17.9 percent of the employment in the ROI.

3.2.8.1 Regional Economic Characteristics

Between 2000 and 2011, the civilian labor force of the ROI increased at an average annual rate of 1.1 percent, to 162,796. At the same time, employment in the ROI increased at an average annual rate of 0.9 percent, resulting in a 3.7 percentage point increase in the unemployment rate. Unemployment in the ROI was 7.8 percent in 2011, up from the 2000 level of 4.1 percent. New Mexico experienced similar trends in unemployment rates, increasing 2.7 percentage points over the 12-year period (BLS 2012). **Figure 3–14** illustrates the change in unemployment rates in the ROI and New Mexico from 2000 through 2011.

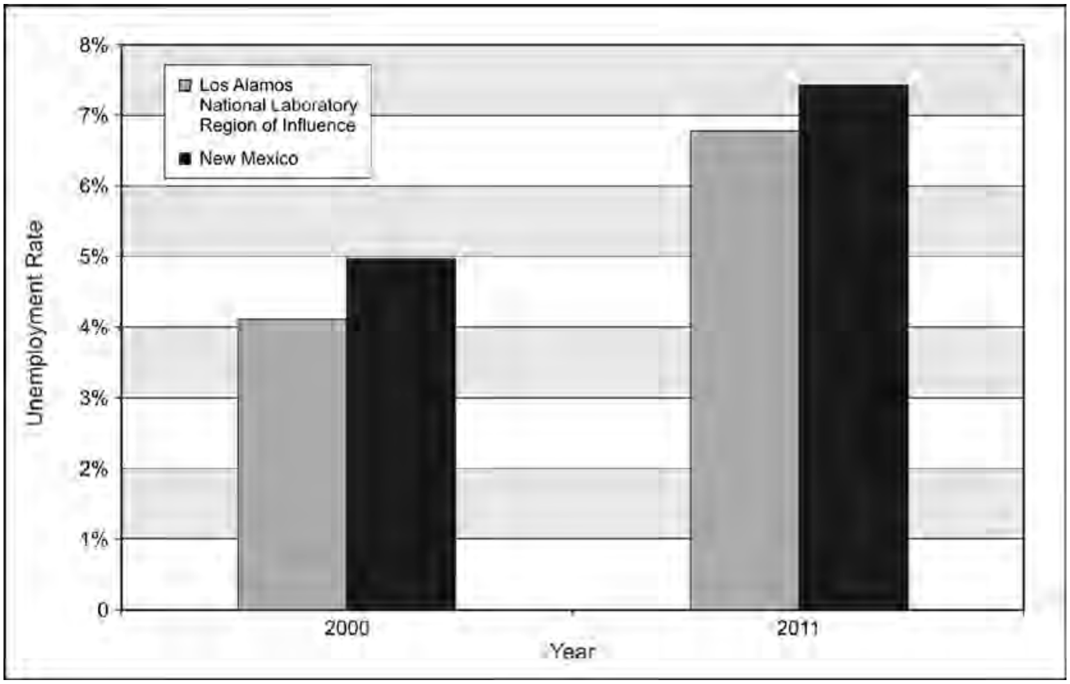

Figure 3–14 Unemployment Rates for the Los Alamos National Laboratory Region of Influence and New Mexico from 2000 through 2011

From 2000 to 2009, the average real per capita income of the ROI increased by approximately 12.7 percent in 2009 dollars, to $40,593. New Mexico experienced a larger increase than in the ROI, increasing 17.4 percent to $33,267 over the same time period. Over the 10-year period, real per capita income in the ROI peaked in 2005 at $40,831. Real per capita income in New Mexico peaked in 2008 at $33,489 (BEA 2012a). **Table 3–38** presents the per capita incomes of the ROI and New Mexico.

Table 3–38 Per Capita Income of the LANL Region of Influence and New Mexico in 2000 and 2009

	LANL Region of Influence		*New Mexico*	
Year	*Nominal*	*Real* [a]	*Nominal*	*Real* [a]
2000	$28,923	$36,033	$22,751	$28,345
2009	$40,593	$40,593	$33,267	$33,267

LANL = Los Alamos National Laboratory.

[a] Real per capita income adjusted to 2009 dollars using the Consumer Price Index for All Urban Consumers U.S. City Average.

Source: BEA 2012a.

In 2009, the government was the largest employer in the ROI, at approximately 21 percent of total employment. Professional scientific and technical services was the next leading industry at approximately 13 percent of employment, followed by retail trade at approximately 10 percent and healthcare and social assistance at approximately 9 percent. Similar employment distributions were seen in New Mexico, where the leading employment sectors were also government, healthcare and social assistance and retail trade at approximately 29 percent, 11 percent, and 10 percent, respectively (BEA 2012b). The major employment sectors in the ROI and New Mexico are presented in **Figure 3–15**.

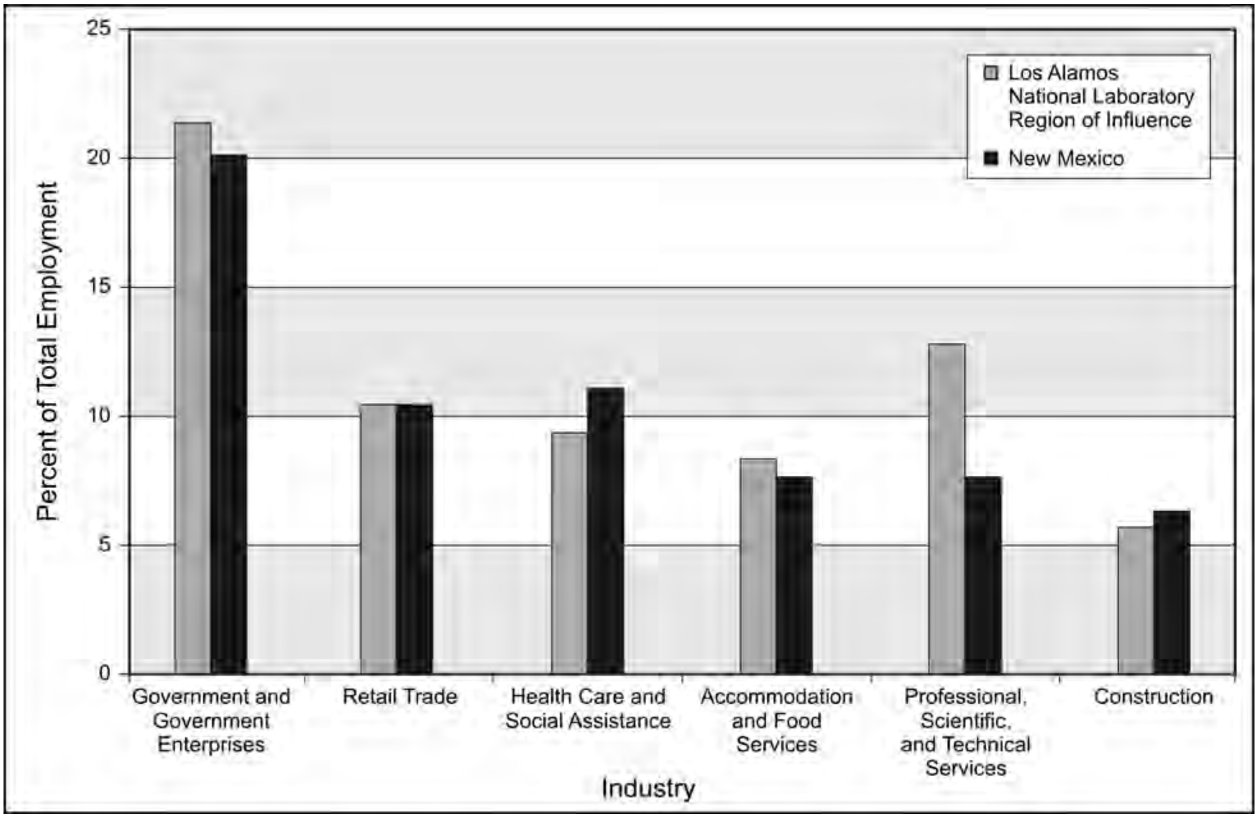

Figure 3–15 Major Employment Sector Distribution for the Los Alamos National Laboratory Region of Influence and New Mexico in 2009

3.2.8.2 Population and Housing

In 2010, the population in the ROI was estimated to be 333,927 (Census 2011a). From 2000 to 2010, the total population in the ROI increased at an average annual rate of approximately 1.8 percent, which was higher than the growth rate in New Mexico. Over the same time period, the total population of New Mexico increased at an average annual rate of approximately 1.2 percent, to 2,059,179 people. The populations of the ROI and New Mexico are shown in **Table 3–39**.

Table 3–39 Total Population of the LANL Region of Influence and New Mexico in 2000 and 2010

Year	*LANL Region of Influence*	*New Mexico*
2000	279,368	1,819,017
2010	333,927	2,059,179

Source: Census 2011a.

From 2000 to 2010, the number of housing units in the ROI increased at an average annual rate of 2.5 percent, to 151,546 units (Census 2010, 2011b). The number of housing units in New Mexico increased at average annual rate of approximately 1.4 percent, resulting in a total number of housing units of 901,388. **Table 3–40** shows the number of housing units in the ROI and New Mexico. The average homeowner vacancy rate for the counties that make up the ROI was 2.2 percent in 2010, slightly higher than the statewide rate for New Mexico of 2 percent. The average renter vacancy rate for the ROI in 2010 was 8.5 percent, compared with the statewide renter vacancy rate of 8.2 percent for New Mexico (Census 2011c, 2011d).

Table 3–40 Total Housing Units in the LANL Region of Influence and New Mexico in 2000 and 2010

Year	*LANL Region of Influence*	*New Mexico*
2000	118,520	780,579
2010	151,546	901,388

Source: Census 2010, 2011b.

3.2.8.3 Local Transportation

Motor vehicles are the primary means of transportation to LANL. Northern New Mexico is bisected by I–25 in a generally northeast–southwest direction. This interstate highway connects Santa Fe with Albuquerque. Regional transportation routes connecting LANL with Albuquerque and Santa Fe are I–25 to US 84/285 to NM 502; with Española, SR-30 to SR- 502; and with Jemez Springs and western communities, SR-4.

Only two major roads, SR-502 and SR-4, access Los Alamos County. Los Alamos County traffic volume on these two segments of highway is primarily associated with LANL activities.

Most commuter traffic originates from Los Alamos County or east of Los Alamos County (Rio Grande Valley and Santa Fe) as a result of the large number of LANL employees that live in these areas. A small number of LANL employees commute to LANL from the west along SR-4.

Workers access LANL using both public transportation and privately owned vehicles. The New Mexico Park and Ride regional bus service delivers 300 riders per day to the site, and Atomic City Transit also serves LANL. Additionally, car/vanpool programs are operated by the State of New Mexico, private companies, and by individuals. The number of workers using privately owned vehicles and car/van pools is 11,750 (DOE 2011g:3-67).

The ability of roadways to function is measured in terms of LOS, which is determined based on the peak hour traffic (see Section 3.1.8). Existing average annual daily traffic and LOS classifications of the public roadways in the vicinity of LANL are provided in **Table 3–41**.

Table 3–41 Existing Annual Average Daily Traffic and Levels of Service of Roadways in the Vicinity of Los Alamos National Laboratory

Location	*Road Type and Number of Lanes*	*AADT per Year (2009)*	*Percent Trucks*	*Existing LOS*
SR-4 at Los Alamos County Line to SR-501	Minor Arterial/Two Lanes	734	9	A
SR-4 at Bandelier Park Entrance	Minor Arterial/Two Lanes	681	7	A
SR-4 at Junction of Pajarito Road – White Rock	Minor Arterial/Two Lanes	9,302	9	D
SR-4 at Jemez Road	Minor Arterial/Two Lanes	9,358	12	D
SR-501 at Junction of SR-4 and Diamond Drive	Minor Arterial/Two Lanes	11,848	11	D
SR-501 at Junction of Diamond Drive	Primary Arterial/Four Lanes	21,211	8	C
SR-501 at SR-502	Primary Arterial/Four Lanes – Divided	17,807	8	C
SR-502 at Oppenheimer Street	Primary Arterial/Four Lanes – Divided	12,817	6	C
SR-502 at Los Alamos/Santa Fe County Line	Primary Arterial/Four Lanes	12,256	9	A

AADT = annual average daily traffic; LOS = Level of Service; SR = New Mexico State Route.
Source: Valencia 2010.

3.2.9 Infrastructure

Site infrastructure characteristics are summarized in **Table 3–42**. Each infrastructure characteristic is further discussed in the following paragraphs.

Table 3–42 Los Alamos National Laboratory Sitewide Infrastructure Characteristics

Resource	*Usage* [a]	*Site Capacity*	*Available Capacity*
Transportation			
Roads (miles)	80 [b]	Not applicable	Not applicable
Railroads (miles)	0	Not applicable	Not applicable
Electricity (megawatt-hours per year)	LANL 724,000 [c] Other 150,000	1,226,000 [d]	352,000
Peak load demand (megawatts)	LANL 127 Other 23	140 [c]	Exceeds available capacity
Fuel			
Natural gas (million cubic feet per year)	LANL 1,255 [c] Other 1,018	8,070 [d]	5,797
Water (million gallons per year)	LANL 428 [c]	LANL 542 [e]	LANL 114

LANL = Los Alamos National Laboratory.

[a] Usage values for electricity, fuel and water are shown for fiscal year 2010 or the projected levels of usage included in the 2008 *LANL SWEIS* (DOE 2008f) adjusted for decisions made in the associated Records of Decision, whichever is higher. Other usage is shown when capacity is shared by all Los Alamos County users, including LANL.

[b] Includes paved roads and paved parking areas only.

[c] Usage numbers include requirements for operating the Modified Chemistry and Metallurgy Research Building Replacement at LANL as described in the *Final Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EIS-0350-S1).

[d] Capacity values are for the entire service area, which includes LANL and other Los Alamos County users.

[e] Equivalent to DOE's leased water rights.

Note: To convert miles to kilometers, multiply by 1.6093; cubic feet to cubic meters, by 0.028317; gallons to liters, by 3.7854. A decatherm is equivalent to 1,000 cubic feet.
Values may be rounded.
Source: DOE 2011g:Tables 3-3, 4-17.

Transportation – About 80 miles (130 kilometers) of paved roads and parking surface have been developed at LANL (see Table 3–42). There is no railway service connection at the site. Local and linking regional roadway systems are discussed in Section 3.2.8.3.

Electricity – Electrical service to LANL is supplied through a cooperative arrangement with Los Alamos County, known as the Los Alamos power pool, which was established in 1985. Electric power is supplied to the pool through two existing regional 115-kilovolt electric power lines. The first line (the Norton-Los Alamos line) is owned by DOE and originates from the Norton substation east of White Rock; the second line (the Reeves Line) is owned by the Public Service Company of New Mexico and originates from the Bernalillo-Algodones Substation south of LANL. Both substations are owned by the Public Service Company of New Mexico (DOE 2008f).

Import capacity is now limited only by the physical capability (thermal rating) of the transmission lines, that is, to approximately 110 to 120 megawatts supplied from a number of hydroelectric, coal, and natural gas power generators throughout the western United States (LANL 2011b). In addition, renewable energy sources such as wind farms and solar plantations are providing a small (about 5 percent) but growing percentage of Public Service Company of New Mexico's total power portfolio (DOE 2008f).

In April 2011, Los Alamos County completed construction of the Abiquiu Low-Flow Turbine Hydropower Project. As a result, the low-flow turbine increased energy generation at the Abiquiu facility from 13.8 megawatts to 16.8 megawatts and currently provides additional power to Los Alamos County, including LANL (DOE 2011j).

Within LANL, NNSA operates a natural gas-fired steam and electrical power generating plant at TA-3 (TA-3 Co-Generation Complex or Power Plant), which is capable of generating 27 megawatts from the combustion turbine generator, and up to 10 megawatts from two steam-driven turbine generators, for a total of 37 megawatts, all shared by the power pool. However, the two steam-driven turbine generators are currently unavailable and have not been used for several years. A third steam-driven turbine generator is also out of service due to a condenser failure (DOE 2011g).

The DOE-maintained electric distribution system at LANL consists of various low-voltage transformers at LANL facilities and approximately 34 miles (55 kilometers) of 13.8-kilovolt distribution lines. It also consists of two older power distribution substations, the Eastern Technical Area Substation and the TA-3 Substation, and a new substation built in 2002, the Western Technical Area Substation. This 115-kilovolt (13.8-kilovolt distribution) substation has a main transformer rated at 56 megavolt-amperes or about 45 megawatts. The new substation provides redundant capacity for LANL and the Los Alamos townsite in the event of an outage at either of LANL's two older substations (DOE 2008f).

Electric power availability from the existing transmission system of the power pool is conservatively estimated at 990,000 megawatt-hours, including recent upgrades to the Abiquiu Hydroelectric Facility. The additional 27 megawatts available from LANL via the combustion turbine generator at the TA-3 Co-Generation Complex give the power pool a total electric energy availability of 1,226,000 megawatt-hours (DOE 2011g). This does not include the megawatts from the unavailable steam-driven turbine generators.

In 2010, the total peak load was 69.23 megawatts for LANL and 13.2 megawatts for the rest of the power pool users. A total of 425,808 megawatt-hours of electricity were used at LANL in 2010 (LANL 2012b). Other Los Alamos County users consumed an estimated 150,000 megawatt-hours for a power pool total electric energy consumption of 575,808 megawatt-hours. An additional usage of 161,000 megawatt-hours per year have been added to LANL's historical usage for the purposes of this analysis to reflect the planned operation of the Modified Chemistry and Metallurgy Research Building Replacement at LANL as described in the *CMRR-NF SEIS* (DOE 2011g). Peak demand related to the operation of the Modified Chemistry and Metallurgy Research Building Replacement is estimated at 26 megawatts, including requirements of RLUOB, which would exceed the site's available capacity if all operations were to experience peak demand at the same time (DOE 2011g:4-35).

The need for upgrades and the limitations of the electric transmission lines that deliver electric power to the Los Alamos power pool was documented in the 2008 *LANL SWEIS* (DOE 2008f). LANL has completed several construction projects to expand and enhance existing power capabilities. Additional upgrades are being considered, including construction of a portion of the line from the Norton substation to the Southern Technical Area substation. The existing underground ducts need upgrading to fully realize the capabilities of the Western Technical Area substation and the upgraded Eastern Technical Area substation. Redundant feeders need to be added to critical facilities, and the aging TA-3 substation needs upgrading to complete the 13.8-kilovolt distribution and 115-kilovolt transmission systems. The current CMR Building and RLUOB are served by the TA-3 substation (DOE 2011g:3-9).

Fuel – Natural gas is the primary heating fuel used at LANL and in Los Alamos County. The natural gas system includes a high-pressure main and distribution system to Los Alamos County and pressure-reducing stations at LANL buildings. LANL and Los Alamos County both have delivery points where gas is monitored and measured. In August 1999, DOE sold the 130-mile-long (210-kilometer-long) main gas supply line and associated metering stations to the Public Service Company of New Mexico. This gas pipeline traverses the area from Kutz Canyon Processing Plant south of Bloomfield, New Mexico, to Los Alamos County. Approximately 4 miles (6.4 kilometers) of the gas pipeline are within LANL boundaries. Natural gas is distributed to the point of use via some 42 miles (68 kilometers) of distribution piping (DOE 2008f).

Natural gas used by LANL is currently used for heating (both steam and hot air), with the TA-3 Co-Generation Complex being the principal user of natural gas at the site. About 200 other smaller boilers are maintained at LANL, which are primarily natural gas fired (DOE 2008f). Relatively small quantities of fuel oil are stored at LANL as a backup fuel source for emergency generators.

Fiscal year 2010 natural gas consumption for LANL and the Los Alamos service area was 1,104 million cubic feet (31 million cubic meters) and 1,018 million cubic feet (29 million cubic meters), respectively. An additional usage of 58 million cubic feet (1.6 million cubic meters) per year has been added to LANL's historical usage for the purposes of this analysis to reflect the planned operation of the Modified Chemistry and Metallurgy Research Building Replacement at LANL as described in the *CMRR-NF SEIS* (DOE 2011g).

Natural gas usage at TA-55 is limited to boilers used for heating. TA-55 is estimated to use approximately 45 million cubic feet (1.3 million cubic meters) of natural gas annually (DOE 2008f).

Water – The Los Alamos County water production system consists of 14 deep wells, 153 miles (246 kilometers) of main distribution lines, pump stations, and storage tanks. The system supplies potable water to all of Los Alamos County, LANL, and Bandelier National Monument. The deep wells are located in three well fields (Guaje, Otowi, and Pajarito). Water is pumped into production lines, and booster pump stations lift this water to reservoir tanks for distribution. Prior to distribution, the entire water supply is disinfected (DOE 2008f).

The system was originally owned and operated by DOE. On September 8, 1998, DOE transferred operation of the system to Los Alamos County under a lease agreement. Under the agreement, DOE retained responsibility for operating the distribution system within LANL boundaries, whereas Los Alamos County assumed full responsibility for ensuring compliance with Federal and state drinking water regulations. DOE retained the right to withdraw an equivalent of about 5,541 acre-feet or 1,806 million gallons (6,840 million liters) of water per year from the main aquifer and its right to purchase a water allocation of 1,200 acre-feet or 391 million gallons (1,480 million liters) per year from the San Juan-Chama Transmountain Diversion Project (DOE 2008f).

On September 5, 2001, DOE transferred ownership of the water production system to Los Alamos County, along with 70 percent (3,879 acre-feet or 1,264 million gallons [4,785 million liters] annually) of the DOE water rights. DOE leased the remaining 30 percent (1,662 acre-feet or 542 million gallons [2,050 million liters] annually) of the water rights to Los Alamos County for 10 years, with the option to renew the lease for four additional 10-year terms. LANL is now considered a Los Alamos County water customer, and DOE is billed and pays for the water LANL uses. The current 10-year agreement (water service contract) with Los Alamos County includes an escalating projection of future LANL water consumption (DOE 2008f). While the contract does not specify a supply limit to LANL, the water right owned by DOE and leased to Los Alamos County (that is, 1,662 acre-feet or 542 million gallons [2,050 million liters] per year) is a target ceiling quantity under which total water consumption at LANL should remain. The distribution system serving LANL facilities consists of a series of reservoir storage tanks, pipelines, and fire pumps. The LANL distribution system is gravity-fed with pumps for high-demand fire situations at limited locations (DOE 2008f).

Los Alamos County has signed a contract with the Bureau of Reclamation for accessing up to 391 million gallons (1,480 million liters) of water per year from the San Juan-Chama Transmountain Diversion Project. The water is currently inaccessible while the project completes engineering studies that will lead directly to the environmental clearance, enabling the county to utilize its entire annual allocation of the San Juan-Chama water supply in the most economical and beneficial way (LACBPU 2010). Use of the San Juan-Chama water, along with conservation, is integral to Los Alamos County's Long-Range Water Supply Plan (DOE 2008f).

Water use for LANL and other Los Alamos County users is shown in Table 3–42. In 2010, LANL operations consumed about 412 million gallons (1,560 million liters) of water. An additional usage of 16 million gallons (61 million liters) per year have been added to LANL's historical usage for the purposes of this analysis to reflect the planned operation of the Modified Chemistry and Metallurgy Research Building Replacement at LANL as described in the *CMRR-NF SEIS* (DOE 2011g). In recent years, total and consumptive water use for both LANL and other Los Alamos County users has increased. Water use at LANL has increased by about 10 percent from 2007 to 2010, whereas from 1999 to 2005, water use at the site decreased (LANL 2010c).

NNSA continues to maintain the onsite distribution system by replacing portions of the more-than-50-year-old system as problems arise. The LANL contractor is also in the process of installing additional water meters and a Supervisory Control and Data Acquisition and Equipment Surveillance System on the water distribution system to keep track of water usage and to determine the specific water use for various applications. Data are being accumulated to establish a baseline for conserving water. NNSA has instituted a number of conservation and water-reuse projects, including improvements to the Sanitary Effluent Recycling Facility to reduce potable water usage (DOE 2008f).

3.2.10 Waste Management

A wide range of waste types are generated through activities at LANL that are related to research, production, maintenance, construction, decontamination, decommissioning, demolition, and environmental restoration. These waste types include wastewaters (sanitary liquid waste, high-explosives-contaminated liquid waste, and industrial effluent); solid waste, including routine office-type (sanitary solid) waste and construction and demolition debris; and radioactive and chemical wastes. Management of these wastes is addressed in detail in the 2008 *LANL SWEIS* (DOE 2008f).

Wastes managed at LANL are regulated in accordance with a variety of Federal and state regulations, applicable to specific waste types and their radiological and nonradiological content. Requirements for waste management activities are determined and documented by institutional requirements. These institutional requirements provide details on proper management of all process wastes and contaminated environmental media. The waste management operation tracks waste-generating processes; waste quantities; chemical and physical characteristics; regulatory status; compliance with applicable treatment and disposal standards; and final disposition (LANL 2011b:2-25–2-26).

Operations are conducted in accordance with the LANL waste minimization and pollution prevention program. The preferred method for minimizing waste is source reduction, including materials substitution and process improvement. Recycling and reuse practices are also implemented, along with volume reduction and treatment options. Progress in pollution prevention initiatives at LANL is measured annually against metrics approved by DOE.

In 2004, LANL began development and implementation of an environmental management system to comply with the then-current DOE Order 450.1. DOE Order 450.1 defined an environmental management system as a continuous cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental missions and goals. The environmental management system at LANL was third-party-certified to the International Organization for Standardization (ISO) 14001:2004 standard in April 2006, and recertified in April 2009, by the National Science Foundation's International Strategic Registrations (LANL 2011b:3-9).

Research, production, maintenance, and construction activities at LANL, as well as the environmental restoration activities, generate radioactive, chemical, and other wastes. The volumes of all types of waste produced at LANL are projected to be large over the next several years because of the need for site remediation pursuant to the 2005 Consent Order and from decontamination, decommissioning, and demolition (DD&D) of facilities, in addition to routine operations. Actual waste volumes from remediation may be smaller than projected, depending on regulatory decisions and because of the employment of possible waste volume reduction and sorting techniques.

3.2.10.1 Waste Generation

Table 3–43 compares 2009 solid waste generation rates by waste type for the TA-55 Plutonium Complex and sitewide LANL. Note that solid sanitary wastes from operations are not tracked on a facility-specific basis, but only on a LANL sitewide basis. As shown in Table 3–43, sitewide 2009 generation rates for TRU waste, LLW, and MLLW were below the 5-year average. The amount of radioactive solid waste can vary significantly from year to year due to decontamination and decommissioning and environmental restoration activities. Waste minimization efforts have reduced waste generation rates for specific waste types as facility processes have been improved and nonhazardous product substitutions implemented (DOE 2008f:4-150). Waste generation rates for liquid LLW and liquid sanitary waste are not included in Table 3–43, but are discussed in the subsections that follow.

Table 3–43 Solid Waste Generation Rates at Los Alamos National Laboratory

	Los Alamos National Laboratory – Total		*TA-55 Plutonium Complex*	
Waste Type	*5-Year Average*	*2009*	*5-Year Average*	*2009*
TRU (cubic meters) [a]	206.4	112.6	109.2	96.3
LLW (cubic meters)	4,977	3,771.9	204.2	58.2
MLLW (cubic meters)	52.2	13.5	5.2	5.3
Hazardous (metric tons) [b]	1,376.2	1,722.9	5.1	9
Nonhazardous (metric tons) [c]	2,350	2,562	N/A	N/A

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; N/A = not available; TA = technical area; TRU = transuranic.

[a] Includes mixed TRU wastes.

[b] Hazardous waste includes all chemical wastes, and not necessarily only those chemicals that are regulated by the Resource Conservation and Recovery Act.

[c] Nonhazardous (sanitary) waste is measured for LANL only (no breakdown by area). The amount of sanitary waste shown includes construction and demolition debris, but it does not include the amount associated with diverted recyclable materials not disposed in a landfill.

Note: To convert metric tons to tons, multiply by 1.1023; cubic meters to cubic feet, multiply by 35.315.

Sources: LANL 2006a:3-9, 2-12, 2007c:2-11, 3-9, 2009a:2-11, 3-9, 2010d:3-9, A-32, 2011b:3-103-13, A-32.

Table 3–44 provides a summary and status of current and planned treatment, storage, and disposal facilities at LANL.

3.2.10.2 Transuranic and Mixed Transuranic Waste

TRU and mixed TRU wastes may be generated during research, development, and stockpile manufacturing and management activities. Waste forms include contaminated scrap and residues, plastics, lead gloves, glass, and personal protective equipment. TRU and mixed TRU wastes may also be generated through environmental restoration, legacy waste retrieval, offsite source recovery, and DD&D activities. TRU and mixed TRU wastes are characterized and certified prior to shipment to WIPP (DOE 2008f:4-153). LANL made its first TRU waste shipment to WIPP in March 1999 (LANL 2011b:A-27) and has completed 923 shipments of TRU and mixed TRU waste to WIPP as of January 2012 (WIPP 2012).

TRU wastes are generated almost exclusively in PF-4, the CMR Building, the RLWTF, and the Solid Radioactive and Chemical Waste Facility; and by the Environmental Programs. In 2009, mixed TRU wastes were generated at only two facilities—PF-4 and the Solid Radioactive and Chemical Waste Facility. The quantities of TRU and mixed TRU waste are combined into one waste category since they are both managed for disposal at WIPP. During 2009, 112.6 cubic meters (4,000 cubic feet) of TRU and mixed TRU waste was generated at LANL, with 96.3 cubic meters (3,400 cubic feet) being generated by operations at PF-4. DOE transported 520 cubic meters (18,000 cubic feet) of TRU wastes to WIPP from LANL, and 77 cubic meters (2,700 cubic feet) of newly generated TRU wastes (nonhazardous) were added to storage. In addition, 285 cubic meters (10,000 cubic feet) of mixed TRU wastes were shipped to WIPP, and approximately 38 cubic meters (1,300 cubic feet) of mixed TRU wastes were added to storage (LANL 2011b:2-28, 3-13, A-32). LANL utilizes several locations for the storage of TRU waste. Storage domes in TA-54 can store up to 76,800 55-gallon drums of TRU, hazardous, and mixed waste. Storage pads capable of storing 2,450 55-gallon drums and a storage building capable of storing 545 55-gallon drums are also located in TA-55. Combined these facilities could store up to 79,800 55-gallon drums of TRU waste.

3.2.10.3 Low-Level Radioactive Waste

LLW is generated at LANL when materials, equipment, and water are used in radiological control areas as part of work activities. When these contaminated items are no longer useable, they are removed from the area as LLW. Typical solid LLW streams include laboratory equipment, service and utility equipment, plastic bottles, disposable wipes, plastic sheeting and bags, paper, and electronic equipment (DOE 2008f:4-151). Environmental restoration and DD&D activities also generate LLW, primarily contaminated soil and debris.

LLW generated at LANL may be disposed of on site at Area G in TA-54 (a small amount of certain types of LLW) or shipped off site for disposal at the Nevada National Security Site or a commercial disposal facility (beginning about 2008, most LLW generated by LANL operations has been disposed of off site) (DOE 2011g:3-65). Approximately 1,415 cubic meters (50,000 cubic feet) were placed into disposal cells and shafts at Area G, with the remaining 2,400 cubic meters (83,000 cubic feet) generated in 2009 disposed of off site. No new disposal cells were constructed, and disposal operations in TA-54 did not expand (LANL 2011b:2-28).

Table 3–44 Waste Treatment, Storage, and Disposal Capabilities at Los Alamos National Laboratory

			Waste Type				
Facility Name	***Capacity***	***Status***	***Transuranic and Mixed Transuranic***	***Low-Level Radioactive***	***Mixed Low-Level Radioactive***	***Hazardous***	***Nonhazardous***
Treatment Facility							
Waste Characterization, Reduction, and Repackaging Facility	Not applicable to newly generated waste [a]	Operating	X				
Radioassay and Nondestructive Test Facility	Five shipments per week [b]	Operating	X				
Building 412 (Formerly called the Decontamination and Volume Reduction System)	Not applicable to newly generated waste [a]	Operating	X				
Transuranic waste drum preparation (TA-55 transuranic waste drum loading)	800 drums per year (55-gallon DOT Type 7A drums)	Operating	X				
Radioactive Liquid Waste Treatment Facility	TRU waste: 70,000 liters per year LLW: 4.0 million liters per year [c]	Operating	X	X	X		
Replacement Radioactive Liquid Waste Treatment Facility	TRU: 29,000 liters per year LLW: 5.0 million liters per year [d]	Design	X	X	X		
High-Explosive Waste Treatment Facility	TA-16 Open Burn: 9,070 kilograms per year; TA-36 + TA-39 Open Detonation: 6,800 kilograms per year	Operating				X	
Sanitary Wastewater System	Average actual: 400 million liters per year Design: 840 million liters per year	Operating					X
Sanitary Effluent Reclamation Facility	Current: 173 million liters per year After upgrade: 617 million liters per year	Operating					X
Los Alamos County Eco Station	Average: 940 tons per week	Operating					X
Storage Facility							
Transuranic, hazardous, chemical, mixed and tritiated waste storage domes at TA-54	76,800 55-gallon drum equivalents	Operating	X	X	X	X	
Outside drum storage pad at TA-55, 55-455 [e]	2,450 55-gallon drum equivalents	Operating	X				
Transuranic waste storage building, TA-55-0185	545 55-gallon drum equivalents	Operating	X				
Transuranic Waste Facility	Normal operations: 825 55-gallon drum equivalents with 2-high stacking Surge capacity: 1,240 drum equivalents with 3-high stacking [f]	Operating	X				

Facility Name	**Capacity**	**Status**	***Waste Type***				
			Transuranic and Mixed Transuranic	***Low-Level Radioactive***	***Mixed Low-Level Radioactive***	***Hazardous***	***Nonhazardous***
Disposal Facility							
Low-level radioactive waste disposal cells, shafts and trenches in Area G	In 2009, 1,415 cubic meters disposed of in Area G.	Operating		X			

DOT = Department of Transportation; LLW = low-level radioactive waste; TA = technical area; TRU = transuranic.

[a] WCCRF and Building 412 are used only for legacy TRU waste repackaging. LANL waste acceptance criteria (WAC) require that newly generated TRU waste meet the WIPP WAC. Hence all newly generated TRU waste will be packaged for shipment to WIPP by the waste generator and will not require use of WCCRF or Building 412.

[b] The number of drums of TRU waste per shipment is dependent on the weight and fissile loading.

[c] The current capacity is about 76 liters per minute (20 gallons per minute) for processing radioactive liquid waste. The facility is assumed to operate 6.5 hours per day, 135 operating days per year.

[d] The capacity would be equivalent to 27 batches per year of liquid radioactive waste, each batch containing about 1,140 liters (300 gallons).

[e] Total capacity under the LANL RCRA permit for all domes and pads. Original capacity expressed in number of gallons but converted to 55-gallon drum equivalents since this is the primary container for storage.

[f] Surge capacity allows for temporary storage of a large quantity of transuranic waste should the need arise.

Note: Waste Management capabilities at LANL are currently being transitioned from Area G in TA-55 to new locations at LANL (see Appendix B, Section B.2.2). To convert cubic meters to cubic feet, multiply by 35.315; to convert liters to gallons, multiply by 0.26417; to convert kilograms to pounds, multiply by 2.2046.

Source: LANL 2012a.

The principal facility for treating radioactive liquid waste at LANL is RLWTF, located in TA-50. RLWTF consists of the treatment facility, support buildings, and liquid and chemical storage tanks and receives liquid waste from various sites across LANL. Several upgrades to RLWTF have been implemented in recent years to upgrade the tank farm, install new ultrafiltration and reverse osmosis equipment, and install new nitrate reduction equipment. RLWTF has the capacity to treat up to 4 million liters (1.1 million gallons) per year of liquid LLW. RLWTF is slated for replacement with a new facility in accordance with the 2008 *LANL SWEIS* ROD; this new facility is being planned with an evaporation unit to eliminate liquid discharges into the environment.

3.2.10.4 Mixed Low-Level Radioactive Waste

Most operational MLLW is generated by stockpile stewardship and research and development programs. Typical waste streams include contaminated lead bricks and debris, spent chemical solutions, fluorescent light bulbs, copper solder joints, and used oil. Environmental restoration and DD&D activities also produce some MLLW. MLLW may be sent for treatment to a variety of permitted commercial facilities (located, for example, in Florida, Tennessee, Texas, Washington, and Utah) with subsequent disposal at the Nevada National Security Site in Nevada or a commercial facility such as the EnergySolutions facility in Utah. In 2009, 13.5 cubic feet (480 cubic feet) of MLLW was transported on site to TA-54 for temporary storage prior to disposition off site (LANL 2011b:2-28, 3-8).

3.2.10.5 Hazardous Waste

Hazardous and toxic wastes are those wastes defined as such pursuant to RCRA and the Toxic Substances Control Act, respectively. Typical hazardous waste streams include solvents, unused chemicals, acids and bases, solids such as barium-containing explosive materials, laboratory trash, and cleanup materials such as rags. Toxic wastes principally include waste materials containing asbestos or PCBs. Special wastes are designated under the New Mexico Solid Waste Regulations and include industrial waste, infectious waste, and petroleum-contaminated soil (DOE 2008f:4-156).

Construction and demolition debris consists primarily of asbestos and construction debris from DD&D projects, and may be disposed of in permitted solid waste landfills pursuant to Subtitle D of RCRA (DOE 2008f:H-61). This waste typically consists of a mixture of materials that would be difficult to separate and sort for recycle or beneficial reuse. In 2009, 1,724 metric tons (1,900 tons) of hazardous waste were generated at LANL. Only 9 metric tons (10 tons) were generated by operations at TA-55.

3.2.10.6 Nonhazardous Waste

The SWWS Plant in TA-46 has the capacity to treat up to 840 million liters (220 million gallons) per year of liquid sanitary waste. In 2009, the plant processed about 85.3 million gallons (323 million liters) of wastewater, all of which was pumped to TA-3 to be either recycled at the TA-3 power plant (as makeup water for the cooling towers), or discharged into Sandia Canyon via permitted Outfall Number 001 (LANL 2011b:3-5).

Sanitary sludge from the SWWS Plant is dried for a minimum of 90 days to reduce pathogens and then disposed of as special waste (as determined by the State of New Mexico) at an authorized, permitted landfill. The volume of sanitary sludge generated and disposed of by DOE is reported in the annual site environmental surveillance report (DOE 2008f:4-148).

Sanitary solid waste is excess material that is not radioactive or hazardous and can be disposed of in a permitted solid waste landfill. Routine sanitary waste consists mostly of food and food-contaminated waste and cardboard, plastic, glass, Styrofoam® packing material, and similar items. Nonroutine sanitary waste is typically derived from construction and demolition projects and includes materials such as concrete, asphalt, dirt, or brush that may be separated and sorted by material for recycle or beneficial reuse. LANL sanitary solid waste was disposed of at the former Los Alamos County Landfill, which no longer receives waste for disposal. The landfill site is located within LANL boundaries. Waste volumes delivered to the landfill varied considerably over the last decade, with a peak of more than 14,000 tons (12,700 metric tons) transferred to the landfill in 2000 due to removal of Cerro Grande Fire debris. A solid waste transfer station, the Los Alamos County Eco Station, has been constructed at the former landfill site. A landfill closure plan for the Los Alamos County Landfill was submitted to NMED in September 2005 (LANL 2011b:3-103-11). Solid waste received at the Los Alamos County Eco Station is transported off site for recycle or disposal, typically to the Rio Rancho and Valencia County solid waste facilities for final disposition.

Industrial effluent is discharged through NPDES-permitted outfalls across LANL. The number of outfalls has been reduced in recent years with an eventual goal of achieving zero liquid discharge from LANL operations. As of December 31, 2009, LANL had 15 permitted wastewater outfalls (14 industrial and 1 sanitary) regulated under NPDES Permit Number NM0028355. In 2009, however, flow was recorded at only 12 outfalls. In 2009, combined discharges totaled 500 million liters (133.3 million gallons). Of this total, 4.5 million liters (1.2 million gallons) were discharged from TA-55 (LANL 2011b:4-2, A-32). Section 3.2.3.1 includes a discussion of the NPDES permit and permitted effluent discharges from LANL.

3.2.11 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. The potentially affected area for LANL includes parts of eight counties throughout New Mexico that make up an area within a 50-mile (80-kilometer) radius of PF-4. To be consistent with the human health analysis, the population distributions of the potentially affected area are calculated using data at the block-group level of spatial resolution from the 2010 census, with the exception of Los Alamos County, where block level data from the 2010 census was used to more accurately represent populations in close proximity to the site (Census 2011f). The 2010 census data has been projected to the year 2020 using data from the 1990 census, 2000 census, and the 2010 census for each of the affected counties within a 50-mile (80-kilometer) radius of PF-4 (Census 1990, 2001, 2011f).

In accordance with CEQ guidance, meaningfully greater minority populations are identified where either the minority population of the affected area exceeds 50 percent, or 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 (CEQ 1997). Meaningfully greater is defined here as 20 percentage points above the population percentage in the general population. The average minority population percentage of New Mexico for the projected 2020 population is approximately 62.7 percent and the average minority population percentage of the counties surrounding LANL is approximately 61.6 percent. Comparatively, a meaningfully greater minority population percentage relative to the general population of the state and surrounding counties would exceed the 50 percent threshold defined by CEQ. Therefore, the lower threshold of 50 percent is used to identify areas with meaningfully greater minority populations surrounding LANL. In order to evaluate the potential impacts on populations in closer proximity to the proposed sites, additional radial distances of 5, 10, and 20 miles (8, 16, and 32 kilometers) are also analyzed. **Table 3–45** shows the composition of the ROI surrounding PF-4 at each of these radial distances.

The total projected population residing in the LANL ROI in 2020 would be approximately 447,541; 55.9 percent of which would be considered members of a minority population. Block-level spatial resolution was used in this analysis for Los Alamos County to allow identification of populations who reside adjacent to the LANL site boundary. Of the 611 blocks in Los Alamos County, 45 (7.4 percent) were identified as containing meaningfully greater minority populations. Finer spatial resolution would not provide any benefit in identifying populations at distances further from LANL. Therefore, block group level spatial resolution was used in the remainder of the 50-mile (80-kilometer) radius. Of the 259 block groups in the remainder of the potentially affected area, approximately 147 (57 percent) were identified as containing meaningfully greater minority populations.

Table 3–45 Projected Populations in the Potentially Affected Area Surrounding Los Alamos National Laboratory in 2020

	5 Miles		*10 miles*		*20 miles*		*50 miles*	
Population	*Population*	*Percent of Total*	*Population*	*Percent of Total*	*Population*	*Percent of Total*	*Population*	*Percent of Total*
Nonminority	8,619	69	13,493	67	21,883	36	197,224	44
Total Hispanic [b]	2,075	17	3,613	18	31,897	52	201,687	45
American Indian or Alaska Native [a]	185	1	1,043	5	5,475	9	27,801	6
Other Minority [a]	3,615	29	5,556	28	34,206	56	222,516	50
Total Minority [a]	3,800	31	6,599	33	39,681	64	250,317	56
Total Population	12,419	100	20,092	100	61,564	100	447,541	100
Low-Income	352	3	777	4	8,712	14	54,194	12

[a] Includes Hispanic persons.

[b] Includes all Hispanic persons regardless of race.

Note: To convert miles to kilometers, multiply by 1.609. Totals may not equal the sum of subcategories due to rounding. The potentially affected area comprises the area within a 50-mile (80-kilometer) radius of the site.

The areas within 5 miles (8 kilometers) of PF-4 contain the lowest concentration of minority populations. The overall composition of the ROI is predominantly nonminority within the first 10 miles (16 kilometers). The area within 20 miles (32 kilometers) contains the highest concentration of minority populations within the ROI. The percent of minority populations decreases slightly in the area within 50 miles (80 kilometers); however, the overall composition of minority populations remains high. Similar to the minority populations, the concentration of low-income populations is lowest within the first 5 miles (8 kilometers).

The Hispanic or Latino population is the largest minority population within each radial distance. **Figures 3–16** and **3–17** display the blocks and block groups identified as having meaningfully greater minority and low-income populations, respectively, surrounding PF-4.

The projected low-income population (those living below the poverty threshold) living within 50 miles (80 kilometers) of PF-4 in 2020 is estimated to be 54,194 people (12 percent). Meaningfully greater low-income populations are identified using the same methodology described for identification of minority populations. The 2010 census does not contain any data relative to income. The Census Bureau's ACS 5-year estimates are the only data set that publishes current data relative to income at the block group level of geography. Therefore, the 2006–2010 ACS 5-year estimates are used to identify low-income populations in the potentially affected area. These populations were then scaled up to be directly comparable to the projected 2020 potentially affected population. The 2006–2010 ACS 5-year estimates show the average low-income population percentage of New Mexico is 18.4 percent and the average low-income population of the counties surrounding PF-4 is 15.1 percent (Census 2011e). Comparatively, a meaningfully greater low-income population percentage using these statistics would be 35.1 percent. Therefore, the lower threshold of 35.1 percent is used to identify areas with meaningfully greater low-income populations surrounding LANL (PF-4). Block-level spatial resolution is unavailable from the ACS 5-year estimates. Therefore, meaningfully greater low-income populations are identified using block group level spatial resolution. Of the 276 block groups that surround PF-4, 14 (5.1 percent) contain meaningfully greater low-income populations.

Figures 3–18 and **3–19** show cumulative total, minority, and low-income populations projected to live within the potentially affected area in 2020 as a function of distance from PF-4. Values along the vertical axis show populations residing within a given distance from these facilities.

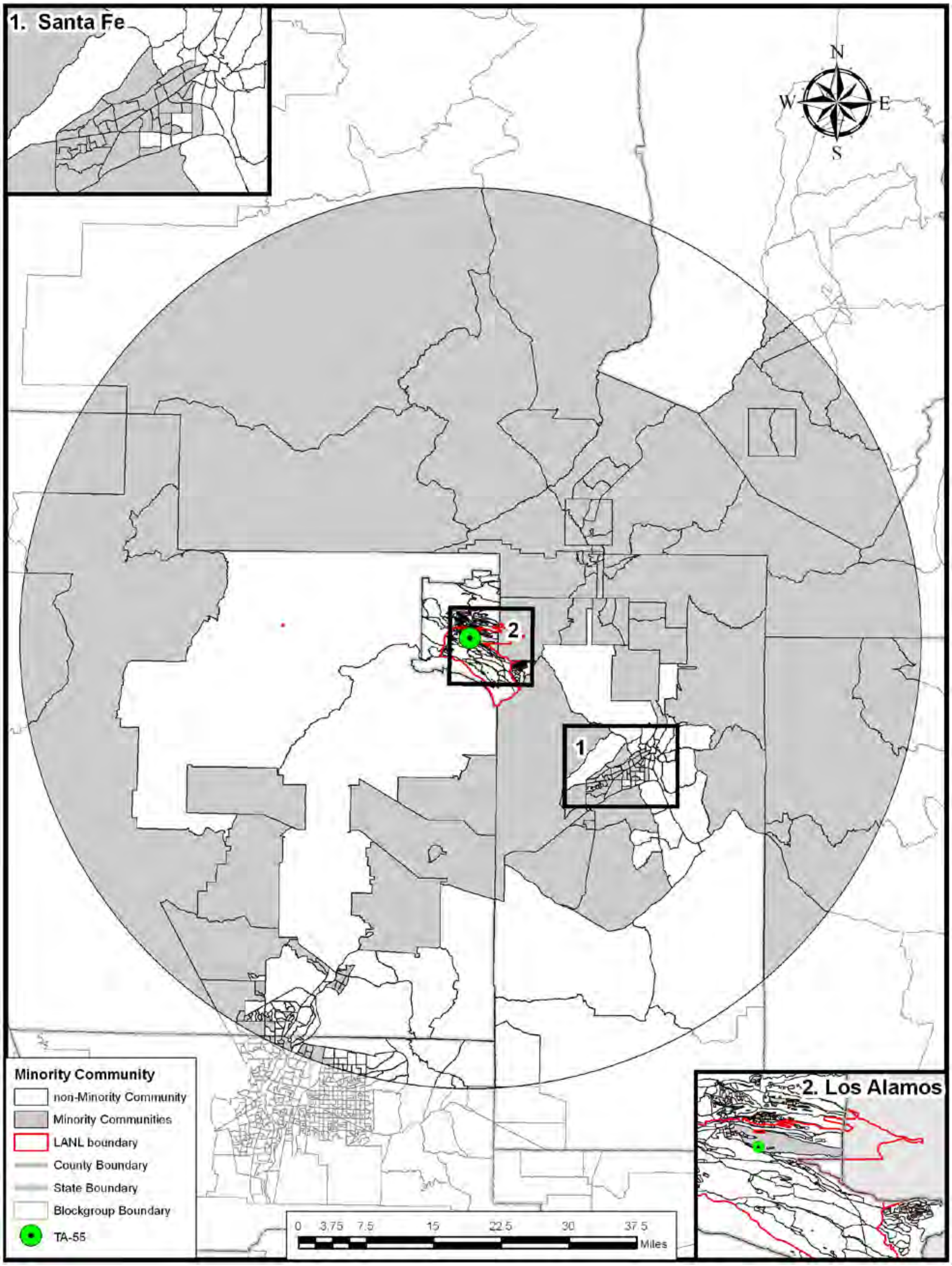

Figure 3–16 Meaningfully Greater Minority Populations Surrounding Los Alamos National Laboratory

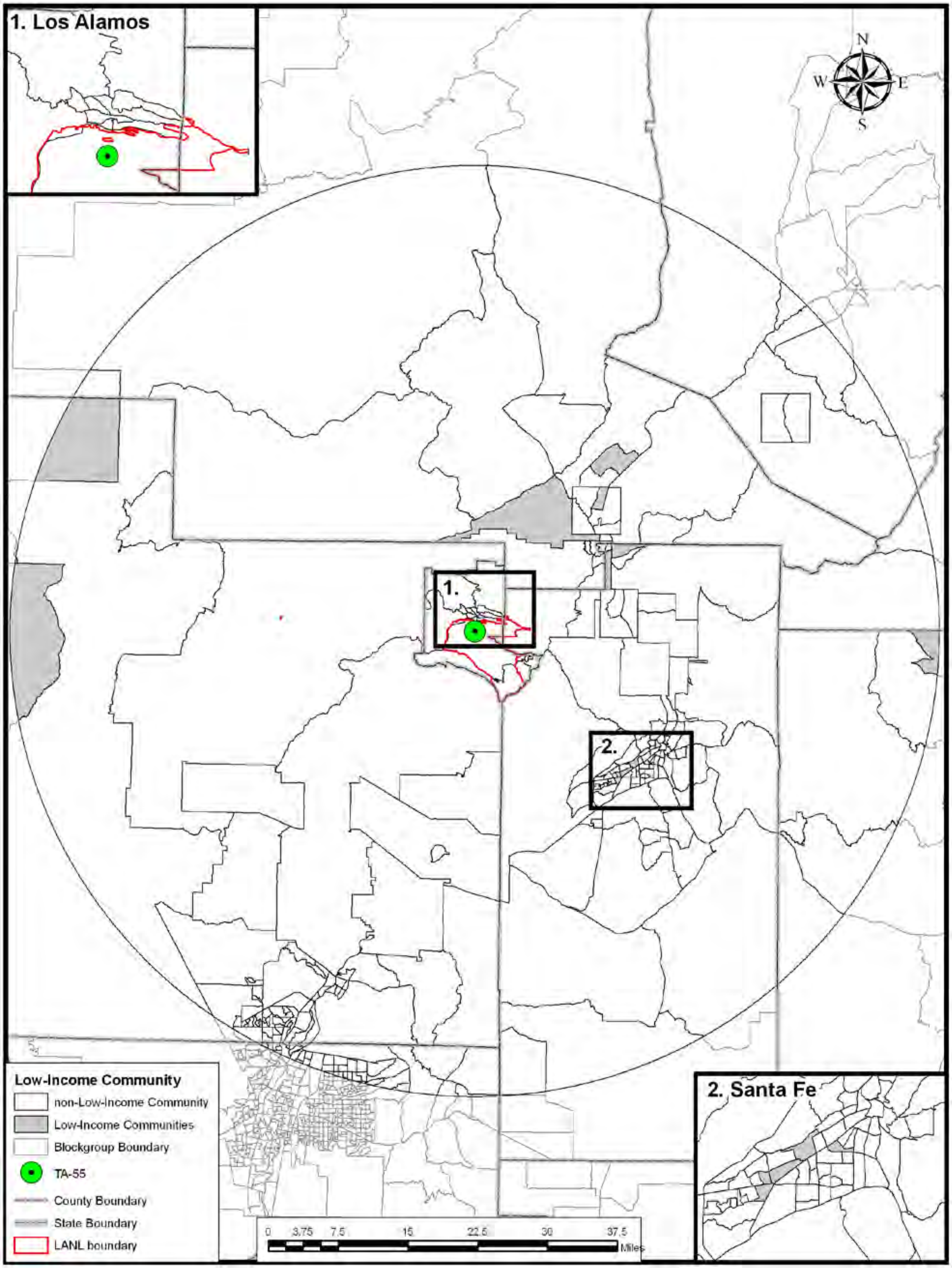

Figure 3–17 Meaningfully Greater Low-Income Populations Surrounding Los Alamos National Laboratory

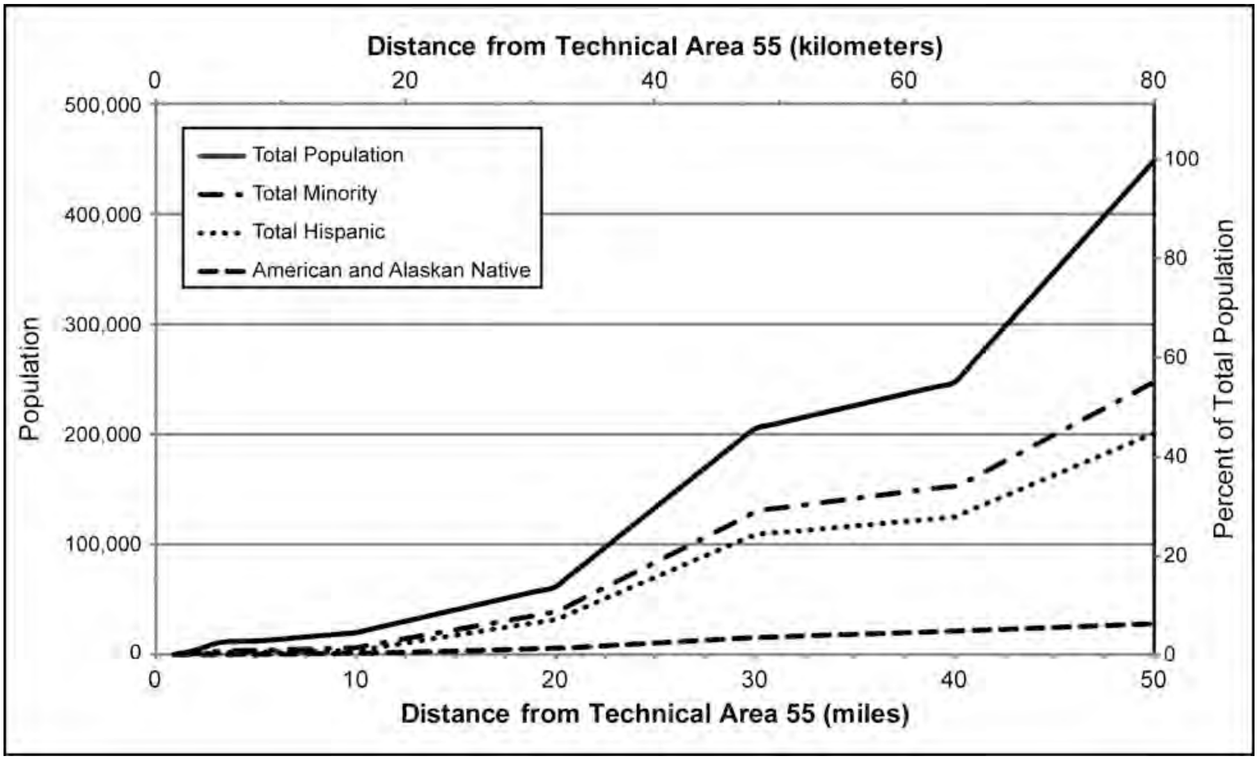

Figure 3–18 Cumulative Minority Populations as a Function of Distance from Los Alamos National Laboratory

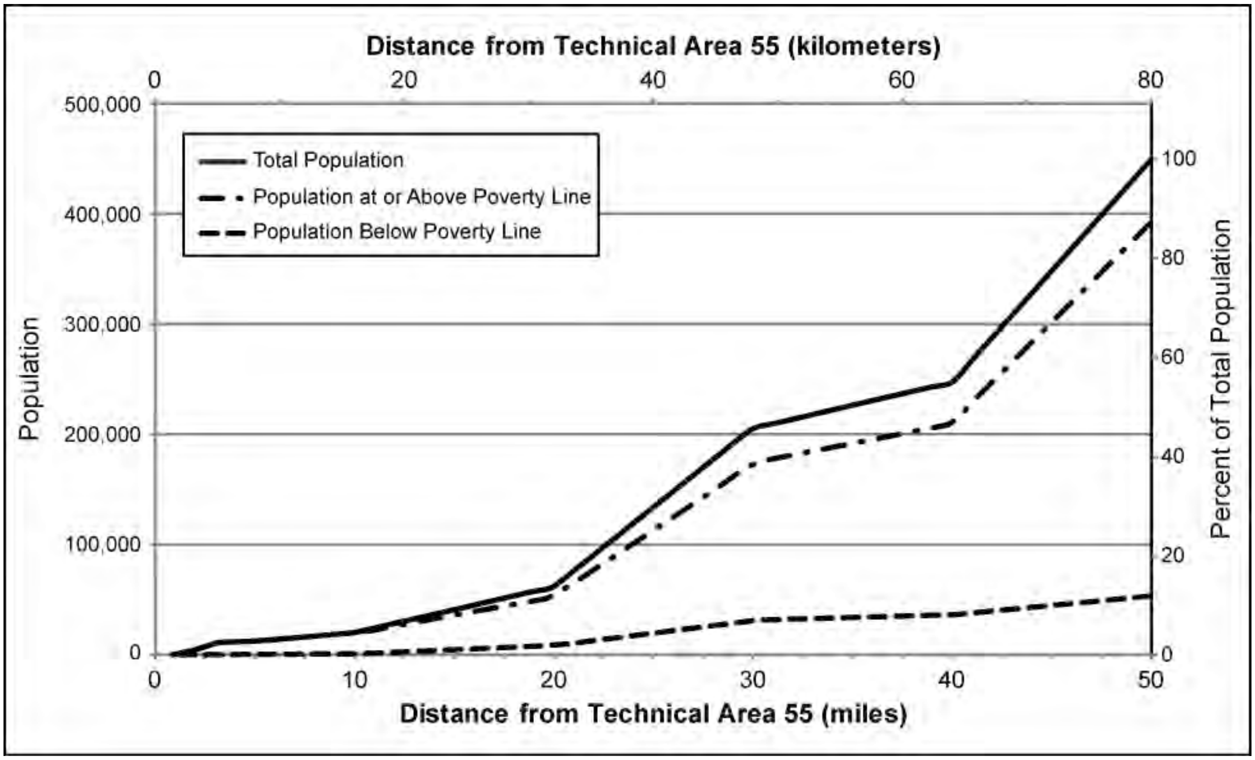

Figure 3–19 Cumulative Low-Income Populations as a Function of Distance from Los Alamos National Laboratory

3.3 Reactor Sites for Mixed Oxide Fuel Irradiation

As explained in the text box at the beginning of this chapter, this section includes only the resource areas that could be affected by the proposed action and alternatives. Consistent with the *SPD EIS*, four resource areas were considered for the two potential TVA reactor sites, Browns Ferry and Sequoyah Nuclear Plants: air quality and noise, radiation exposure and risk, waste management, and environmental justice. Other resource areas were not considered in detail because the use of mixed oxide (MOX) fuel would not impact the resource areas. For example, because the use of MOX fuel at the TVA reactor sites would not be expected to appreciably affect the number of employees working at the sites, no socioeconomic impacts would be expected as a result of a decision to use MOX fuel. Similarly, no new construction would be required at the sites if MOX fuel were used so there would be no impacts on land use, geology and soils, or cultural resources. The level of detail for the resource areas varies, depending on the potential for impacts resulting from each alternative.

3.3.1 Browns Ferry Nuclear Plant Overview

The Browns Ferry Nuclear Plant is located on approximately 840 acres (340 hectares) of federally owned land in Limestone County, Alabama, that is under the custody of TVA. It is approximately 10 miles (16 kilometers) southwest of Athens, Alabama, and about 30 miles (48 kilometers) west of Huntsville, Alabama. The plant is located on the north shore of Wheeler Reservoir. The reservoir, which is on the Tennessee River, is 74 miles (119 kilometers) long. It is formed by Wheeler Dam, a hydroelectric dam located on the river approximately 20 miles (32 kilometers) downriver from the Browns Ferry Nuclear Plant (NRC 2005c:Sections 1.3 and 2.1). The 2010 population within a 50-mile (80-kilometer) radius of the Browns Ferry Nuclear Plant is estimated to be about 819,000 (TVA 2009:Table 2.2-6).

TVA employs about 1,500 full-time equivalent employees to maintain and operate the Browns Ferry Nuclear Plant (TVA 2012:4). The Browns Ferry Nuclear Plant comprises three boiling water reactors, Units 1, 2, and 3, each with a gross maximum capacity of approximately 1,160 megawatts of electricity (1,158, 1,161, and 1161 megawatts, respectively) (TVA 2012). The reactors are operated by TVA under Operating Licenses DPR-33, DPR-52, and DPR-68 (NRC 2005c). The operating licenses were renewed in May 2006, which will allow continued operation of Units 1, 2, and 3 until 2033, 2034, and 2036, respectively (TVA 2010b). TVA plans to increase the generating capacity of each unit to approximately 1,295 megawatts with an extended power uprate (TVA 2012). The Browns Ferry Nuclear Plant units are cooled by pumping water from Wheeler Reservoir into the turbine generator condensers and discharging it back to the reservoir via three large submerged diffuser pipes (NRC 2005c:Section 2.1.3). Cooling towers may or may not be used, depending on ambient (e.g., river temperature, air temperature, dew point temperature) and operating conditions. When cooling towers are not in service, the withdrawal and return rates are about the same (2,031,528 gallons per minute [7,689,333 liters per minute]). When cooling towers are in service, 33,215 gallons per minute (125,720 liters per minute) of the withdrawn water is evaporated in the cooling towers (TVA 2012:5).

New (unirradiated) fuel is transferred directly to the used fuel storage pool upon receipt. There is a dry storage vault in the Reactor Building, but it no longer is used to store new fuel. Fuel transfer during refueling is conducted underwater. Irradiated (used) fuel is stored underwater in the Reactor Building until prepared for shipment from the site or for additional interim storage at the onsite Independent Spent Fuel Storage Installation. During a typical 24-month fuel cycle (TVA 2012:5), 312 used fuel assemblies are generated. A Fuel Pool Cooling and Cleanup System is provided to remove decay heat from used fuel stored in the fuel pool and to maintain a specified water temperature, purity, clarity, and level.

Security at the site is provided in accordance with NRC regulations and includes security checkpoints, barbed wire fencing, surveillance cameras, and intruder detection.

In addition to the information presented in this section, more details about the affected environment at the Browns Ferry Nuclear Plant Units 1, 2, and 3 can be found on the NRC website: http://www.nrc.gov/ in NRC Docket Numbers 50–259, 50–260, and 50–296, respectively.

3.3.1.1 Air Quality and Noise

State monitoring data for Limestone County, nearby Huntsville, and adjoining counties include ambient monitoring data for PM_{10}, $PM_{2.5}$, and ozone. Concentrations of PM_{10} and $PM_{2.5}$ in the region in 2008 were within the NAAQS. Monitoring values in Huntsville, the nearest ozone monitor to Browns Ferry Nuclear Plant, exceeded the ozone 8-hour standard value on two occasions in 2008 (EPA 2010). Neither Limestone County nor the adjoining counties are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 2009d).

The primary sources of nonradiological air pollutants at Browns Ferry include emergency diesel generators and employee vehicles (TVA 2012).

Major noise emission sources on the site include various industrial facilities, equipment, and machines. Although traffic is the primary source of noise at the site boundary and at residences near roads, the acoustic environment along the site boundary and at nearby residences away from traffic noise is typical of rural locations.

3.3.1.2 Radiation Exposure and Risk

The radiation environment of the Browns Ferry Nuclear Plant is addressed in this section in terms of radiological health impacts on humans associated with background radiation and normal operations at the plant. Radiological health impacts on individual members of the public, on the populations living within 50 miles (80 kilometers), on individual Browns Ferry Nuclear Plant workers, and on the total workforce at the plant are presented.

General Environment

Background Radiation – Major sources and levels of background radiation exposure to individuals in the vicinity of the Browns Ferry Nuclear Plant are shown in **Table 3–46**. Background radiation doses are unrelated to plant operations. Annual background radiation doses to individuals are expected to remain constant over time.

Table 3–46 Radiation Exposure of Individuals in the Browns Ferry Nuclear Plant or Sequoyah Nuclear Plant Site Vicinities Unrelated to the Plant Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural background radiation	
Cosmic and terrestrial radiation [a]	90
Radon-220 and -222 in homes (inhaled) [b]	228
Other background radiation [b]	
Diagnostic x-rays and nuclear medicine	300
Occupational	0.5
Industrial, security, medical, educational, and research	0.3
Consumer products	13
Total (rounded)	**630**

[a] TVA 2012:3.

[b] NCRP 2009:12, Represent averages for the United States.

Public – The maximally exposed individual (MEI) is a hypothetical person residing near the Browns Ferry Nuclear Plant who would receive the highest effective dose equivalent from plant operations. Typical (representative) Browns Ferry Nuclear Plant operations result in an annual dose of 0.043 millirem to the MEI from all pathways (TVA 2012:3). This dose is well below the annual permissible public exposure guideline values of 5 millirem from atmospheric releases and 3 millirem from liquid releases (10 CFR Part 50, Appendix I – Numerical Guides to meet the "as low as reasonably achievable" [ALARA] criterion) and the 25-millirem standard from all pathways combined (40 CFR Part 190). It is also below the annual limit of 100 millirem total effective dose equivalent to an individual member of the public that is given in 10 CFR 20.1301. The MEI dose is well below the 318 millirem[15] received annually by an average individual in the vicinity of the Browns Ferry Nuclear Plant from natural background radiation.

Using a risk estimator of 600 LCFs per 1 million person-rem to the public (or 0.0006 LCFs per rem) (DOE 2004d:22), the LCF risk to the MEI from annual Browns Ferry Nuclear Plant operations is estimated to be 3×10^{-8}. That is, the estimated annual probability of this person developing a fatal cancer sometime in the future from normal plant operations is about 1 in 33 million.

The annual dose to the population residing within 50 miles (80 kilometers) of the Browns Ferry Nuclear Plant was calculated to be 0.15 person-rem from typical plant operations (TVA 2012:2). This is well below the annual dose of 247,000 person-rem received by this same population from natural background radiation.[16] Plant operations are projected to cause no LCFs in the population within 50 miles (80 kilometers) of the Browns Ferry Nuclear Plant. Using the risk estimator of 600 LCFs per 1 million person-rem, the calculated LCF risk is 9×10^{-5} from 1 year of operations; this indicates an annual risk of 1 in 11,000 of a single excess latent fatal cancer occurring in the population as a result of normal Browns Ferry Nuclear Plant operations.

Workers – Browns Ferry Nuclear Plant workers may receive an additional dose from working in facilities with nuclear materials. In conformance with the requirements given in 10 CFR 20.1101 (b), procedures and engineering controls are employed to achieve occupational doses that are ALARA. For the 5-year period from 2005 through 2009, the average annual dose to an individual worker from plant operations was 175 millirem and the maximum annual dose to a worker was 1,398 millirem (TVA 2012:4). These values are below the NRC annual radiological dose limit of 5,000 millirem (10 CFR Part 20.1201). Over the same period, the average annual total worker dose to the 3,042 workers who received a measurable dose was 532 person-rem (TVA 2012:4). Using a risk estimator of 600 LCFs per 1 million person-rem, the risk of an LCF for the average worker would be 0.0001 annually. No fatal cancers are projected for the worker population from normal plant operations.

Health Effect Studies

The National Cancer Institute publishes national, state, and county incidence rates of various types of cancer (NCI 2011). However, the published information does not present an association of these rates with their causes, e.g., specific facility operations and human lifestyles. **Table 3–47** presents incidence rates for the United States, Alabama, Tennessee, Limestone County, and the four counties in Alabama and the two counties in Tennessee that are adjacent to Limestone County.

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[15] *The dose from cosmic and terrestrial radiation measured by TVA is 90 millirem per year (TVA 2012:3); the average dose to an individual in the United States from radon-220 and -222 is 228 millirem per year (NCRP 2009:12).*

[16] *This value is based on an annual natural background radiation dose of 318 millirem to an individual, including doses from radon-220 and -222. If only cosmic and terrestrial radiation is considered, the population dose would be 70,044 person-rem (TVA 2012:3).*

Table 3–47 Cancer Incidence Rates [a] for the United States, Alabama, Tennessee, and Counties in the Vicinity of the Browns Ferry Nuclear Plant Site, 2004–2008

	All Cancers	*Thyroid*	*Breast*	*Lung and Bronchus*	*Leukemia*	*Prostate*	*Colon and Rectum*
United States	465	11	121.1	67.9	12.4	152.7	47.6
Alabama	462.7	7.7	116.8	76.5	11.2	159.8	50.2
Limestone County [b]	450.2	8	100.6	81.6	14.5	150.6	45.3
Lauderdale County	468.8	11.6	110.2	79.2	12.6	141.3	55.7
Lawrence County	403.7	(c)	93.7	73.4	(c)	132.5	51.5
Madison County	444.3	8.8	125.3	65	14.1	136.6	47.7
Morgan County	513	4.5	119.3	81.9	15.5	202.4	49
Tennessee	462.2	10.5	117.2	80.9	11.5	142.2	48.8
Giles County	416.6	19	98.3	78.4	11.2	113.2	57.4
Lincoln County	430	14.7	115.5	74.4	11.5	97.8	57.3

[a] Age-adjusted incidence rates; cases per 100,000 persons per year.

[b] Location of the Browns Ferry Nuclear Plant.

[c] Data have been suppressed by the National Cancer Institute to ensure confidentiality and stability of rate estimates when the annual average count is three or fewer cases.

Source: NCI 2011.

Emergency Preparedness

The design and operating procedures instituted in accordance with the regulations for operating the Browns Ferry Nuclear Plant and the plant's highly trained workforce make it unlikely that an accidental release of radiation would take place. Nevertheless, emergency preparedness is an integral part of the programs at the plant to assure that the impacts on people associated with an accident are controlled to the extent possible. The Emergency Management Program for Browns Ferry is based on the following principles:

- Identification and characterization of accidental radiation releases
- Analysis of potential accidents associated with the radiation releases
- Prediction of consequences of the releases at various locations
- Planned response actions to minimize exposure of workers and the public

The Browns Ferry Nuclear Plant emergency plan specifies the actions to be taken in the case of an emergency. Designated plant personnel work closely with Federal, state, and local agencies to ensure that coordinated emergency response plans are in place to protect plant employees and the public in the event of an accident whose predicted dose may exceed Federal government protective action guidelines. As a condition for obtaining and maintaining an operating license for the Browns Ferry Nuclear Plant, TVA developed and updates both on- and offsite emergency plans. The onsite emergency plan, including updates, is approved by NRC. The offsite plan is evaluated by FEMA, then provided to NRC. NRC considers TVA's resolution of FEMA's findings as a condition of maintaining the Browns Ferry Nuclear Plant operating license.

The on- and offsite plans are closely coordinated. The onsite plan includes a series of emergency plan implementing procedures that define the responsibilities and actions to be taken by plant personnel in the event of an emergency. The offsite plan defines two "emergency planning zones." One zone covers an area within a 10-mile (16-kilometer) radius of the plant, in which people could be potentially harmed by exposure to direct radiation. Necessary sheltering and evacuation of communities are planned for within this zone. The second zone covers an area out to a 50-mile (80-kilometer) radius from the plant, where radioactive materials could contaminate water supplies, food crops, and livestock, and interdiction may be necessary. Mitigation measures implemented in this zone would depend on the contamination levels measured and their locations.

Each year, TVA; the State of Alabama; and the Counties of Lauderdale, Lawrence, Limestone, and Morgan provide emergency preparedness planning information to residents and businesses within 10 miles (16 kilometers) of the Browns Ferry Nuclear Plant. Included in this information is an evacuation map showing transportation routes, checklists of emergency and evacuation supplies, and instructions on obtaining potassium iodide tablets.[17] In the event of an emergency, sirens in this zone would sound and additional relevant information would be provided through local radio and television stations. Actions people should take if advised to take shelter or leave an area are included in the preparedness information and would be augmented by real-time information provided through local media.

As part of the reactor oversight process, NRC reviews TVA's emergency procedures and training annually. These reviews include regular drills and exercises that assist TVA in identifying areas needing improvement. TVA is required to exercise its full emergency plan for the Browns Ferry Nuclear Plant with NRC, FEMA, and offsite authorities at least once every 2 years. However, the emergency sirens are tested more frequently.

3.3.1.3 Waste Management

Solid wastes generated in conjunction with operation of the Browns Ferry Nuclear Plant can be subdivided into four general categories: LLW, MLLW, hazardous waste, and nonhazardous waste.

Solid LLW consists of spent resins, and dry active waste (contaminated protective clothing, paper, rags, glassware, and trash). This waste is temporarily stored on site and subsequently transported to a licensed disposal facility (TVA 2002:3-5). The generation of MLLW is sporadic, but when generated, MLLW is shipped to a licensed treatment, storage, and disposal facility (TVA 2012). **Table 3–48** shows the quantity of solid waste generated at the Browns Ferry Nuclear Plant.

Table 3–48 Solid Waste Generation at the Browns Ferry Nuclear Plant

Waste Type	*Annual Generation* [a]
Low-level radioactive waste [b] Cubic meters (cubic feet)	1,986 (70,134)
Mixed low-level radioactive waste [c] Cubic meters (cubic feet)	0.1 (3.5)
Hazardous waste Kilograms (pounds)	1,351 (3,000)
Nonhazardous waste Metric tons (tons)	612 (675)

[a] Reflective of three-unit operation.
[b] Average of data from 2006 to 2009.
[c] Based on fiscal years 2008 to 2009.
Source: TVA 2012:4.

Hazardous wastes include paint-related materials, spent solvents used for cleaning and degreasing, and universal wastes such as spent batteries and fluorescent light tubes. TVA operates a hazardous waste storage facility in Muscle Shoals, Alabama that holds a RCRA Part B permit for temporary storage of hazardous wastes. The hazardous waste storage facility serves as a central collection point for TVA-generated hazardous wastes, and maintains contracts with waste treatment and disposal facilities. All hazardous waste generated at the Browns Ferry Nuclear Plant is shipped to the hazardous waste storage facility for consolidation, storage, and disposal through approved and licensed facilities. The Browns

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[17] *Potassium iodide (KI) is a chemical compound that can be used to protect the thyroid gland from possible radiation injury caused by radioactive iodine (radioiodine).*

Ferry Nuclear Plant recycles paint solvents (primarily methyl ethyl ketone) using an onsite still. Universal wastes are collected and shipped to recycling firms to be recycled. While not a hazardous waste as defined in the RCRA regulations, used oil is also generated at the Browns Ferry Nuclear Plant as a result of maintenance activities. Used oil is collected, stored on site, and shipped to an approved recycling center for energy recovery (TVA 2002:3-6).

Nonhazardous waste includes sanitary waste and construction and demolition debris. Sanitary waste is collected and transported to a state-licensed regional landfill permitted to accept Subtitle D waste materials from Limestone County. The Browns Ferry Nuclear Plant has an active recycling program that segregates and recycles scrap metal, cardboard, paper, batteries, and aluminum cans at approved state and local recycling facilities. The Browns Ferry Nuclear Plant operates a state-permitted construction/demolition landfill (Permit Number 42-02) within the confines of the Browns Ferry Nuclear Plant site (TVA 2002:3-5).

Liquid waste consists of 2.3 million liters (600,000 gallons) per day of wastewater (TVA 2012:4). The wastewater contains low levels of radionuclides that are monitored prior to release to Wheeler Reservoir on the Tennessee River in accordance with NPDES permit requirements.

3.3.1.4 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. The potentially affected area surrounding the Browns Ferry Nuclear Plant includes parts of 21 counties throughout Alabama and Tennessee that make up an area within a 50-mile (80-kilometer) radius of the Browns Ferry Nuclear Plant site. To be consistent with the human health analysis, the population distributions of the potentially affected area are calculated using data at the block-group level of spatial resolution from the 2010 census (Census 2011f), and have been projected to the year 2020 using data from the 1990 census, 2000 census, and the 2010 census for each of the affected counties within a 50-mile (80-kilometer) radius of the Browns Ferry Nuclear Plant (Census 1990, 2001, 2011f).

In accordance with CEQ guidance, meaningfully greater minority populations are identified where either the minority population of the affected area exceeds 50 percent, or if 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 (CEQ 1997). Meaningfully greater is defined here as 20 percentage points above the population percentage in the general population. The 2020 population projections estimate the average minority population percentage of the states surrounding the Browns Ferry Nuclear Plant as 30.2 percent and the average minority population percentage of the counties surrounding the Browns Ferry Nuclear Plant as 21.8 percent. Comparatively, a meaningfully greater minority population percentage relative to the general population of the state and surrounding counties would be 41.8 percent. Therefore, the lower threshold of 41.8 percent is used to identify areas with meaningfully greater minority populations surrounding the Browns Ferry Nuclear Plant. In order to evaluate the potential impacts on populations in closer proximity to the Browns Ferry Nuclear Plant, additional radial distances of 5, 10, and 20 miles (8, 16, and 32 kilometers) are also analyzed. **Table 3–49** shows the composition of the ROI surrounding the Browns Ferry Nuclear Plant at each of these distances.

The total projected population residing within the potentially affected area in 2020 would be approximately 1,087,041, approximately 24 percent of which would be considered minority. Of the 699 block groups in the potentially affected area, approximately 119 (17 percent) were identified as containing meaningfully greater minority populations.

Table 3–49 Projected Populations in the Potentially Affected Area in 2020

Population Group	5 Miles		10 Miles		20 Miles		50 Miles	
	Population	Percent of Total	Population	Percent of Total	Population	Percent of Total	Population	Percent of Total
Nonminority	2,379	73	26,712	63	159,155	71	820,861	76
Black or African American [a]	591	18	10,582	25	33,231	15	155,108	14
Total Hispanic [b]	190	6	3,658	9	19,247	9	61,586	6
American Indian or Alaska Native [a]	19	1	477	1	2,860	1	9,665	1
Other Minority [a]	272	8	4,831	11	27,722	12	101,407	9
Total Minority [a]	882	27	15,890	37	63,813	29	266,180	24
Total Population	3,261	100	42,602	100	222,968	100	1,087,041	100
Low-Income	406	12	6,864	16	31,255	14	160,412	15

[a] Includes Hispanic persons.

[b] Includes all Hispanic persons regardless of race.

Note: To convert miles to kilometers, multiply by 1.609. Totals may not equal the sum of subcategories due to rounding. The potentially affected area comprises the area within a 50-mile (80-kilometer) radius of the site.

The overall composition of the projected populations within every radial distance is predominantly nonminority. The concentration of minority populations is the greatest in the area within 10 miles, where the minority population accounts for approximately 37 percent. The Black or African American population is the largest minority group within every radial distance of the potentially affected area, constituting approximately 25 percent of the total population within 10 miles; and 14 percent of the total population within 50 miles. The Hispanic or Latino population constitutes about 9 percent of the total population within 10 miles, and approximately 6 percent of the total population within 50 miles.

The projected low-income population (those living below the poverty threshold) in 2020 is estimated to be 160,412 people (15 percent). Meaningfully greater low-income populations are identified using the same methodology described above for identification of minority populations. The 2010 census does not contain any data relative to income. The Census Bureau’s ACS 5-year estimates are the only data set that publishes current data relative to income at the block group level of geography. Therefore, the 2006–2010 ACS 5-year estimates are used to identify low-income populations in the potentially affected area. These populations were then scaled up to be directly comparable to the projected 2020 potentially affected population. The 2006–2010 ACS 5-year estimates show the average low-income population percentage of the states surrounding the Browns Ferry Nuclear Plant is 17 percent, and the low-income population percentage of the counties surrounding the Browns Ferry Nuclear Plant is 15 percent (Census 2011e). Comparatively, a meaningfully greater low-income population percentage would be 35.3 percent. Therefore, the lower threshold of 35.3 percent is used to identify low-income populations surrounding the Browns Ferry Nuclear Plant. Of the 699 block groups that surround the Browns Ferry Nuclear Plant, 62 (8.9 percent) contain meaningfully greater low-income populations.

Figure 3–20 displays the block groups identified as meaningfully greater minority and low-income populations surrounding the Browns Ferry Nuclear Plant.

Figures 3–21 and **3–22** show cumulative minority and low-income populations projected to live within the potentially affected area in 2020 as a function of distance from the Browns Ferry Nuclear Plant. Values along the vertical axis show populations residing within a given distance from the plant.

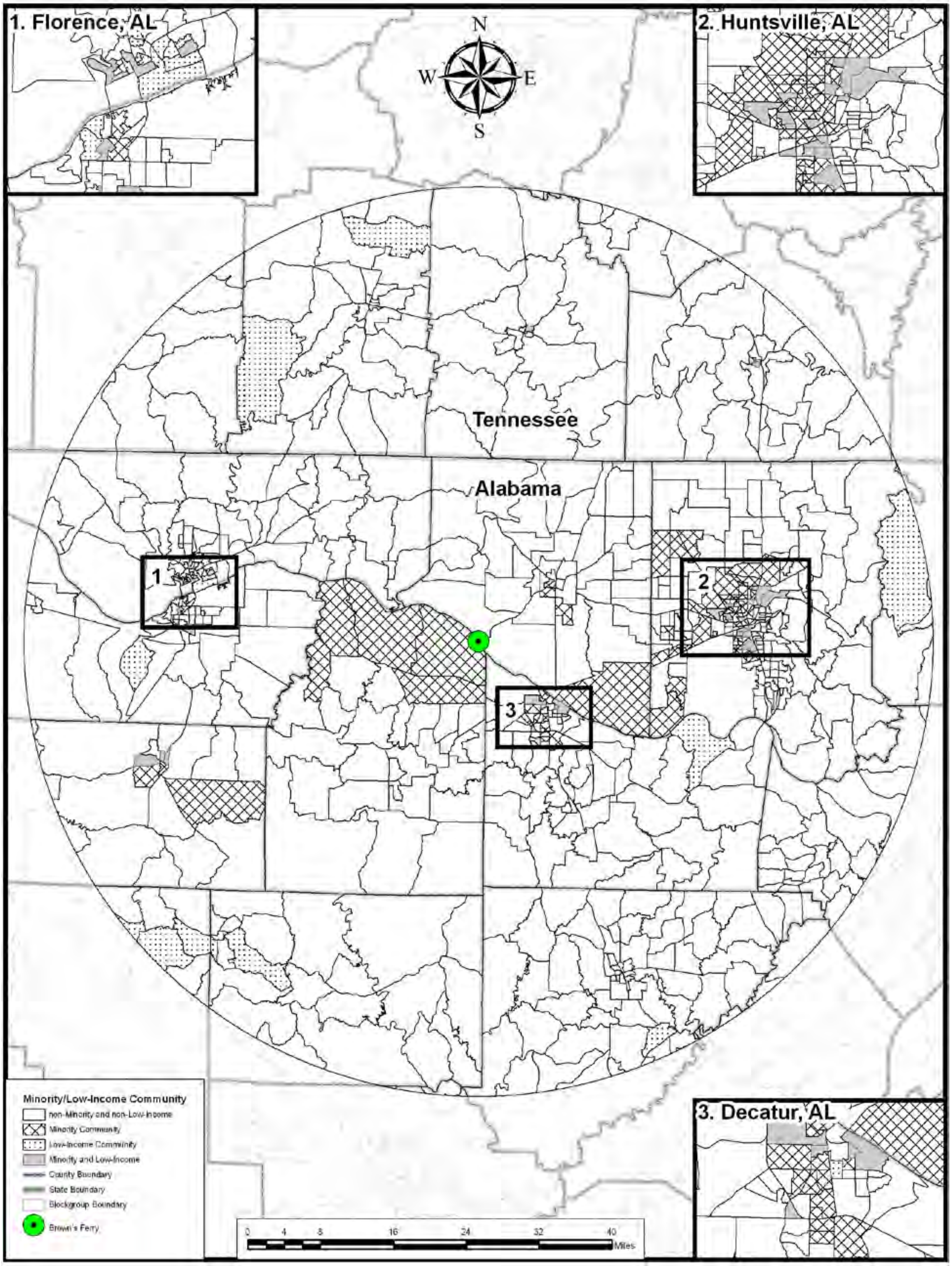

Figure 3–20 Meaningfully Greater Minority and Low-Income Populations Surrounding the Browns Ferry Nuclear Plant

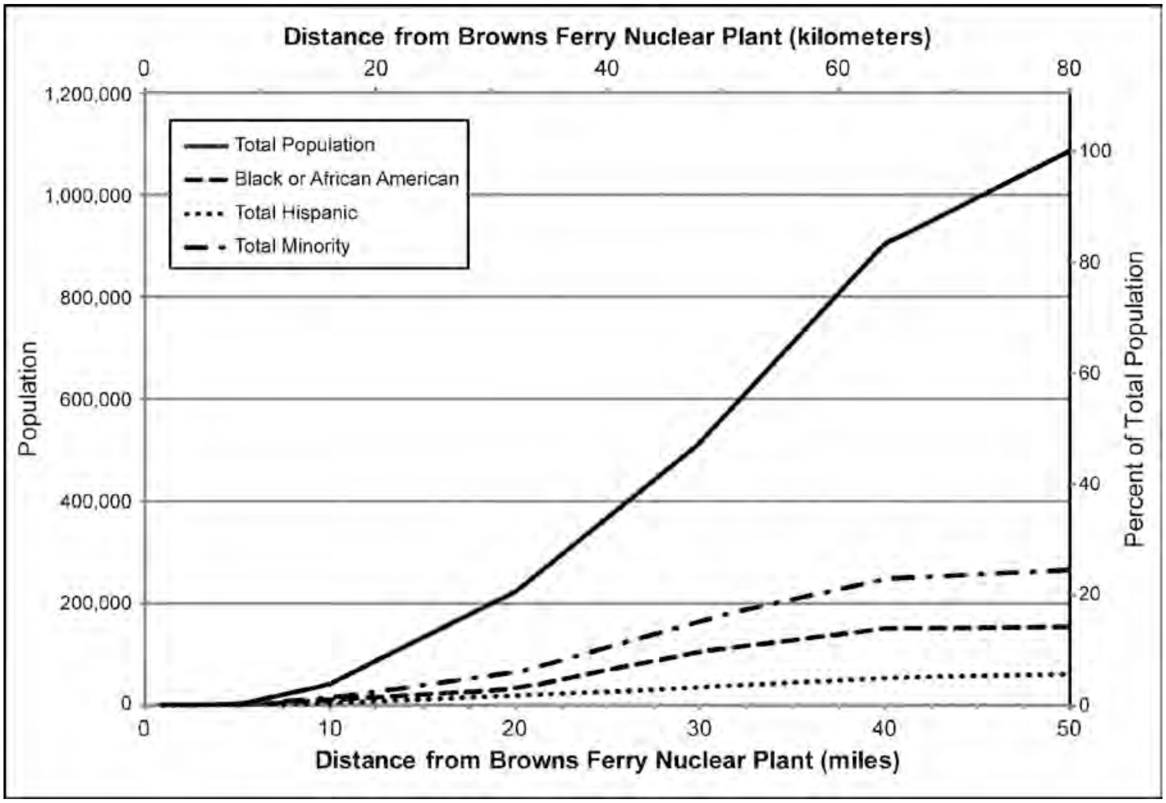

Figure 3–21 Cumulative Minority Populations as a Function of Distance from the Browns Ferry Nuclear Plant

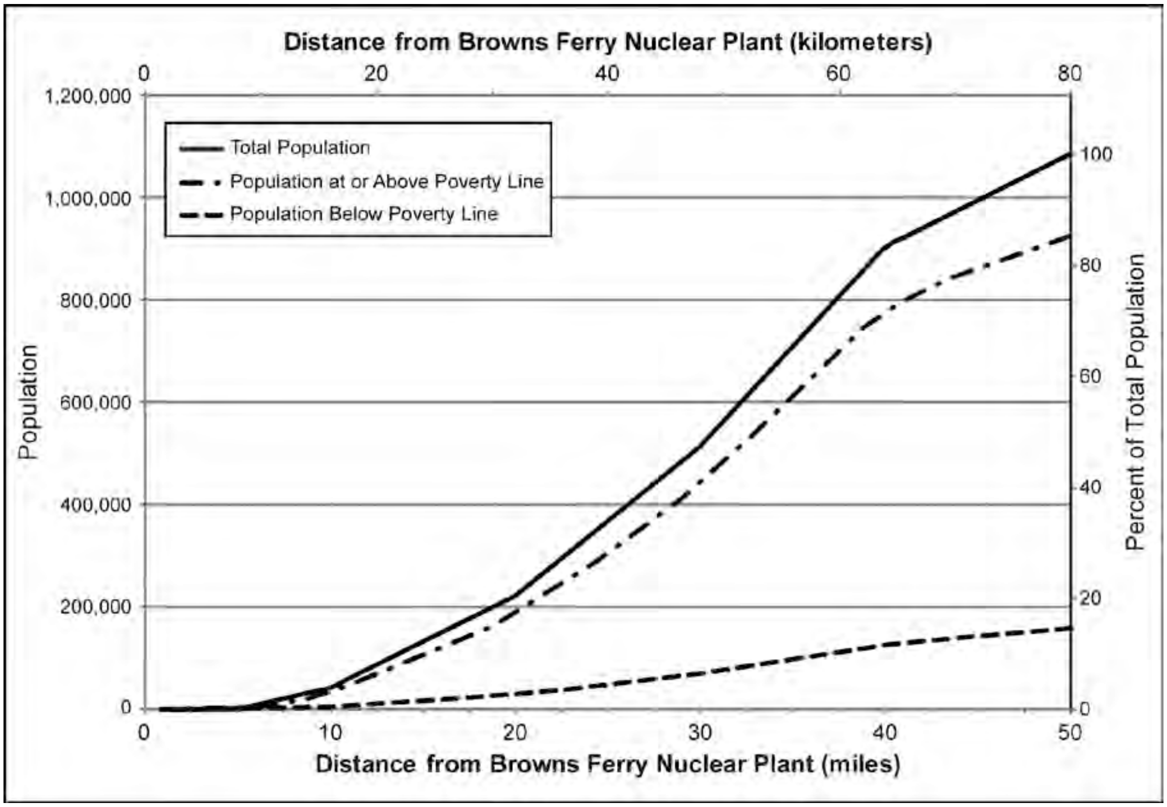

Figure 3–22 Cumulative Low-Income Populations as a Function of Distance from the Browns Ferry Nuclear Plant

3.3.2 Sequoyah Nuclear Plant Overview

The Sequoyah Nuclear Plant is located on approximately 525 acres (212 hectares) of federally owned land that is under the custody of TVA in Hamilton County, Tennessee. It is approximately 6 miles (10 kilometers) east of Soddy-Daisy, Tennessee, and 7.5 miles (12 kilometers) northeast of Chattanooga, Tennessee. The site is located on a peninsula on the western shore of Chickamauga Reservoir, which is along the Tennessee River (TVA 2010c:Section 2.1). The 2010 population within a 50-mile (80-kilometer) radius of the Sequoyah Nuclear Plant is estimated to be about 983,000 (TVA 2010c:Table 2.1.3-12).

TVA employs about 1,150 full-time equivalent employees to maintain and operate the Sequoyah Nuclear Plant (TVA 2012:4). The Sequoyah Nuclear Plant comprises two pressurized water reactors, each with a gross maximum capacity of approximately 1,205 megawatts of electricity (1,216 and 1,194 megawatts, respectively) (TVA 2012). The reactors are operated by TVA under Operating Licenses DPR–77 and DPR–79, which were granted in 1980 and 1981, respectively, with expiration dates of 2020 and 2021. TVA is currently seeking an extension of the Sequoyah Nuclear Plant for another 20 years, through 2040 for Unit 1 and 2041 for Unit 2 (75 FR 18572).

The Sequoyah Nuclear Plant units are cooled by water taken from and returned to the Chickamauga Reservoir. During operations, cooling towers may or may not be used. When cooling towers are not in use, the withdrawal rate is 1,068,958 gallons per minute (4,046,006 liters per minute) and the discharge rate is 1,068,888 gallons per minute (4,045,741 liters per minute). When cooling towers are in service, less than 32,786 gallons per minute (124,095 liters per minute) of the withdrawn water is evaporated in the cooling towers (TVA 2012:5).

New (unirradiated) fuel assemblies are removed one at a time from the shipping cask and stored dry in the fuel storage racks located in the fuel storage area or wet in the used fuel pool. Used fuel is removed from the reactor vessel by the manipulator crane and placed in the Fuel Transfer System. During a typical 18-month fuel cycle, 81 used fuel assemblies are generated. In the used fuel pool, the fuel is removed from the Fuel Transfer System and placed in the storage racks. After a suitable decay period, the fuel may be removed from storage and loaded in a shipping cask for removal from the site or the used fuel assemblies may be placed in interim storage at the Sequoyah Nuclear Plant Independent Spent Fuel Storage Installation. Used fuel is handled entirely under water from the time it leaves the reactor vessel until it is placed in a cask for shipment from the site or until the used fuel assemblies are placed in interim storage at the Sequoyah Nuclear Plant Independent Spent Fuel Storage Installation (TVA 2010c:1.2-4, 2012).

Security at the site is provided in accordance with NRC regulations and includes security checkpoints, barbed wire fencing, surveillance cameras, and intruder detection.

In addition to the information presented in this section, more details about the affected environment at the Sequoyah Nuclear Plant Units 1 and 2 can be found on the NRC website: http://www.nrc.gov/ in NRC Docket Numbers 50–327 and 50–328, respectively.

3.3.2.1 Air Quality and Noise

State monitoring data for Hamilton County and adjoining counties include ambient monitoring data for nitrogen dioxide, PM_{10}, $PM_{2.5}$, and ozone. Concentrations of nitrogen dioxide, PM_{10}, and $PM_{2.5}$ in these counties were within the NAAQS. Monitoring values for ozone at the nearest monitors to Sequoyah Nuclear Plant in Hamilton County exceeded the 8-hour standard value on several occasions in 2008 (EPA 2010). The adjoining counties are designated as in attainment with respect to the NAAQS for criteria air pollutants, except for Hamilton County, which is designated nonattainment for $PM_{2.5}$ (EPA 2009e).

The primary sources of nonradiological air pollutants at the Sequoyah Nuclear Plant include emergency diesel generators and employee vehicles (TVA 2012).

Major noise emission sources on the site include various industrial facilities, equipment, and machines. Although traffic is the primary source of noise at the site boundary and at residences near roads, the acoustic environment along the site boundary and at nearby residences away from traffic noise is typical of rural locations.

3.3.2.2 Radiation Exposure and Risk

The human radiation environment of the Sequoyah Nuclear Plant is addressed in this section in terms of radiological health impacts associated with background radiation and normal operations at the plant in the same manner as for the Browns Ferry Nuclear Plant.

General Environment

Background Radiation – The major sources and levels of background radiation exposure to individuals in the vicinity of the Sequoyah Nuclear Plant are the same as for the Browns Ferry Nuclear Plant shown in Table 3–46.

Public – Typical (representative) Sequoyah Nuclear Plant operations result in an annual dose to the MEI from all pathways of 0.15 millirem (TVA 2012:3). This dose is well below the annual permissible public exposure guideline values of 5 millirem from atmospheric releases and 3 millirem from liquid releases (10 CFR Part 50, Appendix I – Numerical Guides to meet the ALARA criterion), and the 25-millirem standard for exposure from all pathways combined (40 CFR Part 190). It is also below the annual limit of 100 millirem total effective dose equivalent to an individual member of the public that is given in 10 CFR 20.1301. The MEI dose is well below the 318 millirem[18] received annually by an average individual in the vicinity of the Sequoyah Nuclear Plant from natural background radiation.

Using a risk estimator of 600 LCFs per 1 million person-rem (or 0.0006 LCFs per rem) (DOE 2004d:22), the LCF risk to the MEI from annual Sequoyah Nuclear Plant operations is estimated to be 9×10^{-8}. That is, the estimated annual probability of this person developing a fatal cancer sometime in the future from normal plant operations is 1 in 11 million.

The annual dose to the population residing within 50 miles (80 kilometers) of the Sequoyah Nuclear Plant was calculated to be 2.5 person-rem from typical plant operations (TVA 2012:2). This is well below the annual dose of 337,000 person-rem received by this same population from background radiation.[19] Plant operations are projected to cause no LCFs in the population within 50 miles (80 kilometers) of the Sequoyah Nuclear Plant. Using the risk estimator of 600 LCFs per 1 million person-rem, the calculated LCF risk is 0.002 from 1 year of operations; this indicates an annual risk of 1 in 500 of a single excess latent fatal cancer occurring in the population as a result of normal Sequoyah Nuclear Plant operations.

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[18] *The dose from cosmic and terrestrial radiation measured by TVA is 90 millirem per year (TVA 2012:3); the average dose to an individual in the United States from radon-220 and -222 is 228 millirem per year (NCRP 2009:12).*

[19] *This value is based on an annual natural background radiation dose of 318 millirem to an individual, including doses from radon-220 and -222. If only cosmic and terrestrial radiation is considered, the population dose would be 95,400 person-rem (TVA 2012:3).*

Workers – Sequoyah Nuclear Plant workers may receive an additional dose from working in facilities with nuclear materials. In conformance with the requirement given 10 CFR 20.1101 (b), procedures and engineering controls are employed to achieve occupational doses that are ALARA. For the 5-year period from 2005 through 2009, the average dose to the individual worker from plant operations was 110 millirem and the maximum dose to a worker was 751 millirem (TVA 2012:4). These values are below the NRC annual radiological dose limit of 5,000 millirem (10 CFR Part 20.1201). In the same year, the total worker dose to the 1,289 workers who received a measurable dose was 142 person-rem (TVA 2012:4). Using a risk estimator of 600 LCFs per 1 million person-rem, the risk of an LCF for the average worker would be 0.00007 annually. No fatal cancers are projected for the worker population from 1 year of normal plant operation.

Health Effects Studies

The National Cancer Institute publishes national, state, and county incidence rates of various types of cancer (NCI 2011). However, the published information does not present an association of these rates with their causes, e.g., specific facility operations and human lifestyles. **Table 3–50** presents incidence rates for the United States; Tennessee; Georgia; Hamilton County, Tennessee; and for the six counties in Tennessee and four counties in Georgia that are adjacent to Hamilton County. Additional information about cancer profiles near the Sequoyah Nuclear Plant is available in the National Cancer Institute's publication (NCI 2011).

Table 3–50 Cancer Incidence Rates [a] for the United States, Tennessee, Georgia, and Counties in the Vicinity of the Sequoyah Nuclear Plant Site, 2004–2008

	All Cancers	*Thyroid*	*Breast*	*Lung and Bronchus*	*Leukemia*	*Prostate*	*Colon and Rectum*
United States	465	11	121.1	67.9	12.4	152.7	47.6
Tennessee	462.2	10.5	117.2	80.9	11.5	142.2	48.8
Hamilton County [b]	472.4	10.4	117.6	78.2	11.1	164.2	45.3
Bradley County	403.2	10.1	109.1	60.8	9.1	89.3	44.4
Bledsoe County	343.9	(c)	100.1	72.1	(c)	106.4	36.8
Marion County	457.1	(c)	123.1	92.4	11.1	119.7	43.7
Meigs County	546	(c)	134.5	104	(c)	139.4	50.6
Rhea County	603.1	12.5	198.5	113.6	12.2	133.4	59.2
Sequatchie County	428.8	(c)	92	68.3	(c)	115.8	39
Georgia	460.9	9.1	119.2	72.2	11.5	167.4	46.7
Catoosa County	410	9.3	96	79.4	13	95	44.5
Dade County	482.8	(c)	119.6	88.8	(c)	130.9	44.2
Walker County	460.2	7	88.3	105.5	11.9	130.6	42.1
Whitfield County	488.8	12	113.8	104	12.4	151	44.3

[a] Age-adjusted incidence rates; cases per 100,000 persons per year.
[b] Location of the Sequoyah Nuclear Plant.
[c] Data have been suppressed by the National Cancer Institute to ensure confidentiality and stability of rate estimates when the annual average count is three or fewer cases.
Source: NCI 2011.

Emergency Preparedness

The design and operating procedures instituted in accordance with the regulations for operating the Sequoyah Nuclear Plant and the plant's highly trained workforce make it unlikely that an accidental release of radiation would take place. Nevertheless, emergency preparedness is an integral part of the safety programs at the Sequoyah Nuclear Plant, and an approved emergency plan is required to maintain its NRC operating license. The emergency plans for the Sequoyah Nuclear Plant are structurally the same as those for the Browns Ferry Nuclear Plant discussed in Section 3.3.1.2. However, specifics such as locations of onsite facilities and the associated number of workers; population densities around the plant; and zone evacuation times, which depend on road systems and population densities, are different.

Each year, TVA, the State of Tennessee, Bradley and Hamilton Counties, and the City of Cleveland within Bradley County provide emergency preparedness planning information to residents and businesses within 10 miles (16 kilometers) of the Sequoyah Nuclear Plant. The information includes instructions on actions people should take if advised to seek shelter or leave an area. Included is an evacuation map showing transportation routes, emergency and evacuation supply checklists, and instructions on obtaining potassium iodide tablets.[20] In the event of an emergency, sirens in this zone would sound and the planning information would be augmented by real-time information provided by local television and radio stations.

Oversight and testing of the Sequoyah Nuclear Plant emergency plan and necessary training are similar to that discussed for the Browns Ferry Nuclear Plant.

3.3.2.3 Waste Management

Solid wastes generated in conjunction with operation of the Sequoyah Nuclear Plant can be subdivided into four general categories: LLW, MLLW, hazardous waste, and nonhazardous waste. In general, these different waste types are managed in a similar manner as described in Section 3.3.1.3 for the Browns Ferry Nuclear Plant. LLW and MLLW are stored on site and subsequently transported to offsite licensed disposal facilities. TVA transports hazardous waste generated at the Sequoyah Nuclear Plant to its hazardous waste storage facility in Muscle Shoals, Alabama. Nonradioactive hazardous waste is transported to local offsite disposal facilities. **Table 3–51** shows the quantity of solid waste generated at the Sequoyah Nuclear Plant.

Table 3–51 Solid Waste Generation at the Sequoyah Nuclear Plant

Waste Type	*Annual Generation* [a]
Low-level radioactive waste [b] Cubic meters (cubic feet)	394 (13,914)
Mixed low-level radioactive waste [c] Cubic meters (cubic feet)	0.1 (3.5)
Hazardous waste [d] kilograms (pounds)	481 (1,062.6)
Nonhazardous waste [d] Metric tons (tons)	705.9 (778.1)

[a] Reflective of two-unit operation.
[b] Average of data from 2006 to 2009.
[c] Based on fiscal years 2008 to 2009.
[d] Based on data from 2009.
Source: TVA 2012:4.

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[20] *Potassium iodide (KI) is a chemical compound that can be used to protect the thyroid gland from possible radiation injury caused by radioactive iodine (radioiodine).*

Liquid waste consists of 265,000 liters (70,000 gallons) per day of wastewater (TVA 2012:4). The wastewater contains low levels of radionuclides that are monitored prior to release to the Tennessee River in accordance with NPDES permit requirements.

3.3.2.4 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. The potentially affected area surrounding the Sequoyah Nuclear Plant includes parts of 32 counties throughout Alabama, Georgia, North Carolina, and Tennessee that make up an area within a 50-mile (80-kilometer) radius of the Sequoyah Nuclear Plant site. To be consistent with the human health analysis, the population distributions of the potentially affected area are calculated using data at the block-group level of spatial resolution from the 2010 census (Census 2011f), and have been projected to the year 2020 using data from the 1990 census, 2000 census, and the 2010 census for each of the affected counties within a 50-mile (80-kilometer) radius of the Sequoyah Nuclear Plant (Census 1990, 2001, 2011f).

In accordance with CEQ guidance, meaningfully greater minority populations are identified where either the minority population of the affected area exceeds 50 percent, or if 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 (CEQ 1997). Meaningfully greater is defined here as 20 percentage points above the population percentage in the general population. The 2020 population projection estimates show the average minority population percentage of the four states surrounding the Sequoya Nuclear Plant as 38.3 percent and the average minority population percentage of the counties surrounding the Sequoyah Nuclear Plant site as 18.7 percent. Comparatively, a meaningfully greater minority population percentage relative to the general population of the state and surrounding counties would be 38.7 percent. Therefore, the lower threshold of 38.7 percent is used to identify areas with meaningfully greater minority populations surrounding the Sequoya Nuclear Plant. In order to evaluate the potential impacts on populations in closer proximity to the Sequoya Nuclear Plant site, additional radial distances of 5, 10, and 20 miles (8, 16, and 32 kilometers) are also analyzed. **Table 3–52** shows the composition of the ROI surrounding the Sequoya Nuclear Plant at each of these distances and illustrates the racial and ethnic composition of the minority population in the potentially affected areas surrounding the Sequoyah Nuclear Plant.

Table 3–52 Projected Populations in the Potentially Affected Area in 2020

	5 Miles		***10 miles***		***20 miles***		***50 miles***	
Population	***Population***	***Percent of Total***	***Population***	***Percent of Total***	***Population***	***Percent of Total***	***Population***	***Percent of Total***
Nonminority	26,097	94	91,473	90	389,888	75	968,905	80
Black or African American	407	1	4,454	4	78,232	15	97,556	8
Total Hispanic [b]	567	2	2,556	3	28,611	6	104,986	9
American Indian or Alaska Native [a]	95	0	325	0	2,078	0	5,474	0
Other Minority [a]	1,154	4	5,821	6	47,573	9	140,021	12
Total Minority [a]	1,656	6	10,600	10	127,883	25	243,051	20
Total Population	27,753	100	102,073	100	517,771	100	1,211,956	100
Low-Income	2,563	9	7,335	7	79,698	15	203,554	17

[a] Includes Hispanic persons.

[b] Includes all Hispanic persons regardless of race.

Note: To convert miles to kilometers, multiply by 1.609. Totals may not equal the sum of subcategories due to rounding. The potentially affected area comprises the area within a 50-mile (80-kilometer) radius of the site.

The potentially affected area around the location of the Sequoyah Nuclear Plant is defined by a circle with a 50-mile (80-kilometer) radius. The total projected population residing within that area in 2020 would be approximately 1,211,956, approximately 20 percent of which would be considered minority. Of the 781 block groups in the potentially affected area, approximately 110 (14 percent) were identified as containing meaningfully greater minority populations.

The overall composition of the populations within every radial distance is predominantly nonminority. The concentration of minority populations is the greatest in the area within 20 miles (32 kilometers), where the total minority population accounts for approximately 25 percent. The Hispanic or Latino population is the largest minority group within the potentially affected area, constituting approximately 2 percent of the total population within 5 miles (8 kilometers), and approximately 9 percent of the total population within 50 miles (80 kilometers). The Black or African American population is the largest minority population within the 20-mile (32-kilometer) radius, constituting about 15 percent of the total population.

The projected low-income population (those living below the poverty threshold) in 2020 is estimated to be 203,554 people (17 percent). Meaningfully greater low-income populations are identified using the same methodology described above for identification of minority populations. The Census Bureau's ACS 5-year estimates are the only data set that publishes current data relative to income at the block group level of geography. Therefore, the 2006–2010 ACS 5-year estimates are used to identify low-income populations in the potentially affected area. These populations were then scaled up to be directly comparable to the projected 2020 potentially affected population. The 2006–2010 ACS 5-year estimates show the average low-income population percentage of the four states surrounding the Sequoyah Nuclear Plant is 16 percent and the average low-income population percentage of the counties surrounding the Sequoyah Nuclear Plant is 16.3 percent (Census 2011e). Comparatively, a meaningfully greater low-income population percentage would be 36 percent. Therefore, the lower threshold of 36 percent is used to identify areas with meaningfully greater low-income populations surrounding the Sequoyah Nuclear Plant. Of the 781 block groups that surround the Sequoyah Nuclear Plant, 71 (9.1 percent) contain meaningfully greater low-income populations.

Figure 3–23 displays the block groups identified as meaningfully greater minority and low-income populations surrounding the Sequoyah Nuclear Plant.

Figures 3–24 and **3–25** show cumulative total, minority, and low-income populations projected to live within the potentially affected area in 2020 as a function of distance from the Sequoyah Nuclear Plant. Values along the vertical axis show populations residing within a given distance from the Sequoyah Nuclear Plant.

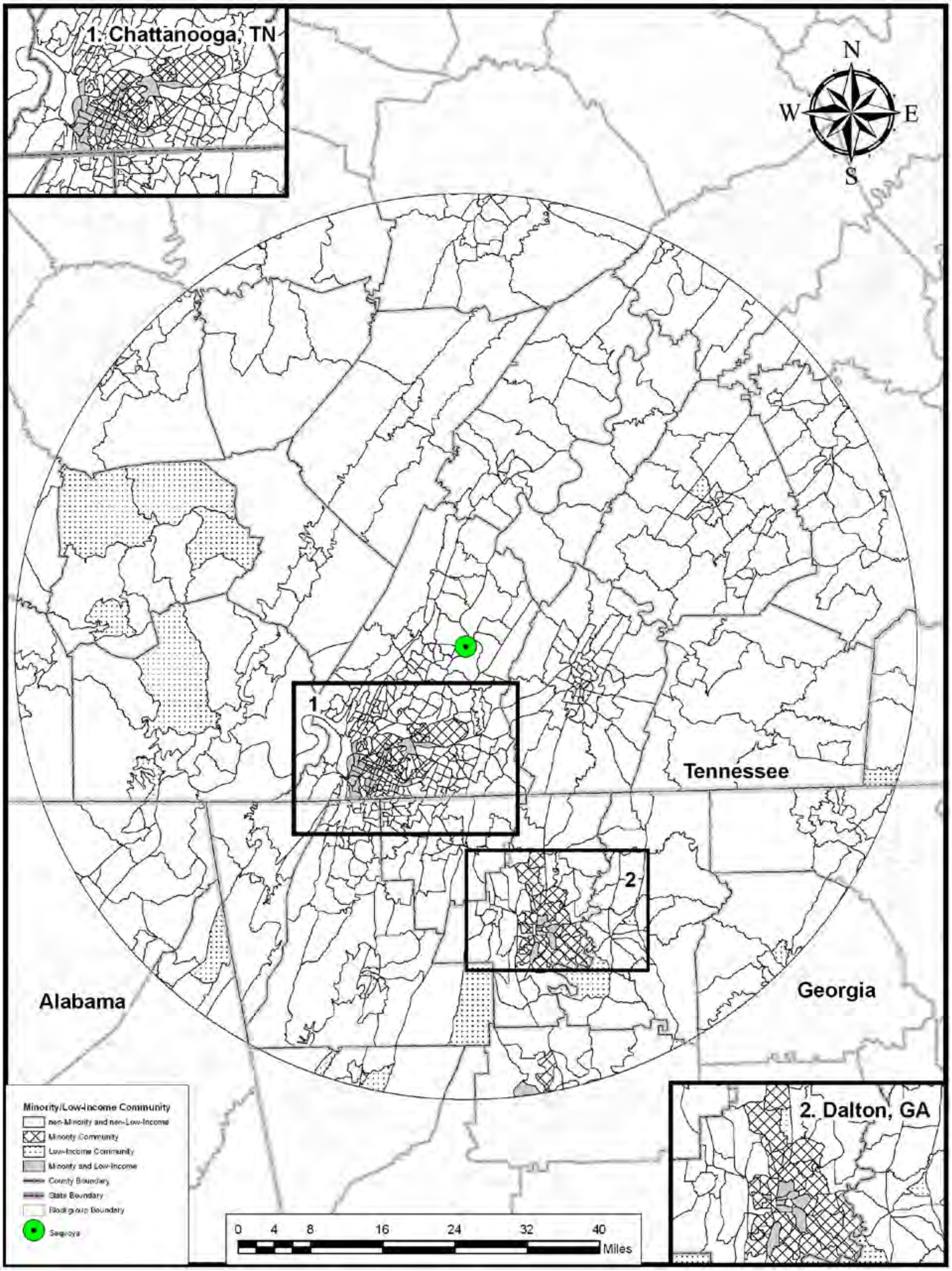

Figure 3–23 Meaningfully Greater Minority and Low-Income Populations Surrounding the Sequoyah Nuclear Plant

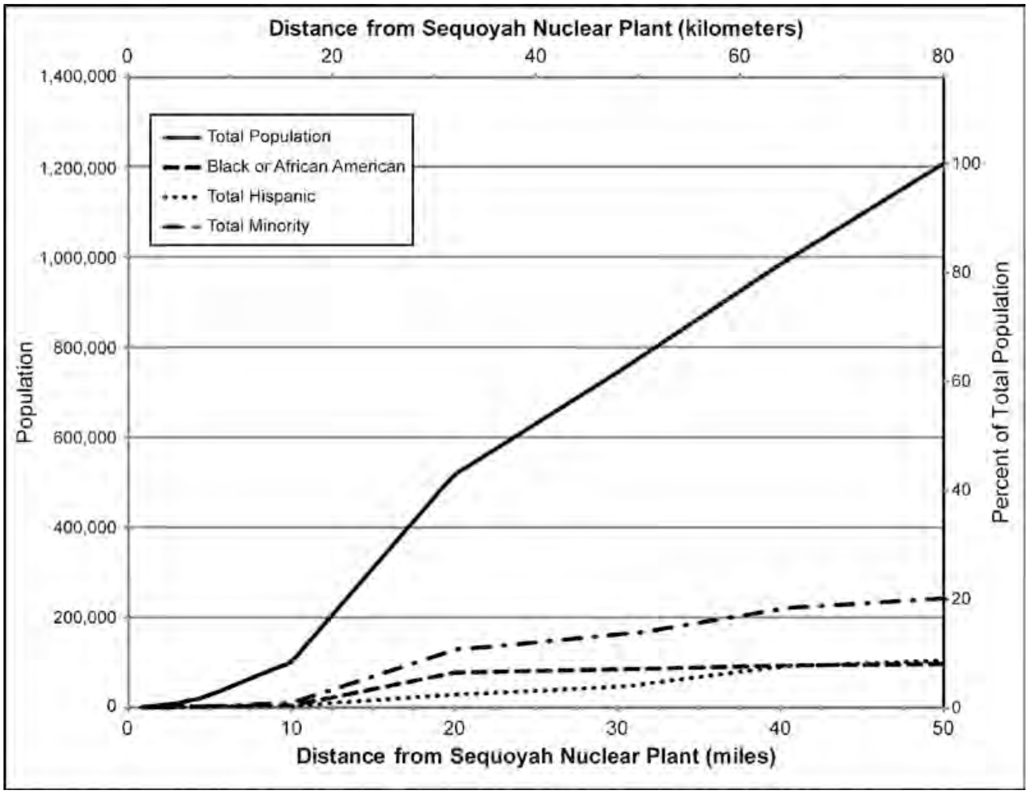

Figure 3–24 Cumulative Minority Populations as a Function of Distance from the Sequoyah Nuclear Plant

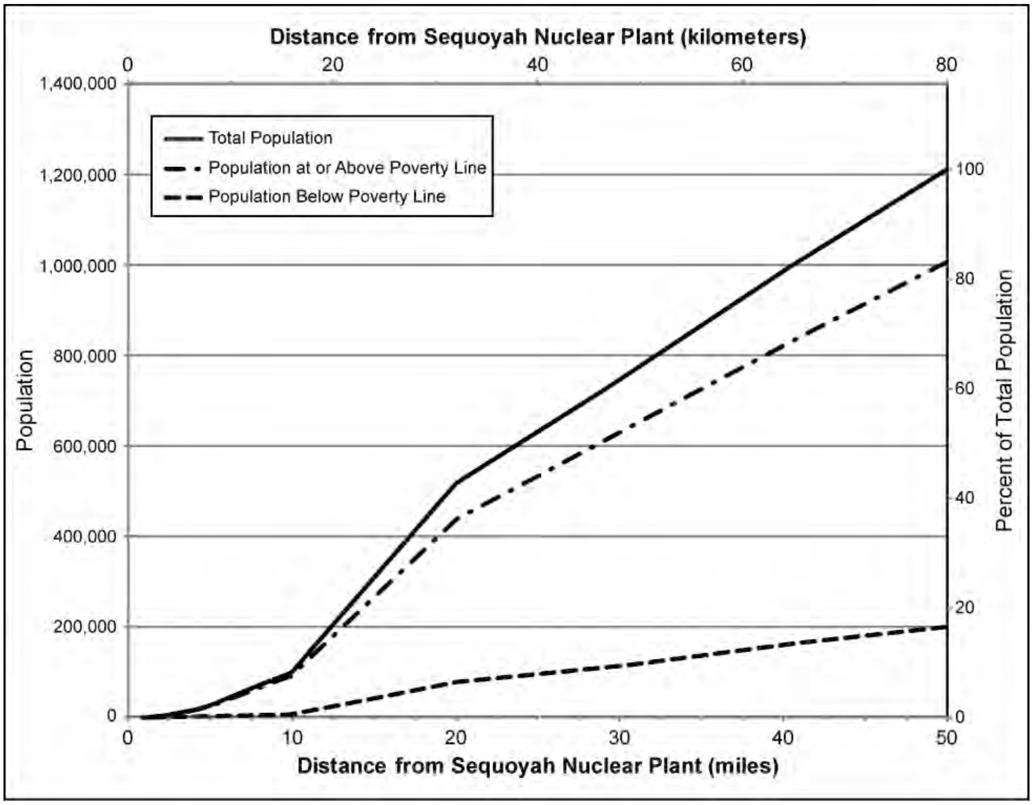

Figure 3–25 Cumulative Low-Income Populations as a Function of Distance from the Sequoyah Nuclear Plant

CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

4.0 ENVIRONMENTAL CONSEQUENCES

Chapter 4 describes the environmental impacts of the alternatives evaluated in this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement*. Each alternative is described in Chapter 2, Section 2.3, and visually depicted in Figures 2–2 through 2–6. Those resource areas having the greatest potential for environmental impacts are discussed in Sections 4.1.1 through 4.1.6: air quality, human health impacts, socioeconomics, waste management, transportation, and environmental justice, respectively. Impacts on remaining resource areas (land resources, geology and soils, water resources, noise, ecological resources, cultural resources, and infrastructure) are addressed in Section 4.1.7. Sections 4.2 and 4.3, respectively, address the potential incremental impacts that could result from processing additional surplus plutonium, and from processing plutonium at reduced rates or from constructing and operating smaller plutonium facilities. Section 4.4 addresses the avoided environmental impacts associated with use of mixed oxide fuel in commercial reactors rather than only low-enriched uranium fuel. Cumulative impacts are addressed in Section 4.5; deactivation, decontamination, and decommissioning in Section 4.6; irreversible and irretrievable commitments of resources in Section 4.7; the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity in Section 4.8; and mitigation in Section 4.9. Environmental consequences under the alternatives are compared in Chapter 2, Section 2.6.

In accordance with the National Environmental Policy Act (NEPA), the U.S. Department of Energy (DOE) has prepared this chapter of this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* to describe the environmental consequences from the execution of alternatives addressed in this *SPD Supplemental EIS*.

Alternatives and Options. The alternatives addressed in this *SPD Supplemental EIS* are described in Chapter 2, Section 2.3, and represent combinations of options for pit disassembly and conversion (described in Section 2.1) and plutonium disposition (described in Section 2.2). **Figure 4–1** illustrates the relationship of the surplus plutonium disposition alternatives and options, and the presentation of impacts, in this *SPD Supplemental EIS*, while the alternatives and options are summarized in the following text box. As shown in the text box, each alternative is comprised of one or two plutonium disposition options; and for each alternative, one to four options are analyzed for pit disassembly and conversion.

Each resource area addressed in Section 4.1 contains an assessment of the environmental consequences from implementing a particular mix of pit disassembly and conversion and plutonium disposition options,[1] from operation of principal plutonium support facilities at the Savannah River Site (SRS) and Los Alamos National Laboratory (LANL), and from shipment of mixed oxide (MOX) fuel assemblies to, and their use at, commercial nuclear power reactors. At SRS, the principal plutonium support facilities are the plutonium storage and surveillance capabilities at K-Area (principally the Material Storage Area [MSA] and the K-Area Interim Surveillance capability [KIS]), the Waste Solidification Building (WSB), and the waste management capability at E-Area. At LANL, the principal plutonium support facility is the waste management capability at Technical Area 54 (TA-54). The commercial nuclear power reactors addressed in this *SPD Supplemental EIS* are the Browns Ferry and Sequoyah Nuclear Plants operated by the Tennessee Valley Authority (TVA) near Athens, Alabama, and Soddy-Daisy, Tennessee, respectively; and one or more generic commercial nuclear power reactors that could be located anywhere in the United States. Information about the facilities addressed in this *SPD Supplemental EIS* is provided in Appendix B.

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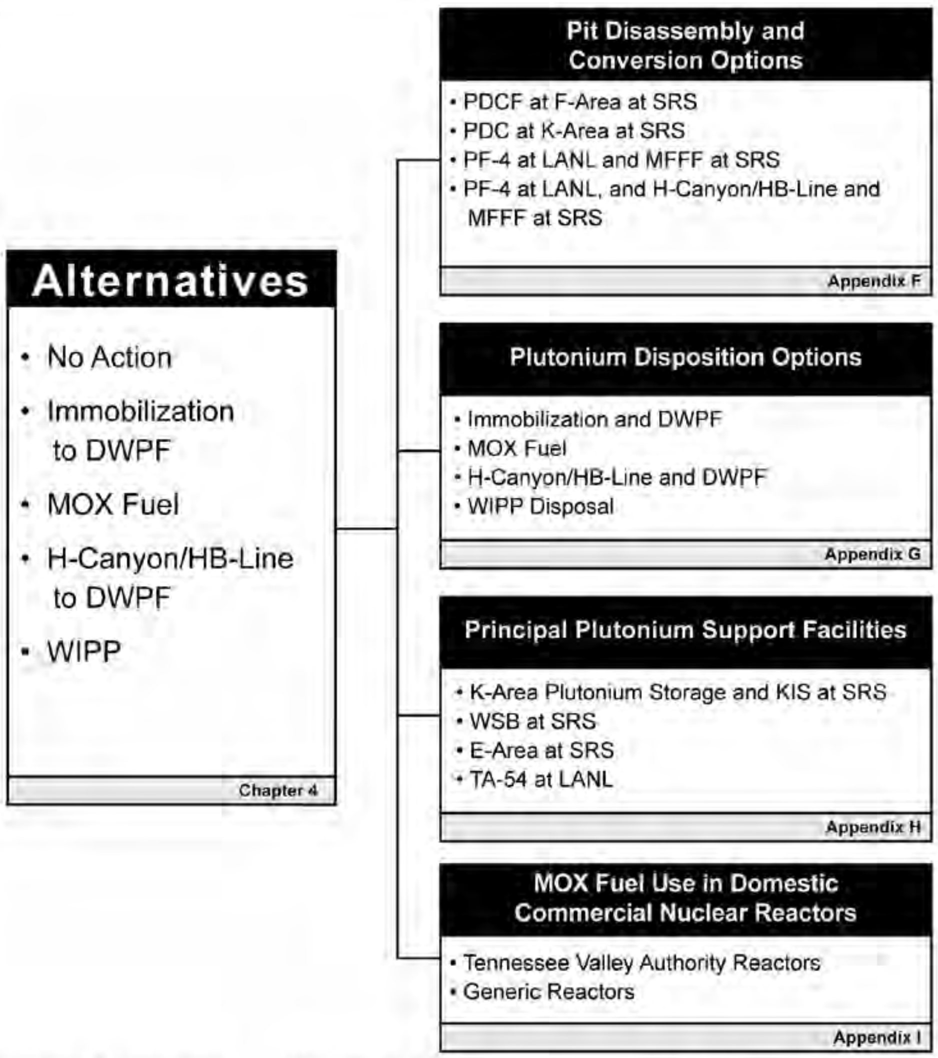
[1] *Two additional options are considered under the MOX Fuel and WIPP Alternatives for disposal of non-pit plutonium as transuranic waste. Under these alternatives, impacts are evaluated assuming that all surplus non-pit plutonium shipped to the Waste Isolation Pilot Plant for disposal as transuranic waste (2 and 6 metric tons [2.2 and 6.6 tons], respectively) would be processed and repackaged before shipment. The additional options involve: (1) using more efficient packaging (called criticality control containers) that hold more plutonium per package; and (2) directly shipping unirradiated Fast Flux Test Facility fuel to the Waste Isolation Pilot Plant without first disassembling and repackaging the fuel.*



DWPF = Defense Waste Processing Facility
KIS = K-Area Interim Surveillance
LANL = Los Alamos National Laboratory
MFFF = Mixed Oxide Fuel Fabrication Facility
MOX = mixed oxide
PDC = Pit Disassembly and Conversion Project
PDCF = Pit Disassembly and Conversion Facility
PF-4 = Plutonium Facility
SRS = Savannah River Site
TA = technical area
WIPP = Waste Isolation Pilot Plant
WSB = Waste Solidification Building

Note: Appendices C and D provide details about the analyses of human health effects at DOE facilities under normal and accident conditions, respectively, while Appendix E provides details about the analysis of human health effects from transportation of materials.

Figure 4–1 Relationship of Surplus Plutonium Disposition Alternatives and Options, and the Presentation of Impacts, in this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

This chapter does not address impacts from continued storage of plutonium at the Pantex Plant (Pantex) under the No Action Alternative. Annual impacts would be small, as described in the *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996b), its 2003 supplement analysis (DOE 2003a), and the *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* (DOE 2008j). Continued storage would not increase these impacts (summarized in Appendix A, Section A.2.1). This chapter also does not address impacts from construction of the Mixed Oxide Fuel Fabrication Facility (MFFF) (other than optional installation of metal oxidation furnaces), construction of the principal plutonium support facilities, or minor upgrades to the Plutonium Facility (PF-4) in TA-55 at LANL to facilitate disassembly and conversion of 2 metric tons (2.2 tons) of pit plutonium. MFFF is already under construction and impacts have been assessed (DOE 1999b; NRC 2005a). Principal plutonium support facilities at SRS and LANL are already operational or are under construction; impacts from facilities under construction have been assessed (DOE 2008f, 2008i). The minor upgrades to PF-4 needed to support a 2-metric-ton (2.2-ton) pit disassembly and conversion effort, which is underway, are summarized in Appendix B, Section B.2.1, and have been assessed (DOE 2008f).

Surplus Plutonium Disposition Alternatives

Alternative	*Pit Disassembly and Conversion Option*	*Plutonium Disposition Option*
No Action	PDCF	MOX Fuel (34 metric tons) [a]
Immobilization to DWPF	PDCF; PF-4 and MFFF; or PF-4, HC/HBL, and MFFF	MOX Fuel (34 metric tons) and Immobilization and DWPF (13.1 metric tons)
MOX Fuel	PDCF; PDC; PF-4 and MFFF; or PF-4, HC/HBL, and MFFF	MOX Fuel (45.1 metric tons) and WIPP Disposal (2 metric tons)
HC/HBL to DWPF	PDCF; PDC; PF-4 and MFFF; or PF-4, HC/HBL, and MFFF	MOX Fuel (41.1 metric tons) and HC/HBL and DWPF (6 metric tons)
WIPP	PDCF; PDC; PF-4 and MFFF; or PF-4, HC/HBL, and MFFF	MOX Fuel (41.1 metric tons) and WIPP Disposal (6 metric tons)

Pit Disassembly and Conversion and Plutonium Disposition Options

Pit Disassembly and Conversion (at LANL and SRS)	*Plutonium Disposition (at SRS)*
PDCF. Pit disassembly and conversion to plutonium oxide would principally occur at PDCF at F-Area at SRS. Pit disassembly and conversion of 2 metric tons of plutonium would occur at PF-4 at TA-55 at LANL; the plutonium oxide would be shipped to SRS.	*Immobilization and DWPF*. Plutonium would be immobilized at a K-Area immobilization capability, and canisters of immobilized plutonium would be filled with vitrified HLW at DWPF at S-Area, and stored in GWSBs.
PDC. Pit disassembly and conversion to plutonium oxide would principally occur at PDC at K-Area at SRS. As under the PDCF Option, pit disassembly and conversion of 2 metric tons of plutonium would occur at PF-4 at LANL.	*MOX Fuel*. Plutonium would be fabricated into MOX fuel at MFFF. MOX fuel would be shipped to and used at commercial nuclear power plants. [b]
PF-4 and MFFF. Pit disassembly would occur at PF-4 at TA-55 at LANL. Disassembled pits would be converted to plutonium oxide and shipped to SRS, or plutonium metal would be shipped to SRS and converted to plutonium oxide at metal oxidation furnaces in MFFF at F-Area. [c]	*HC/HBL and DWPF*. Non-pit plutonium would be dissolved at HC/HBL and combined with vitrified HLW at DWPF. Canisters containing vitrified HLW and surplus plutonium would be stored in GWSBs.
PF-4, HC/HBL, and MFFF. Pit disassembly would occur at PF-4 at LANL and at K-Area at SRS. Pits disassembled at PF-4 would be converted to plutonium oxide and shipped to SRS, or plutonium metal would be shipped to SRS and converted to plutonium oxide at HC/HBL or in metal oxidation furnaces at MFFF. Pits disassembled at K-Area would be converted to plutonium oxide at HC/HBL. [d]	*WIPP Disposal*. Non-pit plutonium would be combined with inert material at HC/HBL, and placed within POCs. POCs would be staged at E-Area at SRS pending shipment to WIPP near Carlsbad, New Mexico, for disposal as TRU waste.

DWPF = Defense Waste Processing Facility; GWSB = Glass Waste Storage Building; HC/HBL = H-Canyon/HB-Line; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; POC = pipe overpack container; SRS = Savannah River Site; TA = Technical Area; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

[a] Under the No Action Alternative, storage of 13.1 metric tons of plutonium would continue at the Pantex Plant and SRS.

[b] Under the MOX Fuel Alternative, 4 metric tons of non-pit plutonium would be converted to plutonium oxide at HC/HBL before fabrication into MOX fuel at MFFF.

[c] All plutonium converted to plutonium oxide at MFFF would be fabricated into MOX fuel.

[d] Conversion to plutonium oxide at HC/HBL may include vacuum salt distillation pretreatment in HB-Line to separate plutonium from chloride and fluoride salts.

Note: To convert metric tons to tons, multiply by 1.1023.

This chapter does not address impacts from disposal of transuranic (TRU) waste at the Waste Isolation Pilot Plant (WIPP) or disposal of used fuel (also known as spent fuel or spent nuclear fuel). Impacts from TRU waste disposal are addressed in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b), and incorporated by reference in this *SPD Supplemental EIS* (see Appendix A, Section A.2.2).

Approach to Analysis. Following the impact assessment methods described in Appendix F of the *Surplus Plutonium Disposition Final Environmental Impact Statement (SPD EIS)* (DOE 1999b), impacts for each alternative are estimated based on facility characteristics and requirements from Chapter 2 and Appendix B of this *SPD Supplemental EIS* and affected environment information from Chapter 3. Impact assessment methods presented in the *SPD EIS* are not repeated herein, although differences between those analyses and analyses for this *SPD Supplemental EIS* are described in the resource area sections in this chapter.

The primary focus of this chapter is to compare impacts among the five alternatives addressed in this *SPD Supplemental EIS*. The analysis for each alternative addresses impacts as a function of the pit disassembly and conversion option when the impacts differ by option. Detailed facility-specific impacts are provided in Appendices C, D, and F through J.

Facility-specific periods of construction and operation were assumed as summarized for each alternative in Appendix B, Table B–2. The construction periods were assumed based on current plans and schedules and could vary somewhat upon implementation. The assessed impacts and operational periods only reflect those that could be attributed to the surplus plutonium disposition alternatives addressed in this *SPD Supplemental EIS*.[2]

4.1 Impacts from Alternatives

4.1.1 Air Quality

Nonradioactive air pollutant impacts at SRS and LANL under each alternative are evaluated in this section. Radioactive air pollutant impacts at SRS and LANL are evaluated in Section 4.1.2.

Activities under the alternatives could result in emissions of criteria, hazardous, and toxic air pollutants from facility construction and operation. Air pollutant emissions were evaluated for construction activities. In addition, projected air pollutant concentrations at site boundaries were evaluated for operational activities and compared to applicable standards and significance levels. Significance levels are concentrations below which no further analysis is necessary for that pollutant for the purpose of permitting. Concentrations above the significance levels would need to undergo further analysis to consider the cumulative impacts from other sources within the impact area (EPA 1990:C28; Page 2010a, 2010b; 40 CFR 51.165(b) (2)). Where new modeling was performed for this *SPD Supplemental EIS*, current U.S. Environmental Protection Agency (EPA) models were used. For example, the EPA AERMOD dispersion model (EPA 2004) was used unless stated otherwise. As required, updated emissions and resultant concentrations were determined based on information provided in cited references.

The maximum concentration values presented in this section are the highest 1st high concentrations calculated at a specific receptor. Use of the highest 1st high concentrations is appropriate for comparison with significance levels. However, use of the highest 1st high concentrations is not always appropriate for comparison with ambient air quality standards. As discussed in footnote "a" of Chapter 3, Table 3–7, the ambient air quality standards allow the use of a variety of methods for evaluating the number of

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[2] *For example, the assumed operational periods for the Defense Waste Processing Facility under the* SPD Supplemental EIS *alternatives only reflect the time estimated to process surplus plutonium and not the time required for processing all high-level radioactive waste. Similarly, the annual impacts assessed for the Defense Waste Processing Facility only reflect those impacts that would be attributable to processing plutonium at the facility and not the annual impacts for operating the facility for all waste. This is because surplus plutonium would constitute only a fraction of the material that would be annually vitrified at the Defense Waste Processing Facility.*

exceedances allowed before the standard is considered to not be met. For example, the basis for compliance with the 1-hour nitrogen dioxide standard in this *SPD Supplemental EIS* is a 3-year average of the 98th percentile of the daily maximum 1-hour average. However, EPA guidance (EPA 2011b) on demonstrating compliance with the 1-hour nitrogen dioxide National Ambient Air Quality Standards (NAAQS) is to use the eighth-highest daily maximum 1-hour value (not the highest 1-hour value) as an unbiased surrogate for the 98th percentile.

EPA's final rule for "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (40 CFR 93.150 – 93.165) requires a conformity determination for certain-sized projects in nonattainment areas. A conformity determination is not necessary to meet the requirements of the conformity rule for the alternatives considered in this *SPD Supplemental EIS* because SRS and LANL are located in areas that are in attainment for all criteria pollutants (DOE 2000).

Emissions from shipping unirradiated MOX fuel to domestic commercial nuclear power reactors are addressed in Appendix I, as are impacts on air quality from use of a 40 percent MOX fuel core in these reactors. As described in Appendix I, emissions from shipping unirradiated MOX fuel to domestic commercial nuclear power reactor sites are not expected to be substantially different than those from shipping low-enriched uranium (LEU) fuel to these reactor sites. In addition, the use of a 40 percent MOX fuel core in domestic commercial nuclear power reactors is not expected to meaningfully change the impacts on air quality that currently occur from use of a 100 percent LEU fuel core. Therefore, the impacts from shipping unirradiated MOX fuel to domestic commercial nuclear power reactors, and from irradiation of MOX fuel at these reactors, are not discussed further in this section.

In addition, although pit disassembly and conversion at PF-4 at LANL occurs under all alternatives, this section only addresses in detail those impacts on air quality that could result from construction activities at PF-4 under the action alternatives for the PF-4 at LANL and MFFF at SRS Option (PF-4 and MFFF Option) and the PF-4 at LANL, and H-Canyon/HB-Line and MFFF at SRS Option (PF-4, H-Canyon/HB-Line, and MFFF Option). These activities are needed under these alternatives and options to process 35 metric tons (38.6 tons) of plutonium. No construction is needed at PF-4 under the No Action Alternative, and for the PDCF at F-Area at SRS Option (PDCF Option) and the PDC at K-Area at SRS Option (PDC Option) under the action alternatives, to process 2 metric tons (2.2 tons) of plutonium, and thus there would be no construction impacts on air quality. Furthermore, there would be no increase in criteria or nonradioactive toxic air pollutant emissions at PF-4 from pit disassembly and conversion operations under any alternative. This is because emissions of pollutants to the air from PF-4 operations result from tests of emergency diesel generators, and the frequency and extent of these tests at PF-4 would not change whether 2 or 35 metric tons (2.2 tons or 38.6 tons) of plutonium were processed at PF-4 (LANL 2012a). Therefore, impacts on air quality from operations at PF-4 are not addressed further in this section because no increase in air pollutant concentrations would result from activities at PF-4 under any alternative.

Finally, under all alternatives, it is not expected that surplus plutonium disposition activities at the principal plutonium support facilities at LANL would result in significant increases in emissions of criteria or nonradioactive toxic air pollutants. Therefore, the impacts under the alternatives from activities at the principal LANL plutonium support facilities are not discussed further in this section.

4.1.1.1 No Action Alternative

Construction—Construction-related impacts would include nonradioactive air pollutant emissions from construction of the Pit Disassembly and Conversion Facility (PDCF). This construction activity would emit particulate matter and other pollutants from operation of diesel-powered construction equipment and a concrete batch plant, as well as from vehicles and other mobile sources. Construction of PDCF, as currently designed, would require land in addition to that analyzed in the *SPD EIS* (DOE 1999b). Earthmoving and other construction activities are expected to result in emissions higher than those estimated in the *SPD EIS*. Estimated nonradioactive air pollutant concentrations at the SRS site boundary from PDCF construction are provided in Appendix F, Table F–1. These concentrations would not exceed the NAAQS or applicable state standards. Peak year air pollutant emissions (metric tons per year) from construction of PDCF are provided in Appendix F, Table F–2.

Operations—Estimated contributions to air pollutant concentrations at the SRS site boundary from facility operations under the No Action Alternative are presented in **Table 4–1**. Principal sources of emissions include PDCF, MFFF, and WSB (see Appendices F, G, and H, respectively). Additional sources of operational air pollutants include boilers that provide heating for plutonium management activities at K-Area, including plutonium storage and KIS. No change is expected in the annual emissions from operation of the K-Area facilities under this alternative.

Concentrations of toxic pollutants from WSB were estimated to be below 0.0001 percent of the acceptable source impact levels for all the toxic pollutants except nitric acid, which was estimated at 0.12 percent. Emissions from KIS, PDCF, and MFFF would include small quantities of nickel, nickel oxide, beryllium, beryllium oxide, and fluoride (WSRC 2008a). Emissions would be in compliance with all air pollutant control regulations (SCDHEC 2010b, 2010c, 2011). Mitigation of air pollutants and protection of workers are discussed in Sections 4.9.4 and 4.9.6, respectively.

Table 4–1 indicates that the applicable standards for criteria pollutants would not be exceeded. In addition, when the concentrations (maximum permitted contribution) from existing sources at SRS (see Chapter 3, Table 3–7) and ambient concentrations (see Chapter 3, Table 3–8) are added to the contributions shown in Table 4–1, the applicable standards would still not be exceeded. Because the maximum concentrations would not necessarily occur at the same location or time, the addition of these values provides a conservative estimate of the potential maximum site boundary concentrations. Actual values are expected to be lower. Emissions of PM_{10} (particulate matter less than or equal to 10 microns in aerodynamic diameter) were used to represent $PM_{2.5}$ (particulate matter less than or equal to 2.5 microns in aerodynamic diameter) emissions when $PM_{2.5}$ emission factors were not available, which may overstate the emissions of $PM_{2.5}$. If a background concentration for $PM_{2.5}$ and the contribution from existing facilities were added to the $PM_{2.5}$ concentrations for the alternative, the $PM_{2.5}$ 24-hour or annual standard could be exceeded. This could occur as a result of the conservative nature of the site boundary concentration estimates. The contributions to concentrations of criteria pollutants are below significance levels except for the nitrogen dioxide 1-hour average contribution.

DOE expects that the replacement biomass-fired cogeneration plant and biomass-fired steam generating units at K- and L-Areas at SRS would decrease the annual overall air pollutant emissions rates for particulate matter by about 360 metric tons (400 tons), nitrogen oxides by about 2,300 metric tons (2,500 tons), and sulfur dioxide by about 4,500 metric tons (5,000 tons). Annual emissions of carbon monoxide would increase by about 180 metric tons (200 tons) and volatile organic compounds by about 25 metric tons (28 tons) (DOE 2008e:30-31). These changes are reflected in the concentrations listed in Chapter 3, Table 3–7.

Annual employee vehicle emissions associated with operations under the No Action Alternative in the peak employment year are expected to increase by about 15 percent at SRS over 2010 emissions based on the change in employment (SRNS 2012). However, implementation of policies to reduce the use of current fuels (e.g., gasoline, diesel fuel) and increase the use of alternative fuels (e.g., E-85) is expected to reduce the levels of vehicle emissions (Executive Order 13514; DOE Order 436.1), somewhat offsetting the projected increase in emissions under this alternative. Estimated total emissions from shipping waste, construction materials, and materials other than unirradiated MOX fuel are presented in **Table 4–2**.

Table 4–1 Summary of Air Pollutant Concentrations at the Site Boundary from Savannah River Site Operations by Alternative

Pollutant and Averaging Period	***Pit Disassembly and Conversion Option***	***More Stringent Standard or Guideline*** [a]	***Significance Level*** [b]	***Alternative***				
				No Action	***Immobilization to DWPF***	***MOX Fuel***	***HC/HBL to DWPF***	***WIPP***
Criteria Pollutants (micrograms per cubic meter)								
Carbon monoxide – 8 hour	PDCF	10,000	500	37	55	37	37	37
	PDC	10,000	500	N/A	N/A	36	36	36
	PF-4 and MFFF	10,000	500	N/A	41	23	23	23
	PF-4, HC/HBL, and MFFF	10,000	500	N/A	41	23	23	23
Carbon monoxide – 1 hour	PDCF	40,000	2,000	150	290	150	150	150
	PDC	40,000	2,000	N/A	N/A	120	120	120
	PF-4 and MFFF	40,000	2,000	N/A	219	79	79	79
	PF-4, HC/HBL, and MFFF	40,000	2,000	N/A	219	79	79	79
Nitrogen dioxide – annual	PDCF	100	1	0.091	0.12	0.091	0.091	0.091
	PDC	100	1	N/A	N/A	0.092	0.092	0.092
	PF-4 and MFFF	100	1	N/A	0.074	0.05	0.05	0.05
	PF-4, HC/HBL, and MFFF	100	1	N/A	0.074	0.05	0.05	0.05
Nitrogen dioxide – 1 hour	PDCF	188	7.5	120 [c]	160 [c]	120	120	120
	PDC	188	7.5	N/A	N/A	73 [c]	73 [c]	73 [c]
	PF-4 and MFFF	188	7.5	N/A	39 [c]	N/R	N/R	N/R
	PF-4, HC/HBL, and MFFF	188	7.5	N/A	39 [c]	N/R	N/R	N/R
PM_{10} – annual	PDCF	50	1	<0.001 [c]	0.0012 [c]	<0.001 [c]	<0.001 [c]	<0.001 [c]
	PDC	50	1	N/A	N/A	<0.001 [c]	<0.001 [c]	<0.001 [c]
	PF-4 and MFFF	50	1	N/A	0.0012	0.00041	0.00041	0.00041
	PF-4, HC/HBL, and MFFF	50	1	N/A	0.0012	0.00041	0.00041	0.00041
PM_{10} – 24 hour	PDCF	150	5	1.3	2.3	1.3	1.3	1.3
	PDC	150	5	N/A	N/A	1.4	1.4	1.4
	PF-4 and MFFF	150	5	N/A	1.8	0.78	0.78	0.78
	PF-4, HC/HBL, and MFFF	150	5	N/A	1.8	0.78	0.78	0.78
$PM_{2.5}$ – annual	PDCF	15	0.3	0.0022	0.0022	0.0014	0.0014	0.0014
	PDC	15	0.3	N/A	N/A	0.0014	0.0014	0.0014
	PF-4 and MFFF	15	0.3	N/A	0.0012	0.0004	0.00041	0.00041
	PF-4, HC/HBL, and MFFF	15	0.3	N/A	0.0012	0.0004	0.00041	0.00041
$PM_{2.5}$ – 24 hour	PDCF	35	1.2	1.1	2.1	1.1	1.1	1.1
	PDC	35	1.2	N/A	N/A	1.3	1.3	1.3
	PF-4 and MFFF	35	1.2	N/A	1.8	0.78	0.78	0.78
	PF-4, HC/HBL, and MFFF	35	1.2	N/A	1.8	0.78	0.78	0.78
Sulfur dioxide – annual	PDCF	80	1	0.0031	0.01 [c]	0.0031	0.0031	0.0031
	PDC	80	1	N/A	N/A	0.004	0.004	0.004
	PF-4 and MFFF	80	1	N/A	0.01	0.003	0.003	0.003
	PF-4, HC/HBL, and MFFF	80	1	N/A	0.01	0.003	0.003	0.003
Sulfur dioxide – 24 hour	PDCF	365	5	4.8	13	4.8	4.8	4.8
	PDC	365	5	N/A	N/A	5	5	5
	PF-4 and MFFF	365	5	N/A	13	4.8	4.8	4.8
	PF-4, HC/HBL, and MFFF	365	5	N/A	13	4.8	4.8	4.8

Pollutant and Averaging Period	*Pit Disassembly and Conversion Option*	*More Stringent Standard or Guideline* [a]	*Significance Level* [b]	*Alternative*				
				No Action	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
Sulfur dioxide – 3 hour	PDCF	1,300	25	22 [c]	81 [c]	22 [c]	22 [c]	22 [c]
	PDC	1,300	25	N/A	N/A	22	22	22
	PF-4 and MFFF	1,300	25	N/A	81	22	22	22
	PF-4, HC/HBL, and MFFF	1,300	25	N/A	81	22	22	22
Sulfur dioxide – 1 hour	PDCF	197	7.8	0.12 [c]	65 [c]	0.12 [c]	0.12 [c]	0.12 [c]
	PDC	197	7.8	N/A	N/A	N/R	N/R	N/R
	PF-4 and MFFF	197	7.8	N/A	65 [c]	N/R	N/R	N/R
	PF-4, HC/HBL, and MFFF	197	7.8	N/A	65 [c]	N/R	N/R	N/R

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; N/R = not reported; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; PM_n = particulate matter less than or equal to *n* microns in aerodynamic diameter; WIPP = Waste Isolation Pilot Plant.

[a] The more stringent of the Federal and South Carolina State standards is presented if both exist for the averaging period.

[b] EPA 1990; Page 2010a, 2010b; 40 CFR 51.165(b)(2).

[c] Value would be somewhat higher because the contribution from at least one facility was not reported and is not included in this total.

Note: Values have been rounded where appropriate. Concentrations are maximums to which the public would be exposed and are typically at the site boundary.

Source: Appendices F, G, and H.

Table 4–2 Criteria Pollutant Emissions from Shipping Waste, Construction Materials, and Materials Other than Unirradiated Mixed Oxide Fuel [a] (metric tons)

Pit Disassembly and Conversion Option	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Carbon monoxide					
PDCF	50	62	62	57	70
PDC	N/A	N/A	67	62	75
PF-4 and MFFF	N/A	47	47	42	56
PF-4, HC/HBL, and MFFF	N/A	49	49	44	57
Nitrogen dioxide					
PDCF	170	210	210	190	240
PDC	N/A	N/A	230	210	250
PF-4 and MFFF	N/A	160	160	140	190
PF-4, HC/HBL, and MFFF	N/A	170	170	150	190
PM_{10}					
PDCF	5.0	6.1	6.1	5.6	6.9
PDC	N/A	N/A	6.6	6.1	7.4
PF-4 and MFFF	N/A	4.7	4.7	4.2	5.6
PF-4, HC/HBL, and MFFF	N/A	4.9	4.9	4.4	5.6
$PM_{2.5}$					
PDCF	4.2	5.1	5.1	4.7	5.8
PDC	N/A	N/A	5.5	5.1	6.2
PF-4 and MFFF	N/A	3.9	3.9	3.5	4.7
PF-4, HC/HBL, and MFFF	N/A	4.1	4.1	3.7	4.7
Sulfur dioxide					
PDCF	0.21	0.25	0.25	0.23	0.29
PDC	N/A	N/A	0.27	0.25	0.31
PF-4 and MFFF	N/A	0.19	0.19	0.17	0.23
PF-4, HC/HBL, and MFFF	N/A	0.20	0.20	0.18	0.23

Pit Disassembly and Conversion Option	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Volatile organic compounds					
PDCF	8.0	9.8	9.8	9.0	11
PDC	N/A	N/A	11.	9.8	12.
PF-4 and MFFF	N/A	7.5	7.5	6.7	8.9
PF-4, HC/HBL, and MFFF	N/A	7.8	7.8	7.0	9.0

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; PM_n = particulate matter less than or equal to *n* microns in aerodynamic diameter; WIPP = Waste Isolation Pilot Plant.

[a] These estimates do not include shipments of unirradiated MOX fuel to Tennessee Valley Authority and generic reactor sites which are addressed in Appendix I.

Note: To convert metric tons to tons, multiply by 1.1023.

Combustion of fossil fuels under this alternative would result in the emission of carbon dioxide, one of the atmospheric gases believed to influence global climate change. Annual carbon dioxide emissions under this alternative, based on estimated fuel use (see Section 4.1.7.7.1); electricity use; employee vehicles; and truck shipments of waste, construction materials, and materials other than unirradiated MOX fuel, would be about 150,000 metric tons (170,000 tons) per year, representing about 0.002 percent of the 2010 annual U.S. emissions of carbon dioxide equivalent[3] (EPA 2012). Direct (Scope 1) emissions[4] from onsite fuel use were estimated to be 3,900 metric tons (4,300 tons), representing a fraction of the total carbon dioxide emissions under this alternative.

4.1.1.2 Immobilization to DWPF Alternative

Construction—At SRS and as addressed in Appendix G, Section G.1.1, with the exception of a 2-acre (0.8-hectare) construction site, construction of the K-Area immobilization capability under this alternative would occur inside existing buildings. Equipment used for construction of the K-Area immobilization capability would generate small quantities of fugitive dust and other emissions (SRNS 2012). Minimal emissions of pollutants would result from modifications to the Defense Waste Processing Facility (DWPF) to support receipt and handling of canisters containing plutonium immobilized at K-Area. In addition, under the PDCF Option, potential emissions from construction-related activities could include those from construction of PDCF as described under the No Action Alternative (Section 4.1.1.1). Under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, no additional construction emissions would be expected from installation of metal oxidation furnaces at MFFF (SRNS 2012). Under the PF-4, H-Canyon/HB-Line, and MFFF Option, no changes in emissions are projected from the K-Area Complex from installation of pit disassembly equipment, or from modifications to H-Canyon/HB-Line to support enhanced conversion of plutonium to plutonium oxide. Under all pit disassembly and conversion options, concentrations of criteria pollutants at the SRS boundary would not exceed the NAAQS or applicable state standards.

At LANL, with the exception of a 2-acre (0.8-hectare) parking and construction trailer site, construction activities under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option would occur inside PF-4. Peak year site boundary concentrations of criteria pollutants from optional modifications to PF-4 are presented in Appendix F, and would not exceed the NAAQS or applicable state standards. Peak-year air pollutant emissions from modifications to PF-4 under these options are provided in Appendix F, Table F–2.

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[3] *Carbon dioxide equivalents include emissions of carbon dioxide and other greenhouse gases multiplied by their global warming potential, a metric for comparing the potential for climate impact of the emissions of different greenhouse gases.*

[4] *The Greenhouse Gas Protocol® (WRI/WBCSD 2011) categorizes direct and indirect emissions into three scopes: Scope 1 includes all direct greenhouse gas emissions; Scope 2 includes indirect emissions from consumption of purchased electricity, heat, or steam; and Scope 3 includes certain other indirect emissions. Direct emissions are from sources that the reporting party owns or controls.*

Operations—Estimated contributions to air pollutant concentrations at the SRS boundary under this alternative from facility operations are presented in Table 4–1. Boundary concentrations are projected to vary depending on the pit disassembly and conversion option. Minimal emissions from operation of the K-Area immobilization capability are expected, other than from operation and testing of diesel generators at K-Area, and no change is expected in emissions from operation of DWPF (see Appendix G, Section G.1.1). No significant increase in air pollutant emissions is expected from storage of vitrified HLW canisters containing immobilized plutonium in the Glass Waste Storage Buildings (GWSBs). Under the PDCF Option, additional contributions to boundary concentrations could result from operation of PDCF. Under the PF-4 and MFFF Option, no changes in site boundary concentrations are projected from operation of metal oxidation furnaces at MFFF. Under the PF-4, H-Canyon/HB-Line, and MFFF Option, no changes in site boundary concentrations are projected from operation of metal oxidation furnaces at MFFF, from pit disassembly at K-Area, or from oxidation of plutonium at H-Canyon/HB-Line for immobilization or fabrication into MOX fuel. Under all pit disassembly and conversion options, contributions from operation of WSB, K-Area storage, and KIS would be the same as those under the No Action Alternative.

Table 4–1 indicates that the applicable standards for criteria pollutants would not be exceeded at SRS. In addition, when the concentrations (maximum permitted contributions) from existing sources at SRS (see Chapter 3, Table 3–7) and ambient concentrations (see Chapter 3, Table 3–8) are added to the contributions shown in Table 4–1, the applicable standards would still not be exceeded. Using PM_{10} as a surrogate for $PM_{2.5}$ indicates that $PM_{2.5}$ is expected to meet the ambient standards. If a background concentration for $PM_{2.5}$ and the contribution from existing facilities were added to the $PM_{2.5}$ contributions for the alternative, the $PM_{2.5}$ 24-hour or annual standard could be exceeded. This could occur as a result of the conservative nature of the site boundary concentration estimates. The contributions for all pit disassembly and conversion options to concentrations of criteria pollutants are below significance levels except for the nitrogen dioxide 1-hour average, the $PM_{2.5}$ 24-hour, and the sulfur dioxide 24-, 3-, and 1-hour contributions. Existing air pollutant concentrations at SRS include contributions from currently operating facilities such as the K-Area Complex, H-Canyon/HB-Line, and DWPF, which are expected to be essentially unchanged under this alternative.

Employee vehicle emissions under the Immobilization to DWPF Alternative in the peak employment year are expected to increase by about 12 to 18 percent at SRS over 2010 emissions. Employee vehicle emissions at LANL would increase by less than 2 percent under any of the pit disassembly and conversion options. Estimated total emissions from shipping waste, construction materials, and materials other than unirradiated MOX fuel are presented in Table 4–2.

Combustion of fossil fuels associated with this alternative would result in the emission of carbon dioxide, one of the gases believed to influence global climate change. Annual carbon dioxide emissions under this alternative, based on fuel use estimates (see Section 4.1.7.7.2); electricity use; employee vehicles; and truck shipments of waste, construction materials, and materials other than unirradiated MOX fuel, would be about 170,000 metric tons (190,000 tons) per year, representing about 0.0025 percent of the 2010 annual U.S. emissions of carbon dioxide equivalent (EPA 2012). Direct (Scope 1) emissions from onsite fuel use were estimated to be 4,000 metric tons (4,400 tons), representing a fraction of the total carbon dioxide emissions under this alternative.

4.1.1.3 MOX Fuel Alternative

Construction—At SRS, potential emissions and air quality impacts could include those from construction of PDCF in F-Area (PDCF Option) as described under the No Action Alternative (Section 4.1.1.1), or from construction of the Pit Disassembly and Conversion Project (PDC) in K-Area (PDC Option) (see Appendix F, Section F.1.2). Peak annual emissions from PDC construction are presented in Appendix F, Table F–2. As under the Immobilization to DWPF Alternative (Section 4.1.1.2), no additional construction emissions are expected from installation of metal oxidation furnaces at MFFF under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Options. Under the PF-4, H-Canyon/HB-Line, and MFFF Option, no changes in emissions are projected from the K-Area

Complex from installation of pit disassembly equipment, or from modifications to H-Canyon/HB-Line to support conversion of plutonium to plutonium oxide. Under any pit disassembly and conversion option, concentrations of criteria pollutants would not exceed the NAAQS or applicable state standards.

At LANL, emissions from modifications to PF-4 under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option would be the same as those in Section 4.1.1.2 under the Immobilization to DWPF Alternative.

Operations—Estimated contributions to air pollutant concentrations at the SRS boundary from facility operations under the MOX Fuel Alternative are presented in Table 4–1. Boundary concentrations are projected to vary depending on the pit disassembly and conversion option. No change in site boundary concentrations is expected from operation of H-Canyon/HB-Line to oxidize 4 metric tons (4.4 tons) of non-pit plutonium for MOX fuel fabrication or to prepare 2 metric tons (2.2 tons) of non-pit plutonium for WIPP disposal. Contributions to boundary concentrations could result from operation of PDCF under the PDCF Option, or from operation of PDC under the PDC Option. Under the PF-4 and MFFF Option, no changes in site boundary concentrations are projected from operation of metal oxidation furnaces at MFFF. Under the PF-4, H-Canyon/HB-Line, and MFFF Option, no changes in existing site boundary concentrations (presented in Chapter 3, Table 3–7) are projected from operation of metal oxidation furnaces at MFFF, from pit disassembly at K-Area, or from oxidation of plutonium at H-Canyon/HB-Line for fabrication into MOX fuel. (Oxidation of plutonium at H-Canyon/HB-Line could include pretreatment using vacuum salt distillation equipment.) Contributions from operation of WSB, K-Area storage, and KIS would be the same under this alternative as those under the No Action Alternative (Section 4.1.1.1).

Table 4–1 indicates that the applicable standards for criteria pollutants would not be exceeded. In addition, when the concentrations (maximum permitted contributions) from existing sources at SRS (see Chapter 3, Table 3–7) and ambient concentrations (see Chapter 3, Table 3–8) are added to the contributions shown in Table 4–1, the applicable standards would still not be exceeded. Using PM_{10} as a surrogate for $PM_{2.5}$ indicates that $PM_{2.5}$ is expected to meet the ambient standards. If a background concentration for $PM_{2.5}$ and the contribution from existing facilities were added to the $PM_{2.5}$ contributions for the alternative, the $PM_{2.5}$ 24-hour or annual standard could be exceeded. This could occur as a result of the conservative nature of the site boundary concentration estimates. The contributions under the PDCF and PDC Options to concentrations of criteria pollutants are below significance levels except for the nitrogen dioxide 1-hour average contribution for both options and the $PM_{2.5}$ 24-hour and sulfur dioxide 24-hour contributions for the PDC Option. Existing air pollutant concentrations at SRS (Chapter 3, Table 3–7) include contributions from currently operating facilities such as the K-Area Complex, H-Canyon/HB-Line, and DWPF, which are expected to be essentially unchanged under this alternative.

Employee vehicle emissions under the MOX Fuel Alternative in the peak employment year are expected to increase by about 7 to 17 percent at SRS compared to 2010 emissions. Employee vehicle emissions at LANL would increase by less than 2 percent under any of the pit disassembly and conversion options. Estimated total emissions from shipping waste, construction materials, and materials other than unirradiated MOX fuel, are presented in Table 4–2.

Combustion of fossil fuels associated with this alternative would result in the emission of carbon dioxide, one of the gases believed to influence global climate change. Annual carbon dioxide emissions under this alternative, based on estimated fuel use (see Section 4.1.7.7.3); electricity use; employee vehicles; and truck shipments of waste, construction materials, and materials other than unirradiated MOX fuel, would be 150,000 metric tons (170,000 tons) per year, representing about 0.002 percent of the 2010 annual U.S. emissions of carbon dioxide equivalent (EPA 2012). Direct (Scope 1) emissions from onsite fuel use were estimated to be 3,900 metric tons (4,300 tons).

4.1.1.4 H-Canyon/HB-Line to DWPF Alternative

Construction—Construction-related emissions under this alternative would be essentially the same as those under the MOX Fuel Alternative. There would be some minor modifications to H-Canyon/HB-Line within an existing structure, with minimal emissions.

Operations—Estimated contributions to air pollutant concentrations at the SRS boundary from facility operations under this alternative are presented in Table 4–1. Air quality impacts from operation under this alternative would be about the same for each pit disassembly and conversion option as those under the MOX Fuel Alternative (Section 4.1.1.3). Contributions to boundary concentrations could result from operation of PDCF under the PDCF Option or from operation of PDC under the PDC Option. Under the PF-4 and MFFF Option, no changes in site boundary concentrations are projected from operation of metal oxidation furnaces at MFFF. Under the PF-4, H-Canyon/HB-Line, and MFFF Option, no changes in site boundary concentrations are projected from operation of metal oxidation furnaces at MFFF, from pit disassembly at K-Area, or from oxidation of plutonium at H-Canyon/HB-Line for fabrication into MOX fuel. Under all pit disassembly and conversion options, contributions from operation of WSB, K-Area storage, and KIS would be the same as those under the No Action Alternative (Section 4.1.1.1).

Under all pit disassembly and conversion options, if an additional dissolver is installed at H-Canyon to address the dissolution of 6 metric tons (6.6 tons) of non-pit plutonium, emissions are expected to slightly increase, but the expected boundary concentrations would still be less than SRS baseline concentrations (SRNS 2012; WSRC 2008a). About 3 percent of DWPF emissions during the immobilization period would be attributable to the vitrification of 6 metric tons (6.6 tons) of plutonium processed through H-Canyon/HB-Line under this alternative. No changes are expected in emissions from GWSB storage of vitrified HLW containing surplus plutonium.

Under this alternative, contributions to air pollutant concentrations would be similar to those under the MOX Fuel Alternative. When the concentrations (maximum permitted contributions) from existing sources at SRS (Chapter 3, Table 3–7) and ambient concentrations (Chapter 3, Table 3–8) are added to the contributions shown in Table 4–1, the applicable standards would still not be exceeded. Using PM_{10} as a surrogate for $PM_{2.5}$ indicates that $PM_{2.5}$ is expected to meet the ambient standards. If a background concentration for $PM_{2.5}$ and the contribution from existing facilities were added to the $PM_{2.5}$ contributions for the alternative, the $PM_{2.5}$ 24-hour or annual standard could be exceeded. This could occur as a result of the conservative nature of the site boundary concentration estimates. The contributions under the PDCF and PDC Options to concentrations of criteria pollutants would be below significance levels, except for the nitrogen dioxide 1-hour average contribution for both options and the $PM_{2.5}$ and the sulfur dioxide 24-hour contributions for the PDC Option.

Employee vehicle emissions under the H-Canyon/HB-Line to DWPF Alternative in the peak employment year are expected to increase by about 7 to 17 percent at SRS over 2010 emissions. Employee vehicle emissions at LANL are expected to increase by less than 2 percent under any of the pit disassembly and conversion options. Estimated total emissions from shipping waste, construction materials, and materials other than unirradiated MOX fuel are presented in Table 4–2.

Combustion of fossil fuels associated with this alternative would result in the emission of carbon dioxide, one of the gases believed to influence global climate change. Annual carbon dioxide emissions under this alternative, based on estimated fuel use (see Section 4.1.7.7.4); electricity use; employee vehicles; and truck shipments of waste, construction materials, and materials other than unirradiated MOX fuel, would be 150,000 metric tons (170,000 tons) per year, representing about 0.002 percent of the 2010 annual U.S. emissions of carbon dioxide equivalent (EPA 2012). Direct (Scope 1) emissions from onsite fuel use were estimated to be 3,900 metric tons (4,300 tons), representing a fraction of the total carbon dioxide emissions under this alternative.

4.1.1.5 WIPP Alternative

Construction—Construction-related emissions under this alternative would be essentially the same as those under the MOX Fuel Alternative. There would be would be some minor modifications to H-Canyon/HB-Line within an existing structure, with minimal emissions.

Operations—Estimated contributions to air pollutant concentrations at the site boundary from facility operations under this alternative are presented in Table 4–1. Air quality impacts from operation under this alternative would be about the same for each pit disassembly and conversion option as those under the MOX Fuel Alternative (Section 4.1.1.3). Contributions to boundary concentrations could result from operation of PDCF under the PDCF Option or from operation of PDC under the PDC Option. Under the PF-4 and MFFF Option, no changes in site boundary concentrations are projected from operation of metal oxidation furnaces at MFFF. Under the PF-4, H-Canyon/HB-Line, and MFFF Option, no changes in site boundary concentrations are projected from operation of metal oxidation furnaces at MFFF, from pit disassembly at K-Area, or from oxidation of plutonium at H-Canyon/HB-Line for fabrication into MOX fuel. Under all pit disassembly and conversion options, contributions from operation of WSB, K-Area Storage, and KIS would be the same as those under the No Action Alternative.

When the concentrations (maximum permitted contributions) from existing sources (see Chapter 3, Table 3–7) and ambient concentrations (see Chapter 3, Table 3–8) are added to the contributions shown in Table 4–1, the applicable standards would still not be exceeded. Using PM_{10} as a surrogate for $PM_{2.5}$ indicates that $PM_{2.5}$ is expected to meet the ambient standards. If a background concentration for $PM_{2.5}$ and the contribution from existing facilities were added to the $PM_{2.5}$ contributions for the alternative, the $PM_{2.5}$ 24-hour or annual standard could be exceeded. This could occur as a result of the conservative nature of the site boundary concentration estimates. The contributions under the PDCF and PDC Options to concentrations of criteria pollutants are below significance levels except for the nitrogen dioxide 1-hour average contribution for both options and the $PM_{2.5}$ and sulfur dioxide 24-hour contributions for the PDC Option.

Employee vehicle emissions under the WIPP Alternative in the peak employment year are expected to increase by about 7 to 17 percent at SRS over 2010 emissions. Employee vehicle emissions at LANL would increase by less than 2 percent under any of the pit disassembly and conversion options. Estimated total emissions from shipping waste, construction materials, and materials other than unirradiated MOX fuel are presented in Table 4–2.

Combustion of fossil fuels associated with this alternative would result in the emission of carbon dioxide, one of the gases believed to influence global climate change. Annual carbon dioxide emissions under this alternative, based on estimated fuel use (see Section 4.1.7.7.5); electricity use; employee vehicles; and truck shipments of waste, construction materials, and materials other than unirradiated MOX fuel, would be 150,000 metric tons (170,000 tons) per year, representing about 0.002 percent of the 2010 annual U.S. emissions of carbon dioxide equivalent (EPA 2012). Direct (Scope 1) emissions from onsite fuel use were estimated to be 3,900 metric tons (4,300 tons), representing a fraction of the total carbon dioxide emissions under this alternative.

4.1.2 Human Health

Following the basic approaches used in the *SPD EIS* (DOE 1999b), this section includes analyses of radiological impacts at SRS, LANL, and commercial nuclear power plants from normal operations and postulated accidents on workers and the general population. It also summarizes impacts from possible chemical accidents and intentional destructive acts at DOE facilities. Details about the assumptions and methods used to evaluate the impacts of normal operations and postulated accidents at DOE facilities are presented in Appendices C and D, respectively, of this *SPD Supplemental EIS*. Details about the impacts associated with the pit disassembly and conversion options are described in Appendix F; plutonium disposition options in Appendix G; and principal plutonium support facilities in Appendix H. Details about the impacts associated with irradiating MOX fuel at TVA and generic reactor sites are addressed in Appendices I and J.

Human health risks from construction, normal operations, and facility accidents are considered for several individual receptors and population groups. These include involved and noninvolved workers, the offsite population, a maximally exposed individual (MEI), and an average individual within the offsite population.

For the purposes of this *SPD Supplemental EIS*, an involved worker is an onsite worker directly or indirectly involved with operations at a facility that is part of the surplus plutonium disposition effort who receives an occupational radiation exposure from direct radiation (i.e., neutron, x-ray, beta, or gamma) or from radionuclides released to the environment as a part of normal operations. Direct exposure (to primarily americium-241 gamma radiation) from handled plutonium materials within a facility would be the chief source of potential occupational exposure to onsite workers. A noninvolved worker is a site worker outside of the facility who would not be subject to direct radiation exposure, but could be incidentally exposed to emissions from the surplus plutonium facilities.

The offsite population comprises members of the general public who live within 50 miles (80 kilometers) of a particular facility being evaluated. The MEI is a hypothetical member of the public at a location of public access that would result in the highest exposure. For purposes of evaluation, the MEI is considered to be at the site boundary during normal operations at SRS, LANL, and the reactor sites, and also during postulated accidents at SRS and LANL. For postulated accidents at the reactor sites, the MEI is assumed to be at the exclusion area boundary, which is outside the area within which the reactor licensee has the authority to determine all activities, including exclusion or removal of personnel and property from the area. An average individual is a hypothetical receptor whose dose is determined by dividing the population dose by the number of individuals in the population.

The GENII 2 [GENII Environmental Dosimetry System, Version 2] computer code (Version 2.10) was used to evaluate the impacts on the MEI, offsite population, and average individual from normal operations at DOE sites as described in Appendix C of this *SPD Supplemental EIS*. Existing data were used to estimate the potential impacts from normal operations at reactor sites. The MACCS2 [MELCOR Accident Consequence Code System - 2], Version 1.13.1, computer code was used to evaluate the impacts on the MEI, offsite population, and onsite noninvolved worker from possible accidents as described in Appendices D and J.

For individuals or population groups, estimates of potential latent cancer fatalities (LCFs) are made using a risk estimator of 0.0006 latent fatal cancers per rem or person-rem (or 600 latent fatal cancers per 1 million rem or person-rem) (DOE 2003b). For doses to individuals equal to or greater than 20 rem, the factor is doubled.

4.1.2.1 Normal Operations

Radioactive materials released from the surplus plutonium operations considered in this *SPD Supplemental EIS* would be tritium or particulates (primarily plutonium and americium isotopes) in emissions that would pass through high-efficiency particulate air (HEPA) filters, sand filters, or both, prior to being released through stacks. For normal operations, the management controls and filter systems ensure minimal releases of radioactive materials and minimize the impacts on onsite personnel and offsite populations.

As shown by the results presented in this section, the annual doses from normal releases under all alternatives are projected to represent small fractions of the annual doses the public would receive from natural background radiation at SRS (less than about 0.003 percent) and at LANL (less than about 0.02 percent).

As indicated in the results for the SRS offsite MEI, the potential annual doses from normal filtered, particulate releases are on the order of 0.01 millirem. A conservative estimate of the dose to a noninvolved onsite SRS worker was calculated using the GENII Version 2 computer code. Assuming this worker was not shielded, was located 1,000 meters (3,300 feet) from the SRS facility with releases resulting in the highest offsite MEI dose, and was on site for 2,080 hours per year, the annual dose would be about 0.010 millirem. This dose is small and comparable to the dose received by the MEI. Thus, the small doses to noninvolved workers from normal facility operations were not evaluated further in this *SPD Supplemental EIS*. Doses to the offsite MEI, the offsite population, and the noninvolved worker under accident conditions were evaluated, however, as described in Appendix D of this *SPD Supplemental EIS*.

Workers at SRS may receive radiation doses slightly above those received by an individual at an offsite location. The average dose measured using thermoluminescent dosimeters near the burial grounds at the center of the site (E-Area) from 2006 through 2010 was 123 millirem; the average dose for this same 5-year period at an offsite control location (Highway 301) was 85 millirem. Because the onsite location is near active radioactive waste management operations, the dose may be conservatively high and not representative of other locations at the site. The 5-year average dose at another onsite monitoring location (D-Area) was 74 millirem, lower than the offsite location (WSRC 2007f, 2008d; SRNS 2009b, 2010f, 2011). This implies that there would be no significant difference between doses at onsite and offsite locations. Using the higher onsite location as a basis and adjusting the doses for a 2080-hour work-year, a worker could receive an annual dose of about 9 millirem from being employed at SRS. A 9-millirem dose is an increase of about 3 percent over the average annual dose one would receive from all sources of natural background radiation. The additional dose results in an increased annual risk of a latent fatal cancer of about 5×10^{-6}, or 1 chance in 200,000.

To compare the impacts among the alternatives, the total number of potential LCFs over the period of operations is reported. These estimates are generated by multiplying the annual number of potential LCFs associated with each facility by the total number of years the facility is projected to operate in support of surplus plutonium activities.

As discussed in Chapter 2, under each alternative, MOX fuel would be provided for use in domestic commercial nuclear power reactors. Appendix I describes the environmental impacts of using this MOX fuel. Although radiation levels at the surface of MOX fuel may be somewhat higher than those for LEU fuel, the occupational doses to plant workers during periods of MOX fuel loading and irradiation are expected to be similar to those for LEU fuel (TVA 2012). The only time an increase in dose would likely occur would be during acceptance inspections at the reactor when the fuel assemblies are first delivered to the plant and workers inspect the fuel assemblies to ensure that there are no apparent problems with them. After inspection, worker doses would be limited because the assemblies would be handled remotely as they are loaded into the reactor and subsequently removed from the reactor and transferred into the used fuel pool. For MOX fuel use at the Browns Ferry and Sequoyah Nuclear Plants, however, TVA personnel have indicated that any potential increases in worker dose would be prevented through the continued implementation of aggressive programs to keep doses as low as reasonably achievable (ALARA). Worker doses at the reactors would continue to meet Federal regulatory dose limits as required by NRC in Title 10, *Code of Federal Regulations*, Part 20 (10 CFR Part 20).

As discussed in Appendix I, potential doses to members of the public would result from emissions associated with reactor operations. No change in radiation dose to the public is expected from normal operation using a partial MOX fuel core compared to operations using a full LEU fuel core. This is consistent with findings in the *SPD EIS* (DOE 1999b).

4.1.2.1.1 No Action Alternative

Construction— Workers constructing PDCF in F-Area would be monitored (badged) as appropriate. As discussed in Section 4.1.2.1, construction workers at SRS may receive a small incremental dose associated with background doses at SRS. None of these exposures is expected to result in any additional LCFs to construction workforces.

Because there is no ground surface contamination in F-Area where PDCF would be constructed, there would be no additional radiological releases to the environment or impacts on the general population from construction activities at this location (DOE 1999b; NRC 2005a:4-7). The same condition applies to any other remaining F-Area construction activities, such as MFFF or WSB.

Operations—**Tables 4–3** and **4–4** summarize the annual and life-of-the-project (total) radiological impacts on operational workers and the public under the No Action Alternative and other alternatives being considered in this *SPD Supplemental EIS*.

Table 4–3 Potential Radiological Impacts on Involved Workers from Operations by Alternative

	Alternative				
Pit Disassembly and Conversion Option	***No Action***	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/ HB-Line to DWPF***	***WIPP***
Total Workforce (number of radiation workers)					
PDCF					
at SRS	947	1,286	1,082	969	1,077
at LANL	85	85	85	85	85
PDC					
at SRS	N/A	N/A	1,082	969	1,077
at LANL			85	85	85
PF-4 and MFFF					
at SRS	N/A	938	734	621	729
at LANL		253	253	253	253
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	1,038	834	721	829
at LANL		253	253	253	253
Annual Collective Worker Dose (person-rem per year)					
PDCF					
at SRS	300	620	320	310	360
at LANL	29	29	29	29	29
PDC					
at SRS	N/A	N/A	320	310	360
at LANL			29	29	29
PF-4 and MFFF					
at SRS	N/A	430	130	120	170
at LANL		190	190	190	190
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	460	160	150	200
at LANL		190	190	190	190
Latent Cancer Fatalities from Annual Collective Worker Dose [b]					
PDCF					
at SRS	0 (0.2)	0 (0.4)	0 (0.2)	0 (0.2)	0 (0.2)
at LANL	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
PDC					
at SRS	N/A	N/A	0 (0.2)	0 (0.2)	0 (0.2)
at LANL			0 (0.02)	0 (0.02)	0 (0.02)
PF-4 and MFFF					
at SRS	N/A	0 (0.3)	0 (0.08)	0 (0.07)	0 (0.1)
at LANL		0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	0 (0.3)	0 (0.1)	0 (0.1)	0 (0.1)
at LANL		0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)
Latent Cancer Fatalities from Life-of-Project Collective Worker Dose [b]					
PDCF					
at SRS	3	4	2	2	3
at LANL	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)
PDC					
at SRS	N/A	N/A	2	2	3
at LANL			0 (0.1)	0 (0.1)	0 (0.1)
PF-4 and MFFF					
at SRS	N/A	3	1	2	2
at LANL		3	3	3	3

	Alternative				
Pit Disassembly and Conversion Option	***No Action***	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/ HB-Line to DWPF***	***WIPP***
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	4	2	2	2
at LANL		3	3	3	3
Average Annual Worker Dose (millirem) [c]					
PDCF					
at SRS	320	480	300	320	330
at LANL	340	340	340	340	340
PDC					
at SRS	N/A	N/A	300	320	330
at LANL			340	340	340
PF-4 and MFFF					
at SRS	N/A	460	180	190	230
at LANL		760	760	760	760
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	440	190	210	240
at LANL		760	760	760	760
Latent Cancer Fatality Risk from Average Annual Worker Dose					
PDCF					
at SRS	2×10^{-4}	3×10^{-4}	2×10^{-4}	2×10^{-4}	2×10^{-4}
at LANL	2×10^{-4}	2×10^{-4}	2×10^{-4}	2×10^{-4}	2×10^{-4}
PDC					
at SRS	N/A	N/A	2×10^{-4}	2×10^{-4}	2×10^{-4}
at LANL			2×10^{-4}	2×10^{-4}	2×10^{-4}
PF-4 and MFFF					
at SRS	N/A	3×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}
at LANL		5×10^{-4}	5×10^{-4}	5×10^{-4}	5×10^{-4}
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	3×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}
at LANL		5×10^{-4}	5×10^{-4}	5×10^{-4}	5×10^{-4}
Latent Cancer Fatality Risk from Life-of-Project Average Annual Worker Dose					
PDCF					
at SRS	3×10^{-3}	2×10^{-3}	1×10^{-3}	2×10^{-3}	2×10^{-3}
at LANL	1×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-3}
PDC					
at SRS	N/A	N/A	1×10^{-3}	2×10^{-3}	2×10^{-3}
at LANL			1×10^{-3}	1×10^{-3}	1×10^{-3}
PF-4 and MFFF					
at SRS	N/A	2×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-3}
at LANL		1×10^{-2}	1×10^{-2}	1×10^{-2}	1×10^{-2}
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	2×10^{-3}	1×10^{-3}	2×10^{-3}	1×10^{-3}
at LANL		1×10^{-2}	1×10^{-2}	1×10^{-2}	1×10^{-2}

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] Includes the contribution from K-Area glovebox pit disassembly activities prior to processing at H-Canyon/HB-Line.

[b] The number of excess LCFs in the population would occur as a whole number. If the number is zero, the value calculated by multiplying the dose by a risk factor of 0.0006 LCF per person-rem (DOE 2003b) is presented in parentheses.

[c] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year (DOE 2009a) and as low as reasonably achievable.

Note: Sums and products presented in the table may differ from those calculated from table entries here and in the appendices due to rounding; to convert metric tons to tons, multiply by 1.1023.

Source: Appendix C, Tables C–41, C–43, C–45, C–47, and C–49.

Table 4–4 Potential Radiological Impacts on the Public from Operations by Alternative

Pit Disassembly and Conversion Option	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Population within 50 Miles (80 kilometers)					
Annual Population Dose (person-rem)					
PDCF					
at SRS	0.54	0.54	0.80	0.55	0.80
at LANL	0.025	0.025	0.025	0.025	0.025
PDC					
at SRS	N/A	N/A	0.78	0.53	0.78
at LANL			0.025	0.025	0.025
PF-4 and MFFF					
at SRS	N/A	0.45	0.71	0.46	0.71
at LANL		0.21	0.21	0.21	0.21
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	0.71	0.97	0.72	0.97
at LANL		0.21	0.21	0.21	0.21
LCFs from Annual Population Dose					
PDCF					
at SRS	0 (3×10^{-4})	0 (3×10^{-4})	0 (5×10^{-4})	0 (3×10^{-4})	0 (5×10^{-4})
at LANL	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})
PDC					
at SRS	N/A	N/A	0 (5×10^{-4})	0 (3×10^{-4})	0 (5×10^{-4})
at LANL			0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})
PF-4 and MFFF					
at SRS	N/A	0 (3×10^{-4})	0 (4×10^{-4})	0 (3×10^{-4})	0 (4×10^{-4})
at LANL		0 (1×10^{-4})	0 (1×10^{-4})	0 (1×10^{-4})	0 (1×10^{-4})
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	0 (4×10^{-4})	0 (6×10^{-4})	0 (4×10^{-4})	0 (6×10^{-4})
at LANL		0 (1×10^{-4})	0 (1×10^{-4})	0 (1×10^{-4})	0 (1×10^{-4})
LCFs from Life-of-Project Population Dose [b]					
PDCF					
at SRS	0 (4×10^{-3})	0 (4×10^{-3})	0 (6×10^{-3})	0 (4×10^{-3})	0 (6×10^{-3})
at LANL	0 (1×10^{-4})	0 (1×10^{-4})	0 (1×10^{-4})	0 (1×10^{-4})	0 (1×10^{-4})
PDC					
at SRS	N/A	N/A	0 (6×10^{-3})	0 (4×10^{-3})	0 (6×10^{-3})
at LANL			0 (1×10^{-4})	0 (1×10^{-4})	0 (1×10^{-4})
PF-4 and MFFF					
at SRS	N/A	0 (5×10^{-3})	0 (7×10^{-3})	0 (5×10^{-3})	0 (7×10^{-3})
at LANL		0 (3×10^{-3})	0 (3×10^{-3})	0 (3×10^{-3})	0 (3×10^{-3})
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	0 (7×10^{-3})	0 (9×10^{-3})	0 (7×10^{-3})	0 (9×10^{-3})
at LANL		0 (3×10^{-3})	0 (3×10^{-3})	0 (3×10^{-3})	0 (3×10^{-3})
Maximally Exposed Individual					
Annual MEI Dose (millirem) [c]					
PDCF					
at SRS	0.0066	0.0066	0.0091	0.0067	0.0091
at LANL	0.0097	0.0097	0.0097	0.0097	0.0097
PDC					
at SRS	N/A	N/A	0.0097	0.0073	0.0097
at LANL			0.0097	0.0097	0.0097
PF-4 and MFFF					
at SRS	N/A	0.0052	0.0077	0.0053	0.0077
at LANL		0.081	0.081	0.081	0.081
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	0.0076	0.010	0.0077	0.010
at LANL		0.081	0.081	0.081	0.081

Pit Disassembly and Conversion Option	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/ HB-Line to DWPF***	***WIPP***
LCF Risk from Annual MEI Dose					
PDCF					
at SRS	4×10^{-9}	4×10^{-9}	5×10^{-9}	4×10^{-9}	5×10^{-9}
at LANL	6×10^{-9}	6×10^{-9}	6×10^{-9}	6×10^{-9}	6×10^{-9}
PDC					
at SRS	N/A	N/A	6×10^{-9}	4×10^{-9}	6×10^{-9}
at LANL			6×10^{-9}	6×10^{-9}	6×10^{-9}
PF-4 and MFFF					
at SRS	N/A	3×10^{-9}	5×10^{-9}	3×10^{-9}	5×10^{-9}
at LANL		5×10^{-8}	5×10^{-8}	5×10^{-8}	5×10^{-8}
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	5×10^{-9}	6×10^{-9}	5×10^{-9}	6×10^{-9}
at LANL		5×10^{-8}	5×10^{-8}	5×10^{-8}	5×10^{-8}
LCF Risk from Life-of-Project MEI Dose					
PDCF					
at SRS	4×10^{-8}	5×10^{-8}	7×10^{-8}	6×10^{-8}	8×10^{-8}
at LANL	4×10^{-8}	4×10^{-8}	4×10^{-8}	4×10^{-8}	4×10^{-8}
PDC					
at SRS	N/A	N/A	7×10^{-8}	6×10^{-8}	8×10^{-8}
at LANL			4×10^{-8}	4×10^{-8}	4×10^{-8}
PF-4 and MFFF					
at SRS	N/A	6×10^{-8}	8×10^{-8}	7×10^{-8}	9×10^{-8}
at LANL		1×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-6}
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	8×10^{-8}	1×10^{-7}	9×10^{-8}	1×10^{-7}
at LANL		1×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-6}
Average Exposed Individual					
Annual Average Individual Dose (millirem)					
PDCF					
at SRS	0.00062	0.00062	0.00092	0.00063	0.00091
at LANL	0.000056	0.000056	0.000056	0.000056	0.000056
PDC					
at SRS	N/A	N/A	0.00094	0.00065	0.00093
at LANL			0.000056	0.000056	0.000056
PF-4 and MFFF					
at SRS	N/A	0.00052	0.00082	0.00053	0.00081
at LANL		0.00047	0.00047	0.00047	0.00047
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	0.00081	0.0011	0.00082	0.0011
at LANL		0.00047	0.00047	0.00047	0.00047
LCF Risk from Annual Average Individual Dose					
PDCF					
at SRS	4×10^{-10}	4×10^{-10}	6×10^{-10}	4×10^{-10}	6×10^{-10}
at LANL	3×10^{-11}	3×10^{-11}	3×10^{-11}	3×10^{-11}	3×10^{-11}
PDC					
at SRS	N/A	N/A	6×10^{-10}	4×10^{-10}	6×10^{-10}
at LANL			3×10^{-11}	3×10^{-11}	3×10^{-11}
PF-4 and MFFF					
at SRS	N/A	4×10^{-10}	6×10^{-10}	4×10^{-10}	6×10^{-10}
at LANL		3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	6×10^{-10}	8×10^{-10}	6×10^{-10}	8×10^{-10}
at LANL		3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}

	Alternative				
Pit Disassembly and Conversion Option	***No Action***	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/ HB-Line to DWPF***	***WIPP***
LCF Risk from Life-of-Project Average Individual Dose					
PDCF					
at SRS	4×10^{-9}	5×10^{-9}	7×10^{-9}	5×10^{-9}	7×10^{-9}
at LANL	2×10^{-10}	2×10^{-10}	2×10^{-10}	2×10^{-10}	2×10^{-10}
PDC					
at SRS	N/A	N/A	7×10^{-9}	5×10^{-9}	7×10^{-9}
at LANL			2×10^{-10}	2×10^{-10}	2×10^{-10}
PF-4 and MFFF					
at SRS	N/A	6×10^{-9}	8×10^{-9}	6×10^{-9}	8×10^{-9}
at LANL		6×10^{-9}	6×10^{-9}	6×10^{-9}	6×10^{-9}
PF-4, H-Canyon/HB-Line, and MFFF [a]					
at SRS	N/A	8×10^{-9}	1×10^{-8}	8×10^{-9}	1×10^{-8}
at LANL		6×10^{-9}	6×10^{-9}	6×10^{-9}	6×10^{-9}

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MEI = maximally exposed individual; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] Under the PF-4, H-Canyon/HB-Line, and MFFF Option, potential doses to members of the public from pit disassembly activities using K-Area gloveboxes would be extremely small (less than those from operation of the K-Area Interim Surveillance capability (SRNS 2012). The potential doses that would be incurred from such operations would essentially be in the form of direct (gamma or neutron) exposure and, thus, facility workers would be the only viable receptors.

[b] The number of excess LCFs in the population would occur as a whole number. If the number is zero, the value calculated by multiplying the dose by a risk factor of 0.0006 LCF per person-rem (DOE 2003b) is presented in parentheses.

[c] The regulatory limit for dose to a member of the public from all DOE sources, due to release of radioactive material other than radon into the air, is 10 millirem per year (40 CFR Part 61, Subpart H).

Note: Sums and products presented in the table may differ from those calculated from table entries here and in the appendices due to rounding. To convert metric tons to tons, multiply by 1.1023.

Source: Appendix C, Tables C–42, C–44, C–46, C–48, and C–50.

The annual collective worker dose under the No Action Alternative (see Table 4–3), inclusive of all potential facility operations and processes, would be 300 person-rem at SRS and 29 person-rem at LANL, with no additional LCFs. Under this alternative, a comparatively small quantity of plutonium pits (2 metric tons [2.2 tons]) would be disassembled and converted to oxide at LANL. Over the life of the project, the collective dose to workers would result in an estimated 3 LCFs at SRS and none at LANL. The average annual dose per full-time-equivalent worker under this alternative would be 320 millirem at SRS and 340 millirem at LANL, with a corresponding risk of the worker developing a latent fatal cancer of about 2.0×10^{-4}, or 1 chance in 5,000, at both sites. The total latent cancer fatality risk per average full-time-equivalent worker over the life of this alternative would be about 3×10^{-3} at SRS, or about 1 chance in 330, and about 1×10^{-3} at LANL, or 1 chance in 1,000. At both sites, doses to actual workers would be monitored and maintained below administrative control levels through the implementation of engineered controls and management measures including implementation of administrative limits and as low as reasonably achievable programs.

Public. For normal operation of all facilities under the No Action Alternative, the annual population dose would be about 0.54 person-rem at SRS and 0.025 person-rem at LANL (see Table 4–4). These population doses are small fractions (about 0.0002 percent at SRS and 0.00001 percent at LANL) of the doses the same populations would receive from natural background radiation. Radiological emissions over the entire duration of the No Action Alternative are estimated to result in no LCFs in the populations surrounding SRS and LANL.

The dose to the MEI is determined by conservatively assuming the MEI receives the maximum dose from each of the facilities from concurrent annual operations. The MEI dose at SRS from 1 year of operations would be 0.0066 millirem, or about 0.002 percent of the dose from natural background radiation. The risk of a latent fatal cancer associated with the dose from 1 year of operations would be about 4×10^{-9}, or

1 chance in 250 million. The MEI dose at LANL from 1 year of operations would be 0.0097 millirem, or about 0.002 percent of the dose from natural background radiation. The risks of a latent cancer associated with the dose from 1 year of operations would be about 6×10^{-9}, or about 1 chance in 170 million. At SRS, the total risk of a latent fatal cancer to the MEI from the dose received over the life of the No Action Alternative would be about 4×10^{-8}. Accordingly, there is 1 chance in 25 million that the MEI would develop an LCF from exposures received over the life of the project. The total risk of a latent fatal cancer to the MEI at LANL from the dose received over the life of the No Action Alternative would be about 4×10^{-8}. In other words, there is 1 chance in 25 million that the LANL MEI would develop a latent fatal cancer from exposures received over the life of the project.

Activities at E-Area in support of this alternative are expected to result in negligible incremental impacts on both workers and the public from the staging of TRU waste awaiting shipment to WIPP, as well as any potential low-level radioactive waste (LLW) or mixed low-level radioactive waste (MLLW) pending offsite shipment, or disposal of LLW. Similarly, activities at TA-54 at LANL in support of pit disassembly and conversion activities at that site would result in no incremental impacts on either workers or the public (SRNS 2012).

4.1.2.1.2 Immobilization to DWPF Alternative

Construction—Under the Immobilization to DWPF Alternative, construction of the new immobilization capability at the K-Area Complex and minor modifications to DWPF to accommodate receipt of can-in-canisters would be required. The majority of the construction activities would occur in areas having dose rates close to background levels, although there would be existing equipment at K-Area that would require decontamination and removal. The external dose rates from this equipment would be low. Annual dose rates to the workforce during the 2 years of decontamination and equipment removal at K-Area would be about 3.3 person-rem per year; the average individual dose rate would be about 92 millirem per year for a construction workforce of 72 workers (SRNS 2012). Minimal worker doses would result from minor modifications to DWPF. As shown in **Table 4–5**, the total construction workforce dose over the 2-year period of decontamination and equipment removal at K-Area would be 6.6 person-rem. Table 4–5 shows other construction activities, including facility modifications, necessary to implement certain pit disassembly and conversion options and to implement certain disposition options. As shown in the table, the construction activities apply under some alternatives, but not others.

Additional construction worker doses could occur depending on the pit disassembly and conversion option.

Under the PDCF Option, as addressed in Section 4.1.2.1.1 there would be no doses to workers constructing PDCF other than those associated with background doses at SRS.

Under the PF-4, H-Canyon/HB-Line, and MFFF Option, modifications would be required to K-Area gloveboxes (for pit disassembly) and H-Canyon/HB-Line (for conversion). Glovebox modification activities at K-Area would require some decontamination and equipment removal that would result in a collective dose of 2.0 person-rem per year to a construction workforce of 20 workers; this would yield an average construction worker dose of 100 millirem per year. The total construction worker dose received over the 2 years required to complete modifications would be 4.0 person-rem. Modifications at H-Canyon/HB-Line would result in a collective dose of up to 0.25 person-rem per year to a construction workforce of 10; this results in an average construction worker dose of 25 millirem per year. The total construction worker dose received over the 2 years required to complete modifications would be 0.5 person-rem.

Table 4–5 Workforce Dose for Individual Facility Construction and Modification Activities

Facility Constructed or Modified (Site)	*Duration (years)*	*Total Workforce Dose (person-rem)*	*LCFs From Total Workforce Dose* [a]	*Alternatives*				
				No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Pit Disassembly and Conversion Option								
PDC (SRS)	2	1.0	6×10^{-4}			✓	✓	✓
K-Area gloveboxes for pit disassembly (SRS)	2	4.0	2×10^{-3}		✓	✓	✓	✓
H-Canyon/HB-Line for dissolution and oxidation (SRS)	2	0.5	3×10^{-4}		✓	✓	✓	✓
PF-4 (for 35 metric tons plutonium throughput) (LANL)	8	140	8×10^{-2}		✓	✓	✓	✓
Disposition Option Facilities								
Immobilization capability in K-Area (SRS)	2	6.6	4×10^{-3}		✓			
H-Canyon/HB-Line for preparation for WIPP disposal (SRS)	2	1.2	7×10^{-4}					✓

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MOX = mixed oxide; PDC = Pit Disassembly and Conversion Project; PF-4 = Plutonium facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] LCFs are estimated using a risk factor of 0.0006 LCF per person-rem (DOE 2003b).

Note: To convert metric tons to tons, multiply by 1.1023.

Under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, metal oxidation furnaces would be added to MFFF. The oxidations furnaces would be installed in an area set aside in MFFF (i.e., separate from the fuel fabrication operations), so construction workers would not be expected to receive any occupational radiation doses.

At SRS, total worker doses for construction or modification of all applicable facilities would range from about 6.6 to 11 person-rem, depending on the pit disassembly and conversion option. No LCFs (4×10^{-3} to 7×10^{-3}) among construction workers would be expected from these doses.

At LANL under the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Option, PF-4 modification activities (e.g., glovebox installations, modifications, and installation of uncontaminated equipment) could result in a collective dose of 18 person-rem per year to a construction workforce of 60 workers. The average construction worker dose would be 300 millirem per year. Modifications would continue over 8 years, resulting in a total workforce dose of 140 person-rem. No LCFs (8×10^{-2}) among construction workers would be expected from these doses.

At both SRS and LANL, the public would receive no doses or associated LCFs as the result of construction activities.

Operations—The potential annual and life-of-the-project (total) radiological impacts on workers and the public from normal operations under this alternative are summarized in Tables 4–3 and 4–4. Under this alternative, the impacts would vary depending on the pit disassembly and conversion option employed.

Workers. The annual collective dose to SRS workers under the Immobilization to DWPF Alternative (see Table 4–3), inclusive of all potential facility operations and processes, would range from 430 to 620 person-rem. The annual collective dose to LANL workers would range from 29 to 190 person-rem. No additional LCFs are projected as a result of these doses. Over the life of the project, the collective dose to SRS workers would result in an estimated 3 to 4 LCFs. At LANL over the life of the project, the collective dose to LANL workers would result in an estimated 0 to 3 LCFs. The average annual dose per full-time-equivalent SRS worker under this alternative would range from approximately 440 to

480 millirem, with a corresponding risk of the worker developing a latent fatal cancer of about 3×10^{-4}, or about 1 chance in 3,300. The average annual dose per full-time-equivalent LANL worker would range from approximately 340 millirem to 760 millirem, with a corresponding risk of the worker developing a latent fatal cancer of 2×10^{-4} (1 chance in 5,000) to 5×10^{-4} (1 chance in 2,000). Over the life of the project, the total average LCF risk per full-time-equivalent SRS worker would be about 2×10^{-3}, or 1 chance in 500. Over the life of the project, the total average LCF risk per full-time-equivalent worker at LANL would range from about 1×10^{-3}, or 1 chance in 1,000, to 1×10^{-2}, or 1 chance in 100. Doses to actual workers would be monitored and maintained below administrative control levels through the implementation of engineered controls, administrative limits, and ALARA programs.

Public. Potential radiological impacts on members of the public are summarized in Table 4–4. For normal operations under the Immobilization to DWPF Alternative, the annual population dose would range from 0.45 to 0.71 person-rem at SRS, and 0.025 to 0.21 person-rem at LANL, depending on the pit disassembly and conversion option. These population doses are a small fraction (about 0.0003 percent at SRS and 0.0001 percent at LANL) of the dose the same populations would receive from natural background radiation. Activities occurring over the entire duration of the Immobilization to DWPF Alternative are estimated to result in no LCFs in the population at either SRS or LANL.

The annual dose to the MEI at SRS would range from 0.0052 to 0.0076 millirem, or less than about 0.002 percent of the dose from natural background radiation, depending on the pit disassembly and conversion option. The risk of a latent fatal cancer associated with the dose from 1 year of operations would range from 3×10^{-9} to 5×10^{-9}. The risk of a latent fatal cancer to the MEI from surplus plutonium activities at SRS over the entire duration of this alternative would range from 5×10^{-8} to 8×10^{-8}. Thus, there is less than 1 chance in about 13 million that the dose received by the SRS MEI would result in a latent fatal cancer.

At LANL, the annual dose to the MEI from surplus plutonium operations at PF-4 would range from about 0.0097 millirem to 0.081 millirem, or less than about 0.02 percent of the dose from natural background radiation. The risk of a latent fatal cancer associated with the dose from 1 year of operations would range from 6×10^{-9} to 5×10^{-8}. The risk of a latent fatal cancer to this hypothetical individual from surplus plutonium operations at LANL over the entire duration of this alternative would range from 4×10^{-8} to 1×10^{-6}. Thus, there is 1 chance in 1 million, or less, that the dose received by the LANL MEI over the life of the project would result in a latent fatal cancer.

4.1.2.1.3 MOX Fuel Alternative

Construction—Under all pit disassembly and conversion options, there would be minor modifications to H-Canyon/HB-Line to support the disposition of up to 2 metric tons (2.2 tons) of plutonium to WIPP. These minor modifications would be made as part of normal operations. More extensive modifications to allow processing larger quantities of plutonium for disposal at WIPP are addressed in Section 4.1.2.1.5, WIPP Alternative. Additional construction worker doses could occur depending on the pit disassembly and conversion option.

Under the PDCF Option, as addressed in Section 4.1.2.1.1, there would be no doses to workers constructing PDCF other than those associated with background doses at SRS.

Under the PDC Option, decontamination and equipment removal would be required at K-Area as part of construction activities. An average workforce of 28 would perform the decontamination and equipment removal in 2 years. The average worker dose from this activity would be 18 millirem per year. The collective worker dose would be 0.5 person-rem per year, or 1 person-rem to complete the decontamination and equipment removal.

Under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, metal oxidation furnaces would be added to MFFF as addressed under the Immobilization to DWPF Alternative (Section 4.1.2.1.2) with no occupational radiation doses among construction workers.

Under the PF-4, H-Canyon/HB-Line, and MFFF Option, doses to workers from modifications to K-Area and H-Area to support pit disassembly and conversion would be the same as those for this option under the Immobilization to DWPF Alternative (Section 4.1.2.1.2).

At SRS, total worker doses from construction or modification of all applicable facilities would range from negligible to about 4.5 person-rem, depending on the pit disassembly and conversion option. No LCFs (up to 3×10^{-3}) among construction workers would be expected from these doses.

At LANL under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, PF-4 modification activities would result in the same doses and risks among construction workers as those under the Immobilization to DWPF Alternative (Section 4.1.2.1.2).

At both SRS and LANL, there would be no doses and associated LCFs in the public as the result of construction activities.

Operations—The potential annual and life-of-the-project (total) radiological impacts on workers and the public from normal operations under the MOX Fuel Alternative are summarized in Tables 4–3 and 4–4. Under this alternative, a range of impacts is possible, depending on the pit disassembly and conversion option.

Workers. The annual collective dose to workers under the MOX Fuel Alternative (see Table 4–3), inclusive of all potential facility operations and processes, would range from 130 to 320 person-rem at SRS, depending on the pit disassembly and conversion option, and from 29 to 190 person-rem at LANL. No additional LCFs are projected as a result of these doses. Over the life of the project, the collective dose to workers would result in 1 to 2 LCFs at SRS and 0 to 3 LCFs at LANL. The average annual dose per full-time-equivalent SRS worker would range from 180 to 300 millirem, with a corresponding risk of the worker developing a latent fatal cancer of 1×10^{-4} to 2×10^{-4} (1 chance in 5,000 to 1 chance in 10,000). The average annual dose per full-time-equivalent LANL worker would range from approximately 340 to 760 millirem, with a corresponding risk of the worker developing a latent fatal cancer of 2×10^{-4} (1 chance in 5,000) to 5×10^{-4} (1 chance in 2,000). Over the life of the project, the total average latent cancer fatality risk per full-time-equivalent worker would be about 1×10^{-3} (1 chance in 1,000) at SRS and range from about 1×10^{-3} (1 chance in 1,000) to 1×10^{-2} (1 chance in 100) at LANL. Doses to actual workers would be monitored and maintained below administrative control levels through the implementation of engineered controls, administrative limits, and ALARA programs.

Public. For normal operations of the facilities under the MOX Fuel Alternative (see Table 4–4), the annual population dose at SRS would range from 0.71 to 0.97 person-rem, depending on the pit disassembly and conversion option, and at LANL, from 0.025 to 0.21 person-rem. These doses are small fractions (less than about 0.0004 percent at SRS and 0.0001 percent at LANL) of the doses the same populations would receive from natural background radiation. Activities occurring over the entire duration of the MOX Fuel Alternative are estimated to result in no LCFs in the population.

The annual dose to the MEI at SRS would range from 0.0077 to 0.01 millirem, or less than about 0.003 percent of the dose from natural background radiation. The risk of a latent fatal cancer associated with the dose from 1 year of operations would be 5×10^{-9} to 6×10^{-9}. The risk of a latent fatal cancer to the MEI from surplus plutonium activities at SRS over the entire duration of this alternative would range from 7×10^{-8} to 1×10^{-7}. Thus, there is 1 chance in 10 million, or less, that the dose received by the SRS MEI would result in a latent fatal cancer.

At LANL, the annual dose to the MEI from surplus plutonium operations would range from 0.0097 to 0.081 millirem, or less than about 0.02 percent of the dose from natural background radiation. The risk of a latent fatal cancer associated with the dose from 1 year of operations would range from 6×10^{-9} to 5×10^{-8}. The risk of a latent fatal cancer to the MEI from surplus plutonium operations at LANL over the entire duration of this alternative would range from 4×10^{-8} to 1×10^{-6}. Thus, there is 1 chance in 1 million, or less, that the dose received by the LANL MEI over the life of the project would result in a latent fatal cancer.

4.1.2.1.4 H-Canyon/HB-Line to DWPF Alternative

Construction—Under all pit disassembly and conversion options, there would be minor modifications at H-Canyon/HB-Line to support dissolution of 6 metric tons (6.6 tons) of non-pit plutonium as a precursor for vitrification at DWPF. These modifications would be made as part of normal operations at H-Canyon/HB-Line. Any additional worker radiation doses and risks from construction activities under the pit disassembly and conversion options would be the same as those for these options under the MOX Fuel Alternative (Section 4.1.2.1.3). Total worker doses and risks at SRS for construction or modification of all applicable facilities would also be the same as those under the MOX Fuel Alternative.

At LANL under the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Option, PF-4 modification activities would result in the same doses and risks among construction workers as those under the Immobilization to DWPF Alternative (Section 4.1.2.1.2).

At both SRS and LANL, there would be no doses and associated LCFs in the public as the result of construction activities.

Operations—The potential annual and life-of-the-project (total) radiological impacts on workers and the public from normal operations under the H-Canyon/HB-Line to DWPF Alternative are summarized in Tables 4–3 and 4–4. Under this alternative, a range of impacts is possible depending on the pit disassembly and conversion option.

Workers. The annual collective dose to SRS workers under the H-Canyon/HB-Line to DWPF Alternative (see Table 4–3), inclusive of all potential facility operations/processes would range from 120 to 310 person-rem, with no corresponding additional LCFs. Over the life of the project, the collective dose to SRS workers would result in an estimated 2 LCFs. The average annual dose per full-time-equivalent SRS worker would range from approximately 190 to 320 millirem, with a corresponding annual risk of the worker developing a latent fatal cancer of about 1×10^{-4} to 2×10^{-4} (1 chance in 5,000 to 10,000). Over the life of the project, the total latent cancer fatality risk per full-time-equivalent SRS worker would range from about 1×10^{-3} to 2×10^{-3} (1 chance in about 500 to 1,000). Doses and risks to LANL workers would be the same as those presented for the MOX Fuel Alternative (Section 4.1.2.1.3). At both sites, doses to actual workers would be monitored and maintained below administrative control levels through the implementation of engineered controls, administrative limits, and ALARA programs.

Public. For normal operations of SRS facilities under the H-Canyon/HB-Line to DWPF Alternative (see Table 4–4), the annual population dose would range from 0.46 to 0.72 person-rem depending on the pit disassembly and conversion option. This dose is a small fraction (less than about 0.0003 percent) of the dose the same population would receive from natural background radiation. Activities occurring over the entire duration of the H-Canyon/HB-Line to DWPF Alternative are estimated to result in no LCFs in the population in the SRS vicinity.

The annual dose to the MEI at SRS would range from 0.0053 to 0.0077 millirem, or less than about 0.002 percent of the dose from natural background radiation. The risk of a latent fatal cancer associated with the dose from 1 year of operations would range from 3×10^{-9} to 5×10^{-9}. The risk of a latent fatal cancer to the MEI from surplus plutonium activities at SRS over the entire duration of this alternative would range from about 6×10^{-8} to 9×10^{-8}. Thus, there is less than 1 chance in about 11 million that the dose received by the SRS MEI would result in a latent fatal cancer.

At LANL, the ranges in doses and risks to the surrounding population and MEI from surplus plutonium operations at PF-4 would be the same as those presented for the MOX Fuel Alternative (Section 4.1.2.1.3).

4.1.2.1.5 WIPP Alternative

Construction— Under all pit disassembly and conversion options, some radiation doses and risks could occur among SRS workers from modifications to the HB-Line to support preparation of 6 metric tons (6.6 tons) of non-pit plutonium for disposal at WIPP. These activities are estimated to result in an annual collective dose of 0.58 person-rem per year to a construction workforce of 10. Over the 2 years required for the modifications, the workforce would receive a total collective dose of 1.2 person-rem. Any additional worker radiation doses and risks from construction activities under the pit disassembly and conversion options would be the same as those for these options under the MOX Fuel Alternative (Section 4.1.2.1.3).

At SRS, total worker doses for construction or modification of all applicable facilities would range from about 1.2 to 5.7 person-rem, depending on the pit disassembly and conversion option. No LCFs (7×10^{-4} to 3×10^{-3}) among construction workers would be expected from these doses.

At LANL under the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Option, PF-4 modification activities would result in the same doses and risks among construction workers as those under the Immobilization to DWPF Alternative (Section 4.1.2.1.2).

At both SRS and LANL, there would be no doses and associated LCFs in the public as the result of construction activities.

Operations—The potential annual and life-of-the-project (total) radiological impacts on workers and the public from normal operations under the WIPP Alternative are summarized in Tables 4–3 and 4–4. Under this alternative, a range of impacts is possible depending on the pit disassembly and conversion option.

Workers. The annual collective dose to SRS workers under the WIPP Alternative (see Table 4–3), inclusive of all potential facility operations and processes, would range from 170 to 360 person-rem per year, with no corresponding additional LCFs. Over the life of the project, the collective dose to SRS workers would result in an estimated 2 to 3 LCFs. The average annual dose per full-time-equivalent SRS worker under this alternative would range from approximately 230 to 330 millirem, with a corresponding risk of the worker developing a latent fatal cancer of about 1×10^{-4} to 2×10^{-4}, or 1 chance in 5,000 to 10,000. Over the life of the project, the total average latent cancer fatality risk per full-time-equivalent SRS worker would range from about 1×10^{-3} to 2×10^{-3} (1 chance in 500 to 1,000). Doses and risks to LANL workers would be the same as those under the MOX Fuel Alternative (Section 4.1.2.1.3). At both sites, doses to actual workers would be monitored and maintained below administrative control levels through the implementation of engineered controls, administrative limits, and ALARA programs.

Public. For normal operations of the SRS facilities under the WIPP Alternative (see Table 4–4), the annual population dose would range from 0.71 to 0.97 person-rem, depending on the pit disassembly and conversion option. This dose is a small fraction (less than 0.0004 percent) of the dose the same population would receive from natural background radiation. Activities occurring over the entire duration of the WIPP Alternative are estimated to result in no LCFs in the population

The annual dose to the MEI at SRS would range from 0.0077 to 0.010 millirem, or less than 0.003 percent of the dose from natural background radiation. The risk of a latent fatal cancer associated with the dose from 1 year of operations would range from about 5×10^{-9} to 6×10^{-9}. The risk of a latent fatal cancer to this hypothetical individual from surplus plutonium disposition activities at SRS over the entire duration of this alternative would range from about 8×10^{-8} to 1×10^{-7}. Thus, there is 1 chance in 10 million, or less, that the dose received by the SRS MEI would result in a latent fatal cancer.

At LANL, the ranges in doses and risks to the surrounding population and MEI from surplus plutonium operations at PF-4 would be the same as those under the MOX Fuel Alternative (Section 4.1.2.1.3).

4.1.2.2 DOE Facility Radiological Accidents

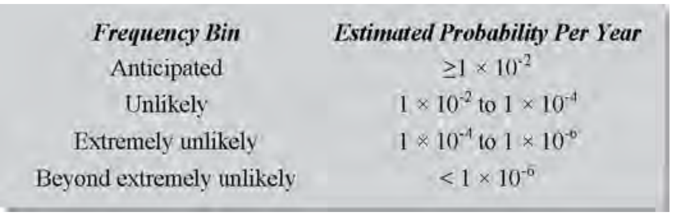
The potential consequences of high-consequence accidents from facility operations under each of the alternatives are reported in this section. Accident analyses are based primarily on accident scenarios and source terms reported in previous NEPA analyses, including the *SPD EIS* (DOE 1999b), and current safety documents (WGI 2005a; WSMS 2007; WSRC 2006c, 2006d, 2006e, 2007c, 2007d, 2007e, 2007h, 2007i, 2007j, 2007k, 2008c). For facilities not directly evaluated in the *SPD EIS* (MSA, KIS, PDC, H-Canyon/HB-Line, and DWPF at SRS, and PF-4 at LANL), accident scenarios and source terms were taken from NEPA (and safety) analyses supporting their operations. More details on methodology, potential accidents, source terms, and consequences are presented in Appendix D of this *SPD Supplemental EIS*.

Documented safety analyses (DSAs) have been prepared for a number of the facilities evaluated in this *SPD Supplemental EIS*. The purpose of the DSAs under current DOE practices differs in fundamental ways from some of the past DOE safety analysis practices. The high-level goal of current DSAs is to identify all the things that could go wrong, without consideration of preventive or mitigative features, in a hazards analysis. The hazards are then evaluated to determine the approximate magnitude of the range of consequences and frequencies, and then binned by level of risk to workers and the public. Safety controls are then identified to prevent these events to the extent practicable, and if they are not preventable, to reduce their frequency and the magnitude of potential consequences.

A central focus of the accident analyses in the current DSAs is to demonstrate that, with safety controls in place, potential bounding accidents have low enough probabilities and consequences that the risks are acceptable. In general, DSAs do not attempt to establish credible bounding estimates of the probabilities or consequences of potential accidents. As such, the source terms for the bounding consequence estimates are often very conservative and may not be realistic or credible. In addition, the actual probabilities of the scenarios may be much lower than the frequency categories assigned.

This challenges the selection of accidents for this *SPD Supplemental EIS* and reporting their likelihood and consequences, because the goal of the accident analysis in this *SPD Supplemental EIS* is to present realistic estimates of accident risks so that fair comparisons can be made among alternatives. If, for example, the accident risks for one facility or alternative are based on realistic estimates and the accident risks for another facility or alternative are based on ultra-conservative accident risks, balanced comparisons are not possible. The mitigative aspect of this problem, however, is that accident risks for all the plutonium facilities are very small. Thus, although differences in the accident risks may be attributed to the methods used to develop these risks, the differences are at accident risk levels that are very small.

The design-basis accident descriptions and source terms used in this *SPD Supplemental EIS* are from recent SRS or LANL facility DSAs and are based on unmitigated design-basis accidents. Each of the plutonium facilities evaluated in this *SPD Supplemental EIS* has been designed and would be operated to reduce the likelihood of these accidents to the extent practicable. The design features and operating procedures would also limit the extent of any accident and mitigate the consequences for workers, the public, and the environment. For all facilities, it is expected that sufficient safety controls would be in place so that the likelihood of any of these accidents happening would be "extremely unlikely" or lower and, if the accidents were initiated, source terms and consequences of the magnitudes reported in the facility DSAs and this *SPD Supplemental EIS* would be very conservative.



Frequency Bin	*Estimated Probability Per Year*
Anticipated	$\geq 1 \times 10^{-2}$
Unlikely	1×10^{-2} to 1×10^{-4}
Extremely unlikely	1×10^{-4} to 1×10^{-6}
Beyond extremely unlikely	$< 1 \times 10^{-6}$

Accident frequencies are generally grouped into the bins of "anticipated," "unlikely," "extremely unlikely," and "beyond extremely unlikely," with estimated annual frequencies of greater than or equal to 1 in 100 (≥ 1 × 10^{-2}), 1 in 100 to 1 in 10,000 (1 × 10^{-2} to 1 × 10^{-4}), 1 in 10,000 to 1 in 1 million (1 × 10^{-4} to 1 × 10^{-6}), and less than 1 in 1 million (1 × 10^{-6}), respectively. The evaluated accidents represent a spectrum of accident frequencies and consequences ranging from low-frequency/high-consequence to high-frequency/low-consequence events (see Appendix D).

Unless otherwise noted, the approaches, methods, and assumptions used in this *SPD Supplemental EIS* are the same as those presented in detail in Appendix M of the *SPD EIS* and used throughout the *SPD EIS* analysis (DOE 1999b). The key assumptions and any new information used in this *SPD Supplemental EIS* are discussed in Appendix D.

For each potential accident, information is provided on impacts for three types of receptors: a noninvolved worker, an MEI, and the offsite population within 50 miles (80 kilometers). The first receptor, a noninvolved worker, is a hypothetical individual working on site, but not involved in the proposed activity. Consistent with the *SPD EIS* (DOE 1999b), the noninvolved worker at SRS was assumed to be downwind at the area boundary, which is taken as a point about 3,300 feet (1,000 meters) from the accident. Such a person outside of the area is assumed to be unaware of the accident or of emergency actions needed for protection, and is assumed to remain in a radioactive plume for its entire passage. At LANL, because of the differences in geography of the area, the noninvolved worker was assumed to be exposed to the full release, without any protection, located at the technical area boundary, a distance of about 720 feet (220 meters) from PF-4. Workers within the vicinity of the surplus plutonium facilities would be trained in how to respond to an emergency and are expected to take proper actions to limit their exposure to a radioactive plume. If they failed to take proper actions, they could receive higher doses. For the accidents addressed in this *SPD Supplemental EIS*, postulated releases would be through filter media to tall stacks for all design-basis accidents. Maximum doses within the area where the plume first touches down could be 1.4 to 2.9 times higher than the doses at 3,300 feet (1,000 meters).

The second and third receptors are an MEI and the offsite population as discussed in Section 4.1.2. The population projected for year 2020 was assumed for the analysis.

Consequences for potential receptors as a result of plume passage were determined without regard for emergency response measures and, thus, are more conservative than those that might actually be experienced if evacuation and sheltering occurred. It was assumed that potential receptors would be fully exposed in fixed positions for the duration of plume passage, thereby maximizing their exposure to the plume. As discussed in Appendix D, Section D.1.4.2, a conservative estimate of total risk was obtained by assuming that all released radionuclides contributed to the inhalation dose rather than being removed from the plume by surface deposition.

Consequences for workers directly involved in the processes under consideration are addressed generically, without an attempt at a scenario-specific quantification of consequences. The uncertainties involved in quantifying accident consequences for an involved worker are quite large for most radiological accidents due to the high sensitivity of results to assumptions about the details of the release and the location and behavior of the affected workers.

No major consequences for the involved worker are expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would be unaffected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of radioactive particulates through inhalation. If a criticality occurred, workers in the immediate vicinity 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 worker's distance from the criticality, and the amount of shielding provided by structures and equipment between 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 structures to high radiation exposure and uptake of radionuclides. For most accidents, immediate emergency response actions would likely reduce the consequences for workers near the accident. Established emergency management programs would be activated in the event of an accident.

The following sections present the consequences of selected accidents for each alternative by pit disassembly and conversion option. Impacts are presented in terms of the projected number of LCFs among the general population if the accident were to occur, the probability that the dose received by the MEI would cause an LCF, and the probability that the dose received by a noninvolved worker downwind of the facility would cause an LCF. The selected accident scenarios represent low-frequency/high-consequence design-basis operational accidents and an extremely low-frequency/high-consequence beyond-design-basis accident scenario involving building collapse for which the accident was assumed to be caused by a catastrophic earthquake. For SRS, results are presented for the limiting design-basis (non-earthquake) accident, a design-basis earthquake with fire accident, and a beyond-design-basis earthquake with fire accident. For LANL, results are presented for the limiting design-basis (non-earthquake) accident, a design-basis earthquake with spill plus fire accident, and a beyond-design-basis earthquake with spill plus fire accident.[5] At both SRS and LANL, the limiting design-basis accident is the highest-consequence accident at any of the facilities associated with a given alternative. For the design-basis and beyond-design-basis earthquake with fire accidents at SRS, the population impacts reflect contributions from all of the surplus plutonium facilities; the MEI and noninvolved worker impacts reflect the largest impacts from a single facility. For the design-basis and beyond-design-basis earthquake with spill plus fire accidents at LANL, the population, MEI, and noninvolved worker impacts reflect those from PF-4. More-detailed discussions of the accident analyses, including additional accident scenarios, doses, accident frequencies, and annual risk (consequences multiplied by accident frequency) are presented in Appendix D.

Impacts from potential accidents at commercial nuclear power reactors using a 40 percent MOX fuel core and a full LEU core are addressed in Section 4.1.2.4 and Appendices I and J. The analysis indicates little difference in potential impacts between the two types of reactor cores.

4.1.2.2.1 No Action Alternative

Potential consequences of the postulated accidents under the No Action Alternative are presented in **Table 4–6** for the offsite population, **Table 4–7** for the MEI, and **Table 4–8** for the noninvolved worker.

The most severe consequences of a design-basis accident for any of the facilities are for accidents in the "extremely unlikely" or "extremely unlikely to beyond extremely unlikely" categories. These are accidents that are not expected to occur over the life of a facility, and could only occur if initiated by severe natural events such as major earthquakes, external events such as aircraft crashes, or multiple failures of independent safety systems. Even so, the magnitudes of the consequences would likely be much less than those estimated in this *SPD Supplemental EIS*. At each of the facilities where there would be enough plutonium for a nuclear criticality to theoretically occur, a criticality could be fatal to workers in the immediate vicinity, and present high doses as far as hundreds of yards away. This type of accident is well understood, and programs and procedures are in place at SRS and LANL to ensure that a criticality accident would not occur.

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[5] At SRS, the design-basis and beyond-design-basis earthquakes are postulated to be of sufficient magnitudes to initiate fires within most affected facilities. At LANL, the design-basis and beyond-design-basis earthquakes are postulated to be of sufficient magnitudes to result in spills of nuclear material followed by fires. Details of the accidents are provided in Appendix D.

Table 4–6 Population[a] Impacts from Selected Accidents by Alternative (number of latent cancer fatalities if the accident were to occur[b])

Pit Disassembly and Conversion Option	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-line to DWPF*	*WIPP*
PDCF					
SRS – Limiting design-basis accident (facility)	0 (1 × 10^{-1}) (PDCF)	0 (4 × 10^{-1}) (immobilization)	0 (2 × 10^{-1}) (HC/HBL)	0 (2 × 10^{-1}) (HC/HBL)	0 (2 × 10^{-1}) (HC/HBL)
SRS – Design-basis earthquake with fire	0 (6 × 10^{-2})	0 (6 × 10^{-2})	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})
SRS – Beyond-design-basis earthquake with fire	7	7	16	16	16
LANL – Limiting design-basis accident (facility)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)
LANL – Design-basis earthquake with spill plus fire	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})
LANL – Beyond-design-basis earthquake with spill plus fire	1 (9 × 10^{-1})	1 (9 × 10^{-1})	1 (9 × 10^{-1})	1 (9 × 10^{-1})	1 (9 × 10^{-1})
PDC					
SRS – Limiting design-basis accident (facility)	N/A	N/A	0 (2 × 10^{-1}) (HC/HBL)	0 (2 × 10^{-1}) (HC/HBL)	0 (2 × 10^{-1}) (HC/HBL)
SRS – Design-basis earthquake with fire	N/A	N/A	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})
SRS – Beyond-design-basis earthquake with fire	N/A	N/A	15	15	15
LANL – Limiting design-basis accident (facility)	N/A	N/A	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	N/A	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	N/A	1 (9 × 10^{-1})	1 (9 × 10^{-1})	1 (9 × 10^{-1})
PF-4 and MFFF					
SRS - Limiting design-basis accident (facility)	N/A	0 (4 × 10^{-1}) (immobilization)	0 (2 × 10^{-1}) (HC/HBL)	0 (2 × 10^{-1}) (HC/HBL)	0 (2 × 10^{-1}) (HC/HBL)
SRS – Design-basis earthquake with fire	N/A	0 (7 × 10^{-3})	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})
SRS – Beyond-design-basis earthquake with fire	N/A	3	12	12	12
LANL – Limiting design-basis accident (facility)	N/A	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	1 (5 × 10^{-1})	1 (5 × 10^{-1})	1 (5 × 10^{-1})	1 (5 × 10^{-1})
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	2	2	2	2
PF-4, H-Canyon/HB-Line, and MFFF					
SRS – Limiting design-basis accident (facility)	N/A	0 (4 × 10^{-1}) (immobilization)	0 (2 × 10^{-1}) (HC/HBL)	0 (2 × 10^{-1}) (HC/HBL)	0 (2 × 10^{-1}) (HC/HBL)
SRS – Design-basis earthquake with fire	N/A	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})	0 (2 × 10^{-1})
SRS – Beyond-design-basis earthquake with fire	N/A	12	12	12	12
LANL – Limiting design-basis accident (facility)	N/A	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)	0 (2 × 10^{-2}) (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	1 (5 × 10^{-1})	1 (5 × 10^{-1})	1 (5 × 10^{-1})	1 (5 × 10^{-1})
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	2	2	2	2

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; immobilization = immobilization capability; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] Impacts on populations within 50 miles (80 kilometers) of the postulated accident.

[b] The number of excess LCFs in the population would occur as a whole number. If the number is zero, the value calculated by multiplying the dose by a risk factor of 0.0006 LCF per person-rem (DOE 2003b) is presented in parentheses.

Source: Appendix D, Tables D–10 through D–18.

Table 4–7 Maximally Exposed Individual Impacts from Selected Accidents by Alternative (risk of a latent cancer fatality if the accident were to occur)

	Alternative				
Pit Disassembly and Conversion Option	***No Action***	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/ HB-line to DWPF***	***WIPP***
PDCF					
SRS – Limiting design-basis accident (facility)	3×10^{-4} (PDCF)	1×10^{-3} (immobilization)	3×10^{-4} (PDCF)	3×10^{-4} (PDCF)	3×10^{-4} (PDCF)
SRS – Design-basis earthquake with fire	1×10^{-4}	1×10^{-4}	4×10^{-4}	4×10^{-4}	4×10^{-4}
SRS – Beyond-design-basis earthquake with fire	2×10^{-2}	2×10^{-2}	5×10^{-2}	5×10^{-2}	5×10^{-2}
LANL – Limiting design-basis accident (facility)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)
LANL – Design-basis earthquake with spill plus fire	9×10^{-4}	9×10^{-4}	9×10^{-4}	9×10^{-4}	9×10^{-4}
LANL – Beyond-design-basis earthquake with spill plus fire	4×10^{-3}	4×10^{-3}	4×10^{-3}	4×10^{-3}	4×10^{-3}
PDC					
SRS –Limiting design-basis accident (facility)	N/A	N/A	2×10^{-4} (HC/HBL)	2×10^{-4} (HC/HBL)	2×10^{-4} (HC/HBL)
SRS –Design-basis earthquake with fire	N/A	N/A	4×10^{-4}	4×10^{-4}	4×10^{-4}
SRS –Beyond-design-basis earthquake with fire	N/A	N/A	7×10^{-2}	7×10^{-2}	7×10^{-2}
LANL – Limiting design-basis accident (facility)	N/A	N/A	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	N/A	9×10^{-4}	9×10^{-4}	9×10^{-4}
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	N/A	4×10^{-3}	4×10^{-3}	4×10^{-3}
PF-4 and MFFF					
SRS – Limiting design-basis accident (facility)	N/A	1×10^{-3} (immobilization)	2×10^{-4} (HC/HBL)	2×10^{-4} (HC/HBL)	2×10^{-4} (HC/HBL)
SRS – Design-basis earthquake with fire	N/A	2×10^{-5}	2×10^{-4}	2×10^{-4}	2×10^{-4}
SRS – Beyond-design-basis earthquake with fire	N/A	7×10^{-3}	4×10^{-2}	4×10^{-2}	4×10^{-2}
LANL – Limiting design-basis accident (facility)	N/A	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	2×10^{-3}	2×10^{-3}	2×10^{-3}	2×10^{-3}
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	9×10^{-3}	9×10^{-3}	9×10^{-3}	9×10^{-3}
PF-4, H-Canyon/HB-Line, and MFFF					
SRS – Limiting design-basis accident (facility)	N/A	1×10^{-3} (immobilization)	2×10^{-4} (HC/HBL)	2×10^{-4} (HC/HBL)	2×10^{-4} (HC/HBL)
SRS – Design-basis earthquake with fire	N/A	3×10^{-4}	2×10^{-4}	2×10^{-4}	2×10^{-4}
SRS – Beyond-design-basis earthquake with fire	N/A	4×10^{-2}	4×10^{-2}	4×10^{-2}	4×10^{-2}
LANL – Limiting design-basis accident (facility)	N/A	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)	7×10^{-5} (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	2×10^{-3}	2×10^{-3}	2×10^{-3}	2×10^{-3}
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	9×10^{-3}	9×10^{-3}	9×10^{-3}	9×10^{-3}

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/LB-Line; immobilization = immobilization capability; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.
Source: Appendix D, Tables D–10 through D–18.

Table 4–8 Noninvolved Worker Impacts from Selected Accidents by Alternative (risk of a latent cancer fatality if the accident were to occur)

	Alternatives				
Pit Disassembly and Conversion Option	***No Action***	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/ HB-line to DWPF***	***WIPP***
PDCF					
SRS –Limiting design-basis accident (facility)	3×10^{-3} (KIS)	3×10^{-2} (immobilization)	3×10^{-3} (KIS)	3×10^{-3} (KIS)	3×10^{-3} (KIS)
SRS –Design-basis earthquake with fire	1×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-3}
SRS –Beyond-design-basis earthquake with fire	9×10^{-1}	9×10^{-1}	1	1	1
LANL – Limiting design-basis accident (facility)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)
LANL – Design-basis earthquake with spill plus fire	6×10^{-2}	6×10^{-2}	6×10^{-2}	6×10^{-2}	6×10^{-2}
LANL – Beyond-design-basis earthquake with spill plus fire	3×10^{-1}	3×10^{-1}	3×10^{-1}	3×10^{-1}	3×10^{-1}
PDC					
SRS – Limiting design-basis accident (facility)	N/A	N/A	3×10^{-3} (KIS)	3×10^{-3} (KIS)	3×10^{-3} (KIS)
SRS – Design-basis earthquake with fire	N/A	N/A	9×10^{-4}	9×10^{-4}	9×10^{-4}
SRS – Beyond-design-basis earthquake with fire	N/A	N/A	1	1	1
LANL – Limiting design-basis accident (facility)	N/A	N/A	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	N/A	6×10^{-2}	6×10^{-2}	6×10^{-2}
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	N/A	3×10^{-1}	3×10^{-1}	3×10^{-1}
PF-4 and MFFF					
SRS – Limiting design-basis accident (facility)	N/A	3×10^{-2} (immobilization)	3×10^{-3} (KIS)	3×10^{-3} (KIS)	3×10^{-3} (KIS)
SRS – Design-basis earthquake with fire	N/A	3×10^{-4}	9×10^{-4}	9×10^{-4}	9×10^{-4}
SRS – Beyond-design-basis earthquake with fire	N/A	4×10^{-1}	1	1	1
LANL – Limiting design-basis accident (facility)	N/A	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	2×10^{-1}	2×10^{-1}	2×10^{-1}	2×10^{-1}
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	6×10^{-1}	6×10^{-1}	6×10^{-1}	6×10^{-1}
PF-4, H-Canyon/HB-Line, and MFFF					
SRS – Limiting design-basis accident (facility)	N/A	3×10^{-2} (immobilization)	3×10^{-3} (KIS)	3×10^{-3} (KIS)	3×10^{-3} (KIS)
SRS – Design-basis earthquake with fire	N/A	9×10^{-4}	9×10^{-4}	9×10^{-4}	9×10^{-4}
SRS – Beyond-design-basis earthquake with fire	N/A	1	1	1	1
LANL – Limiting design-basis accident (facility)	N/A	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)	2×10^{-3} (PF-4)
LANL – Design-basis earthquake with spill plus fire	N/A	2×10^{-1}	2×10^{-1}	2×10^{-1}	2×10^{-1}
LANL – Beyond-design-basis earthquake with spill plus fire	N/A	6×10^{-1}	6×10^{-1}	6×10^{-1}	6×10^{-1}

DWPF = Defense Waste Processing Facility; immobilization = immobilization capability; KIS = K-Area Interim Surveillance capability; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

Source: Appendix D, Tables D–10 through D–18.

A large fire within any of the plutonium facilities is considered a threat because such an accident has the potential to make plutonium airborne and to threaten the integrity of building confinement systems. Facility design considerations and limits on the quantities of combustible materials and ignition sources at a facility prevent or greatly reduce the potential for large fires to occur. Furthermore, the potential consequences would be mitigated by designing the structures to limit the spread of a fire, contain any airborne plutonium, and filter any release to the environment.

The most severe consequences would be associated with "beyond-design-basis" accidents, especially earthquakes. Such seismic events would be so severe that most structures would be subjected to major damage, including collapse. Widespread injuries and fatalities could be expected from falling debris, collapsing structures, and possible resulting fires. Although there would be the potential for LCFs resulting from inhalation of radioactive materials made airborne in the earthquake, the greatest risk of harm would be from the immediate physical threats.

At SRS, the limiting design-basis accident with respect to public receptors would be an overpressurization of an oxide storage can at PDCF. If this accident were to occur, the impacts would be no additional LCFs in the population and an increased risk of the MEI developing an LCF of 3×10^{-4} (about 1 chance in 3,300). The limiting design-basis accident with respect to a noninvolved worker would be a fire in the KIS vault that causes a rupture of a DOE-STD-3013 container.[6] If the accident were to occur, the risk that the noninvolved worker would develop an LCF would be 3×10^{-3} (about 1 chance in 330). Impacts of a design-basis earthquake with fire would be no LCFs in the population and impacts on the MEI and noninvolved worker would be similar to those for the limiting design-basis accident. The beyond-design-basis earthquake with fire accident is projected to result in 7 LCFs in the offsite population; the MEI would not experience an LCF, while the noninvolved worker could experience an LCF.

At LANL, the limiting design-basis accident would be a fire in the PF-4 vault (for the general public) or a hydrogen deflagration from dissolution of plutonium metal at PF-4 (for the MEI and noninvolved worker). If the accident were to occur, the impacts would be no additional LCFs in the population, an increased risk of the MEI developing a latent fatal cancer of 7×10^{-5} (about 1 chance in 14,000), and an increased risk of a noninvolved worker developing a latent fatal cancer of 2×10^{-3} (1 chance in 500). A design-basis earthquake with spill plus fire accident would result in no LCFs in the population and LCF risks to the MEI and noninvolved worker of 9×10^{-4} (about 1 chance in 1,100) and 6×10^{-2} (about 1 chance in 17), respectively. The beyond-design-basis earthquake with spill plus fire accident is projected to result in 1 LCF in the offsite population; the LCF risks to the MEI and noninvolved worker would be 4×10^{-3} (1 chance in 250) and 3×10^{-1} (about 1 chance in 3), respectively.

4.1.2.2.2 Immobilization to DWPF Alternative

Under the Immobilization to DWPF Alternative, in addition to disposition of 34 metric tons (37.5 tons) of surplus plutonium as MOX fuel as under the No Action Alternative, up to 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium would be dispositioned by immobilization in a new K-Area immobilization capability with subsequent combination with vitrified HLW at DWPF. To accomplish this, additional options for pit disassembly and for conversion of pit and metallic plutonium to oxide are considered.

Accident impacts were analyzed for two pit disassembly and conversion options in addition to the PDCF Option identified under the No Action Alternative. These options involve the use of other facilities at SRS as well as expanded PF-4 capabilities at LANL.

The potential consequences of the postulated accidents for the three pit disassembly and conversion options under the Immobilization to DWPF Alternative are presented in Tables 4–6, 4–7, and 4–8.

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[6] *Containers that meet the specifications in DOE-STD-3013,* Stabilization, Packaging, and Storage of Plutonium-Bearing Materials, *DOE-STD-3013-2012 (DOE 2012a).*

Under all pit disassembly and conversion options, the limiting design-basis accident at SRS would be an explosion in a metal oxidation furnace at the K-Area immobilization capability. If this accident were to occur, the impacts on the public would be no additional LCFs in the population and an increased risk of the MEI developing a latent fatal cancer of 1×10^{-3} (1 chance in 1,000). The risk that the noninvolved worker would develop a latent fatal cancer would be 3×10^{-2} (about 1 chance in 33). Impacts of a design-basis earthquake would vary, depending on the pit disassembly and conversion option. The impacts of a design-basis earthquake with fire under the Immobilization to DWPF Alternative would be comparable or fall within the range of impacts projected for the No Action Alternative. There would be no LCFs in the population. The risk of an LCF would range from 2×10^{-5} to 3×10^{-4} (about 1 chance in 3,300 to 50,000) for the MEI and 3×10^{-4} to 1×10^{-3} of (about 1 chance in 1,000 to 3,300) for the noninvolved worker. The beyond-design-basis earthquake with fire is projected to result in 3 to 12 LCFs in the offsite population; the MEI would not experience an LCF while the noninvolved worker could experience an LCF.

At LANL, based on dose to the general public, the limiting design-basis accident would be a fire in the PF-4 vault resulting in an elevated release; based on doses to the MEI or noninvolved worker, it would be hydrogen deflagration from dissolution of plutonium metal at PF-4. If either accident were to occur, the impacts for all pit disassembly and conversion options would be no additional LCFs in the population, an increased risk of the MEI developing a latent fatal cancer of 7×10^{-5} (about 1 chance in 14,000), and an increased risk of a noninvolved worker developing a latent fatal cancer of 2×10^{-3} (1 chance in 500). The impacts are the same for all options because the material at risk is assumed to be the same.

For the design-basis and beyond-design-basis earthquake with spill plus fire accidents, impacts would be somewhat different among the pit disassembly and conversion options because the material at risk is different and involves more material than that for the design-basis accident. For the PDCF Option, the impacts of a design-basis earthquake with spill plus fire accident would be no LCFs in the population and LCF risks to the MEI and noninvolved worker of 5×10^{-4} (1 chance in 2,000) and 6×10^{-2} (about 1 chance in 17), respectively. For the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, the impacts of a design-basis earthquake with spill plus fire accident would be 1 LCF in the population (calculated value of 5×10^{-1}) and LCF risks to the MEI and noninvolved worker of 2×10^{-3} (1 chance in 500) and 2×10^{-1} (1 chance in 5), respectively. For the PDCF Option, the beyond-design-basis earthquake with spill plus fire accident is projected to result in 1 LCF in the offsite population, while the LCF risks to the MEI and noninvolved worker would be 2×10^{-3} (1 chance in 500) and 3×10^{-1} (about 1 chance in 3), respectively. For the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, the beyond-design-basis earthquake with spill plus fire accident is projected to result in 2 LCFs in the offsite population, while the LCF risks to the MEI and noninvolved worker would be 9×10^{-3} (about 1 chance in 110) and 6×10^{-1} (about 1 chance in 1.7), respectively.

4.1.2.2.3 MOX Fuel Alternative

Under the MOX Fuel Alternative, in addition to the pit disassembly and conversion options considered under the Immobilization to DWPF Alternative, the PDC Option is considered. The potential consequences of the postulated accidents for the four pit disassembly and conversion options under the MOX Fuel Alternative are presented in Tables 4–6, 4–7, and 4–8.

At SRS, the limiting design-basis accident is different, depending on the pit disassembly and conversion option and the receptor. For impacts on the offsite population, the limiting design-basis accident would be a level-wide fire in HB-Line for all options. Regardless of the option, no additional LCFs are expected in the population as a result of the accident. The risk of an LCF for the MEI would be about 3×10^{-4} (about 1 chance in 3,300) for the PDCF Option, where the limiting design-basis accident would be an overpressurization of an oxide storage container at PDCF. For the other options, the impact on the MEI would be about 2×10^{-4} (1 chance in 5,000) with the source being a level-wide fire in HB-Line. Under all options an accident at KIS would be the limiting design-basis accident for a noninvolved worker with an increased risk of an LCF of 3×10^{-3} (about 1 chance in 330).

Impacts of a design-basis earthquake with fire would vary depending on the pit disassembly and conversion option. There would be no LCFs in the population under any pit disassembly and conversion option. The risk of an LCF for the MEI would range from 2×10^{-4} to 4×10^{-4} (1 chance in 2,500 to 5,000). Under all pit disassembly and conversion options, the risk of an LCF for the noninvolved worker would range from 9×10^{-4} to 1×10^{-3} (about 1 chance in 1,000 to 1,100). Under all options, the beyond-design-basis earthquake with fire accident is projected to result in about 12 to 16 LCFs in the offsite population; the MEI would not experience a latent cancer fatality, while the noninvolved worker would experience a latent cancer fatality.

At LANL, accident impacts under the PF-4 and MFFF, and PF-4, H-Canyon/HB-Line, and MFFF Options would be the same as those in Section 4.1.2.2.2 under the Immobilization to DWPF Alternative. Impacts under both the PDCF and PDC Options would be the same as those for the PDCF Option under the Immobilization to DWPF Alternative.

4.1.2.2.4 H-Canyon/HB-Line to DWPF Alternative

Under the H-Canyon/HB-Line to DWPF Alternative, the same pit disassembly and conversion options would be considered as those under the MOX Fuel Alternative (Section 4.1.2.2.3). The potential consequences of the postulated accidents for the pit disassembly and conversion options under the H-Canyon/HB-Line to DWPF Alternative are presented in Tables 4–6, 4–7, and 4–8. Under this alternative, the impacts of these accidents would be the same as those under the MOX Fuel Alternative (Section 4.1.2.2.3).

4.1.2.2.5 WIPP Alternative

Under the WIPP Alternative, the same pit disassembly and conversion options as those discussed under the MOX Fuel Alternative would be considered. The potential consequences of the postulated accidents for the pit disassembly and conversion options under the WIPP Alternative are presented in Tables 4–6, 4–7, and 4–8. Under this alternative, the impacts of these accidents would be the same as those under the MOX Fuel Alternative (Section 4.1.2.2.3).

4.1.2.3 DOE Facility Chemical Accidents

The potential for accidents involving hazardous chemicals associated with the proposed surplus plutonium disposition operations to affect noninvolved workers or the public is quite limited.

At SRS, the potential for hazardous chemical impacts on noninvolved workers and the public has been evaluated for many of the facilities that might use larger quantities of hazardous chemicals (SRNS 2010d; WGI 2005c) and no substantial impacts were found for noninvolved workers or the public. For the proposed pit disassembly and conversion project, potential hazardous chemicals were screened to determine if any of the proposed chemicals or amounts that might be used pose a threat to collocated workers 100 meters (328 feet) from a spill or to an offsite individual. All potential concentrations from spills were found to be below the applicable protective guidelines (DOE/NNSA 2012).

Existing SRS facilities are evaluated for hazardous chemical impacts and controls, such as inventory controls, are in place to limit those impacts. For example, the F/H-Area Laboratory safety analysis report indicates that chemical inventories are low enough when compared to emergency response planning guidelines to classify the facility as a general use facility in accordance with SRS guidelines (SRNS 2010d).

Inventories of hazardous chemicals are maintained for each facility. The inventories for most chemicals are small, and because of SRS’s remote location and large size, there is no risk of chemical exposure to the surrounding public population resulting from normal site operations or accidents. Nevertheless, monitoring efforts and baseline studies are regularly performed.

At LANL, the research nature of PF-4 operations requires the use, handling, and storage of a large variety of chemicals, but in relatively small quantities (for example, a few grams or a few hundred liters). As such, there is an extensive list of chemicals that may be present for programmatic purposes, with quantities of regulated chemicals far below the threshold quantities set by EPA (40 CFR 68.130). The hazards associated with these chemicals are well understood and, because of the small quantities, can be managed using standard hazardous material and/or chemical handling programs. They pose minimal potential hazards to public health and the environment in an accident condition. Activity-level probabilistic hazards analyses would be performed to ensure that no onsite inventory exceeds the screening criterion of DOE-STD-1189, *Integration of Safety into the Design Process* (DOE 2008d). There are limited quantities of chemicals stored at PF-4, and no bulk quantities would be needed to support the surplus plutonium disposition activities.

At both SRS and LANL, accidents involving chemicals would primarily present a risk to the involved worker in the immediate vicinity of the accident. DOE safety programs are in place to minimize the risks to workers from both routine operations and accidents involving these materials. Regarding risks from handling toxic or hazardous chemicals, worker safety programs are enforced via required adherence to Federal and state laws; DOE orders and regulations; Occupational Safety and Health Administration and EPA guidelines; and plans and procedures for performing work, including training, monitoring, use of personal protective equipment, and administrative controls.

4.1.2.4 Reactor Accidents

The reactor accident analyses included in Appendix I, Section I.2.2.2.2, of this *SPD Supplemental EIS*, and Chapter 4, Section 4.28.2.5, of the *SPD EIS* (DOE 1999b), indicate that, in the event of a postulated reactor accident, the doses to the public would be somewhat different for different reactors. The results of these accident analyses differ for each reactor based on a number of factors, including the size of the population surrounding the reactor, the distance from the reactor to the surrounding population, and site-specific meteorological conditions. The five sets of commercial nuclear power reactors analyzed in these documents include reactors located near large cities such as Charlotte, North Carolina, as well as reactors located in relatively less-populated areas. The reactors include boiling water reactors and pressurized water reactors operated by Duke Power, Virginia Power (New Dominion Power), and TVA.

Table 4–9 presents a comparison of projected radiological impacts from a series of design-basis and beyond-design-basis accidents that were analyzed in this *SPD Supplemental EIS* and the *SPD EIS.* The comparison is presented as the ratio of the accident impacts involving partial MOX fuel cores to those using full LEU fuel cores. Impacts were estimated for a member of the general public at the exclusion area boundary at the time of the accident (i.e., the MEI) or to the general population residing within 50 miles (80 kilometers) of the reactor. The numbers in parentheses are the calculated ratios (impacts for a partial MOX core divided by impacts for an LEU core); the range of numbers reflects the results for the five sets of reactors that were evaluated. A ratio less than 1 indicates that the MOX fuel core could result in smaller impacts than the same accident with an LEU fuel core. A value of 1 indicates that the estimated impacts are the same for both fuel core types. A ratio larger than 1 indicates that the MOX fuel core could result in larger impacts than the same accident with an LEU fuel core. Outside the parentheses, the table shows a ratio of 1 for all accident scenarios. This is a rounded value because when modeling and analytical uncertainties are considered, the precision of the results is no more than one significant figure.

Table 4–9 Ratio of Doses for Reactor Accidents Involving a Partial Mixed Oxide Fuel Core Compared to a Full Low-Enriched Uranium Fuel Core (partial mixed oxide fuel core dose/full low-enriched uranium fuel core dose) [a, b]

Accident	*MEI*	*Population within 50 Miles (80 kilometers)*
Design-Basis Accidents		
LOCA	1 (0.87 to 1.03)	1 (0.96 to 1.03)
Used-fuel-handling accident	1 (0.90 to 1.00)	1 (0.94 to 1.00)
Beyond-Design-Basis Accidents		
Steam generator tube rupture [c]	1 (1.06 to 1.24)	1 (1.04 to 1.09)
Early containment failure	1 (1.00 to 1.22)	1 (0.96 to 1.05)
Late containment failure	1 (1.01 to 1.10)	1 (0.95 to 1.09)
ISLOCA	1 (0.93 to 1.22)	1 (0.95 to 1.14)

ISLOCA = interfacing systems loss-of-coolant accident; LOCA = loss-of-coolant accident; MEI = maximally exposed individual.

[a] Reactor accidents involving the use of partial MOX fuel cores were assumed to involve reactor cores with approximately 40 percent MOX fuel and 60 percent LEU fuel.

[b] When modeling and analytical uncertainties are considered, the precision of the results is no more than one significant figure.

[c] Steam generator tube rupture is not applicable for boiling water reactors since they do not use steam generators.

Source: Appendix I, Table I–11.

4.1.2.5 Intentional Destructive Acts

DOE's National Nuclear Security Administration (NNSA) has prepared a classified analysis of the potential impacts of intentional destructive acts in support of this *SPD Supplemental EIS*. Substantive details of intentional destructive act scenarios, security countermeasures, and potential impacts are not released to the public because disclosure of this information could be exploited by enemies to plan attacks.

NNSA's strategy for the mitigation of environmental impacts resulting from extreme events, including intentional destructive acts, has three distinct components: (1) prevent or deter successful attacks; (2) plan and provide timely and adequate response to emergency situations; and (3) progress to recovery through long-term response in the form of monitoring, remediation, and support for affected communities and their environment.

Depending on the intentional destructive act, impacts could be similar to or exceed the impacts of accidents analyzed in this *SPD Supplemental EIS*. Classified analyses of intentional destructive acts related to plutonium operations at LANL and storage of plutonium pits at Pantex were prepared for the 2008 *LANL SWEIS* (DOE 2008f) and *Complex Transformation SPEIS* (DOE 2008j), respectively. Information from those analyses and analyses specific to the proposed facilities at SRS is included in the classified appendix of this *SPD Supplemental EIS*. These analyses provide NNSA with information on which to base, in part, decisions regarding surplus plutonium. The classified appendix evaluates several scenarios involving intentional destructive acts, and calculates consequences for the noninvolved worker, MEI, and population in terms of physical injuries, radiation doses, and LCFs. Although the results of the analyses cannot be disclosed, the following general conclusions can be drawn: the potential consequences of intentional destructive acts are highly dependent upon distance to the site boundary and the size and distribution of the surrounding population. That is, the closer and higher density of the surrounding population, the higher the consequences. In addition, it is generally easier and more cost-effective to protect newer than older facilities, because new security features can be incorporated into their design. In other words, protective forces needed to defend new facilities may be smaller than those needed in older facilities due to the inherent security features of newer facilities. New facilities can, as a result of design features, better prevent attacks and reduce the impacts of attacks.

4.1.3 Socioeconomics

Socioeconomic impacts that could result from implementation of the alternatives addressed in this *SPD Supplemental EIS* include impacts on the regional economic characteristics, population and housing, and traffic within the region of influence (ROI). The socioeconomic ROI for SRS is defined as the four-county area of Columbia and Richmond Counties in Georgia, and Aiken and Barnwell Counties in South Carolina. The socioeconomic ROI for LANL is defined as the four-county area of Los Alamos, Rio Arriba, Sandoval, and Santa Fe Counties in New Mexico. **Tables 4–10** and **4–11** provide summaries of construction and operations impacts, respectively, by alternative.

Table 4–10 Summary of Socioeconomic Impacts Related to Facility Construction

		Alternative				
Resource	***Pit Disassembly and Conversion Option*** [a]	***No Action***	***Immobilization to DWPF***	***MOX Fuel***	***HC/HBL to DWPF***	***WIPP***
Direct employment (number of personnel in peak year)	PDCF	722 (SRS) 0 (LANL)	943 (SRS) 0 (LANL)	722 (SRS) 0 (LANL)	722 (SRS) 0 (LANL)	722 (SRS) 0 (LANL)
	PDC	N/A	N/A	741 (SRS) 0 (LANL)	741 (SRS) 0 (LANL)	741 (SRS) 0 (LANL)
	PF-4 and MFFF	N/A	252 (SRS) 46 (LANL)	275 (SRS) 46 (LANL)	275 (SRS) 46 (LANL)	285 (SRS) 46 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	252 (SRS) 46 (LANL)	285 (SRS) 46 (LANL)	285 (SRS) 46 (LANL)	295 (SRS) 46 (LANL)
Indirect employment (number of personnel in peak year) [b]	PDCF	455 (SRS) 0 (LANL)	595 (SRS) 0 (LANL)	455 (SRS) 0 (LANL)	455 (SRS) 0 (LANL)	455 (SRS) 0 (LANL)
	PDC	N/A	N/A	467 (SRS) 0 (LANL)	467 (SRS) 0 (LANL)	467 (SRS) 0 (LANL)
	PF-4 and MFFF	N/A	159 (SRS) 26 (LANL)	173 (SRS) 26 (LANL)	173 (SRS) 26 (LANL)	180 (SRS) 26 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	159 (SRS) 26 (LANL)	180 (SRS) 26 (LANL)	180 (SRS) 26 (LANL)	186 (SRS) 26 (LANL)
Direct earnings in peak year ($ in millions)	PDCF	44 (SRS) 0 (LANL)	57 (SRS) 0 (LANL)	44 (SRS) 0 (LANL)	44 (SRS) 0 (LANL)	44 (SRS) 0 (LANL)
	PDC	N/A	N/A	45 (SRS) 0 (LANL)	45 (SRS) 0 (LANL)	45 (SRS) 0 (LANL)
	PF-4 and MFFF	N/A	15 (SRS) 2.4 (LANL)	17 (SRS) 2.4 (LANL)	17 (SRS) 2.4 (LANL)	17 (SRS) 2.4 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	15 (SRS) 2.4 (LANL)	17 (SRS) 2.4 (LANL)	17 (SRS) 2.4 (LANL)	18 (SRS) 2.4 (LANL)
Direct output in peak year ($ in millions)	PDCF	71 (SRS) 0 (LANL)	92 (SRS) 0 (LANL)	71 (SRS) 0 (LANL)	71 (SRS) 0 (LANL)	71 (SRS) 0 (LANL)
	PDC	N/A	N/A	72 (SRS) 0 (LANL)	72 (SRS) 0 (LANL)	72 (SRS) 0 (LANL)
	PF-4 and MFFF	N/A	25 (SRS) 4.4 (LANL)	27 (SRS) 4.4 (LANL))	27 (SRS) 4.4 (LANL)	28 (SRS) 4.4 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	25 (SRS) 4.4 (LANL)	28 (SRS) 4.4 (LANL)	28 (SRS) 4.4 (LANL)	29 (SRS) 4.4 (LANL)
Value added in peak year ($ in millions)	PDCF	67 (SRS) 0 (LANL)	87 (SRS) 0 (LANL)	67 (SRS) 0 (LANL)	67 (SRS) 0 (LANL)	67 (SRS) 0 (LANL)
	PDC	N/A	N/A	68 (SRS) 0 (LANL)	68 (SRS) 0 (LANL)	68 (SRS) 0 (LANL)
	PF-4 and MFFF	N/A	23 (SRS) 3.8 (LANL)	25 (SRS) 3.8 (LANL)	25 (SRS) 3.8 (LANL)	26 (SRS) 3.8 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	23 (SRS) 3.8 (LANL)	26 (SRS) 3.8 (LANL)	26 (SRS) 3.8 (LANL)	27 (SRS) 3.8 (LANL)
Projected personal income of ROI in peak year ($ in millions)	PDCF	19,5050 (SRS) N/A (LANL)	19,800 (SRS) N/A (LANL)	19,500 (SRS) N/A (LANL)	19,500 (SRS) N/A (LANL)	19,500 (SRS) N/A (LANL)
	PDC	N/A	N/A	19,500 (SRS) N/A (LANL)	19,500 (SRS) N/A (LANL)	19,500 (SRS) N/A (LANL)
	PF-4 and MFFF	N/A	18,300 (SRS) 13,900 (LANL)	18,300 (SRS) 13,900 (LANL)	18,300 (SRS) 13,900 (LANL)	18,300 (SRS) 13,900 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	18,300 (SRS) 13,900 (LANL)	18,300 (SRS) 13,900 (LANL)	18,300 (SRS) 13,900 (LANL)	18,300 (SRS) 13,900 (LANL)

Resource	Pit Disassembly and Conversion Option [a]	Alternative				
		No Action	Immobilization to DWPF	MOX Fuel	HC/HBL to DWPF	WIPP
Projected labor force of ROI in peak year	PDCF	258,000 (SRS) N/A (LANL)	261,000 (SRS) N/A (LANL)	258,000 (SRS) N/A (LANL)	258,000 (SRS) N/A (LANL)	258,000 (SRS) N/A (LANL)
	PDC	N/A	N/A	258,000 (SRS) N/A (LANL)	258,000(SRS) N/A (LANL)	258,000 (SRS) N/A (LANL)
	PF-4 and MFFF	N/A	247,000 (SRS) 185,000 (LANL)	247,000 (SRS) 185,000 (LANL)	247,000 (SRS) 185,000 (LANL)	247,000 (SRS) 185,000 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	247,000 (SRS) 185,000 (LANL)	247,000 (SRS) 185,000 (LANL)	247,000 (SRS) 185,000 (LANL)	247,000 (SRS) 185,000 (LANL)

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; ROI = region of interest; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] As described in Appendix H, no new construction would be needed at any of the principal SRS and LANL plutonium support facilities, with no impact on employment.

[b] Indirect employment was estimated using a direct-effect employment multiplier of 1.63 for SRS and 1.58 for LANL.

Table 4–11 Summary of Socioeconomic Impacts Related to Facility Operations

Resource	Pit Disassembly and Conversion Option	Alternative				
		No Action	Immobilization to DWPF	MOX Fuel	HC/HBL to DWPF	WIPP
Direct employment (number of personnel in peak year)	PDCF	1,677 (SRS) 85 (LANL)	2,111 (SRS) 85 (LANL)	1,636 (SRS) 85 (LANL)	1,676 (SRS) 85 (LANL)	1,636 (SRS) 85 (LANL)
	PDC	N/A	N/A	1,716 (SRS) 85 (LANL)	1,667 (SRS) 85 (LANL)	1,716 (SRS) 85 (LANL)
	PF-4 and MFFF	N/A	1,596 (SRS) 253 (LANL)	1,357 (SRS) 253 (LANL)	1,342 (SRS) 253 (LANL)	1,257 (SRS) 253 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	1,736 (SRS) 253 (LANL)	1,397 (SRS) 253 (LANL)	1,242 (SRS) 253 (LANL)	1,397 (SRS) 253 (LANL)
Indirect employment (number of personnel in peak year) [a]	PDCF	1,995 (SRS) 86 (LANL)	2,511 (SRS) 86 (LANL)	1,946 (SRS) 86 (LANL)	1,993 (SRS) 86 (LANL)	1,946 (SRS) 86 (LANL)
	PDC	N/A	N/A	2,041 (SRS) 86 (LANL)	1,983 (SRS) 86 (LANL)	2,041 (SRS) 86 (LANL)
	PF-4 and MFFF	N/A	1,898 (SRS) 256 (LANL)	1,614 (SRS) 256 (LANL)	1,430 (SRS) 256 (LANL)	1,495 (SRS) 256 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	2,065 (SRS) 256 (LANL)	1,622 (SRS) 256 (LANL)	1,596 (SRS) 256 (LANL)	1,622 (SRS) 256 (LANL)
Direct earnings in peak year ($ in millions)	PDCF	140 (SRS) 7.4 (LANL)	180 (SRS) 7.4 (LANL)	140 (SRS) 7.4 (LANL)	140 (SRS) 7.4 (LANL)	140 (SRS) 7.4 (LANL)
	PDC	N/A	N/A	150 (SRS) 7.4 (LANL)	140 (SRS) 7.4 (LANL)	150 (SRS) 7.4 (LANL)
	PF-4 and MFFF	N/A	140 (SRS) 22 (LANL)	120 (SRS) 22 (LANL)	100 (SRS) 22 (LANL)	110 (SRS) 22 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	150 (SRS) 22 (LANL)	120 (SRS) 22 (LANL)	120 (SRS) 22 (LANL)	120 (SRS) 22 (LANL)
Direct output in peak year ($ in millions)	PDCF	300 (SRS) 11 (LANL)	380 (SRS) 11 (LANL)	290 (SRS) 11 (LANL)	300 (SRS) 11 (LANL)	290 (SRS) 11 (LANL)
	PDC	N/A	N/A	310 (SRS) 11 (LANL)	300 (SRS) 11 (LANL)	310 (SRS) 11 (LANL)
	PF-4 and MFFF	N/A	280 (SRS) 33 (LANL)	240 (SRS) 33 (LANL)	210 (SRS) 33 (LANL)	220 (SRS) 33 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	310 (SRS) 33 (LANL)	250 (SRS) 33 (LANL)	240 (SRS) 33 (LANL)	250 (SRS) 33 (LANL)
Value added in peak year ($ in millions)	PDCF	250 (SRS) 11 (LANL)	320 (SRS) 11 (LANL)	250 (SRS) 11 (LANL)	250 (SRS) 11 (LANL)	250 (SRS) 11 (LANL)
	PDC	N/A	N/A	260 (SRS) 11 (LANL)	250 (SRS) 11 (LANL)	260 (SRS) 11 (LANL)
	PF-4 and MFFF	N/A	240 (SRS) 32 (LANL)	200 (SRS) 32 (LANL)	180 (SRS) 32 (LANL)	190 (SRS) 32 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	260 (SRS) 32 (LANL)	210 (SRS) 32 (LANL)	200 (SRS) 32 (LANL)	210 (SRS) 32 (LANL)

Resource	***Pit Disassembly and Conversion Option***	***Alternative***				
		No Action	***Immobilization to DWPF***	***MOX Fuel***	***HC/HBL to DWPF***	***WIPP***
Projected personal income of ROI in peak year ($ in millions)	PDCF	22,300 (SRS) 13,400 (LANL)	22,300 (SRS) 13,400 (LANL)	22,300 (SRS) 13,400 (LANL)	22,300 (SRS) 13,400 (LANL)	22,300 (SRS) 13,400 (LANL)
	PDC	N/A	N/A	20,700 (SRS) 13,400 (LANL)	20,700 (SRS) 13,400 (LANL)	20,700 (SRS) 13,400 (LANL)
	PF-4 and MFFF	N/A	21,000 (SRS) 13,400 (LANL)	19,200 (SRS) 13,400 (LANL)	20,100 (SRS) 13,400 (LANL)	19,200 (SRS) 13,400 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	21,000 (SRS) 13,400 (LANL)	19,200 (SRS) 13,400 (LANL)	20,100 (SRS) 13,400 (LANL)	19,200 (SRS) 13,400 (LANL)
Projected labor force of ROI in peak year	PDCF	282,000 (SRS) 179,000 (LANL)	282,000 (SRS) 179,000 (LANL)	282,000 (SRS) 179,000 (LANL)	282,000 (SRS) 179,000 (LANL)	282,000 (SRS) 179,000 (LANL)
	PDC	N/A	N/A	269,000 (SRS) 179,000 (LANL)	269,000 (SRS) 179,000 (LANL)	269,000 (SRS) 179,000 (LANL)
	PF-4 and MFFF	N/A	271,000 (SRS) 179,000 (LANL)	255,000 (SRS) 179,000 (LANL)	263,000 (SRS) 179,000 (LANL)	255,000 (SRS) 179,000 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	271,000 (SRS) 179,000 (LANL)	255,000 (SRS) 179,000 (LANL)	263,000 (SRS) 179,000 (LANL)	255,000 (SRS) 179,000 (LANL)

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; ROI = region of interest; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] Indirect employment was estimated using a direct-effect multiplier of 2.19 for SRS and approximately 2 for LANL.

As described in Appendix I, the use of a 40 percent MOX fuel core in domestic commercial nuclear power reactors is not expected to change the socioeconomic impacts that currently occur due to the use of a 100 percent LEU fuel core. Therefore, the impacts from irradiating MOX fuel at domestic commercial nuclear power reactors are not discussed further in this section.

4.1.3.1 Regional Economic Characteristics

Impacts on the regional economy are measured by the projected changes in employment, earnings, and economic output resulting from activities at SRS and LANL. Both short-term, transient construction employment and long-term employment for facility operations would result from the proposed activities. Estimates of the potential impacts on economic output, employment, and earnings under each alternative are derived using multipliers provided from the Regional Input-Output Modeling System (RIMS II) developed by the U.S. Bureau of Economic Analysis (BEA 2012c). To focus the potential impacts on the ROIs, the estimated value added resulting from the economic output is measured against the projected personal income of each ROI. Changes in employment are measured against the projected labor force of the ROIs to realize the magnitude of the potential labor impacts.

4.1.3.1.1 No Action Alternative

Construction—Construction employment under the No Action Alternative is expected to peak in 2017. Approximately 722 people would be directly employed during the construction of PDCF, resulting in an estimated 455 indirect jobs. The peak construction employment under the No Action Alternative is estimated to represent approximately 0.5 percent of the projected SRS ROI labor force.

During the peak year of construction activities, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $67 million, or 0.34 percent of projected personal income in the SRS ROI. Approximately $44 million of the value added would be in the form of earnings of construction workers.

No modifications to PF-4 would be required under the No Action Alternative; therefore, there would be no socioeconomic impacts from construction at LANL.

Operations—Employment under the No Action Alternative would peak in 2026. It is estimated that approximately 1,677 people would be directly employed from plutonium storage at K-Area and operation of KIS, WSB, PDCF, and MFFF. Additional indirect employment of approximately 1,995 jobs is expected to be generated in the SRS ROI. The total additional employment under this alternative is estimated to represent approximately 1.3 percent of the projected SRS ROI labor force. All surplus plutonium disposition activities would be completed by the end of 2036, with the exception of surplus plutonium storage, surveillance, stabilization, and repackaging activities, which would continue until 2051.

During the peak year of operations, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $250 million, or about 1.1 percent of the projected personal income in the SRS ROI. Approximately $140 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium-related activities would continue at SRS through 2051 under the No Action Alternative. The total number of worker-years is estimated to be about 36,400. The total value added from the direct economic activity to the local economy in the form of final goods and services over the life of the project is estimated to be approximately $5.5 billion.

Under the No Action Alternative, additional direct employment at PF-4 would peak at 85 workers annually starting in 2013. Another 86 indirect jobs are expected to be generated in the LANL ROI during this time. Total employment related to PF-4 operations under the No Action Alternative is estimated to represent approximately 0.1 percent of the projected LANL ROI labor force.

During the peak year of pit disassembly and conversion operations at PF-4, it is estimated that the value added from the direct economic activity to the local economy would be approximately $11 million, or about 0.1 percent of the projected personal income of the LANL ROI. Approximately $7.4 million of the value added would be in the form of earnings of workers at PF-4. The total worker-years needed at LANL over the life of the project would be approximately 600. The total value added from the direct economic activity to the local economy in the LANL ROI in the form of final goods and services over the life of the project is estimated to be approximately $76 million.

4.1.3.1.2 Immobilization to DWPF Alternative

Construction—There are multiple pit disassembly and conversion options under the Immobilization to DWPF Alternative. In addition to the option of building a new PDCF, other options are being considered for pit disassembly and conversion whereby existing facilities at LANL and SRS would be modified. These options would result in lower construction requirements compared to those for construction of PDCF (see Appendix F).

Under the PDCF Option, construction employment under the Immobilization to DWPF Alternative is expected to peak in 2018. Approximately 943 people would be directly employed during construction of PDCF and the K-Area immobilization capability. Another 595 indirect jobs are expected to be generated in the SRS ROI. The peak construction employment under the Immobilization to DWPF Alternative is estimated to represent approximately 0.6 percent of the projected ROI labor force.

During the peak year of construction activities, it is estimated that the value added from the direct economic activity to the local economy would be approximately $87 million, or about 0.4 percent of the projected personal income in the SRS ROI. Approximately $57 million of the value added would be in the form of earnings of construction workers.

Under the PF-4 and MFFF Option and PF-4, H-Canyon/HB-Line, and MFFF Option, PDCF would not be constructed. Construction employment at SRS these options would peak in 2013. Approximately 252 people would be directly employed during installation of the metal oxidation furnaces in MFFF. Another 159 indirect jobs are expected to be generated in the SRS ROI. Total employment related to construction activities under the Immobilization to DWPF Alternative is estimated to represent approximately 0.2 percent of the projected SRS ROI labor force.

During the peak year of construction activities at SRS under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Options, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $23 million, and represent approximately 0.1 percent of the projected personal income in the SRS ROI. It is estimated that approximately $17 million of the value added would be in the form of earnings of construction workers.

Modification of PF-4 would be required under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option. Construction employment during PF-4 modifications would peak in 2015 at 46 workers. Another 26 indirect jobs are expected to be generated in the LANL ROI during this time. Peak employment related to modification of PF-4 is estimated to represent approximately 0.04 percent of the projected LANL ROI labor force.

During the peak year of PF-4 modification, it is estimated that the value added from the direct economic activity to the local economy would be approximately $3.8 million, or about 0.03 percent of the projected personal income of the LANL ROI. It is estimated that approximately $2.4 million of the value added would be in the form of earnings of construction workers.

Operations—Employment resulting from implementation of the PDCF Option under the Immobilization to DWPF Alternative would peak during 2026. Approximately 2,111 additional people would be directly employed at SRS at the K-Area immobilization capability, WSB, K-Area storage, KIS, MFFF, and PDCF. Additional indirect employment of approximately 2,511 workers would be generated in the SRS ROI during the peak year of operations. The total additional employment associated with operations under this alternative is estimated to represent approximately 1.6 percent of the projected SRS ROI labor force.

During the peak year of operations at SRS, the value added from the direct economic output to the local economy in the form of final goods and services is estimated to be approximately $320 million, or about 1.4 percent of the projected personal income in the ROI. Approximately $180 million of the value added to the local economy would be in the form of earnings of SRS employees.

All surplus plutonium activities at SRS would be completed by the end of 2038. When compared with the No Action Alternative, the PDCF Option under the Immobilization to DWPF Alternative is expected to decrease the operational timeframe for surplus plutonium activities at SRS by approximately 13 years, while increasing the total number of SRS worker-years needed over the life of the project by approximately 6,900 to 43,300. The total value added from the direct economic activity to the local economy in the form of final goods and services over the life of the project is estimated to be approximately $6.5 billion.

The socioeconomic impacts from operations at LANL under the PDCF Option would be the same as those in Section 4.1.3.1.1 under the No Action Alternative.

Under both the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, employment at SRS resulting from implementing the Immobilization to DWPF Alternative with pit disassembly and conversion at LANL would peak during 2022.

Under the PF-4 and MFFF Option, approximately 1,596 additional people would be directly employed by SRS operations at the K-Area immobilization capability, WSB, K-Area storage, KIS, and MFFF. Additional indirect employment of approximately 1,898 workers would be generated in the SRS ROI during the peak year of operations. The total additional employment associated with operations under this option is estimated to represent approximately 1.3 percent of the projected SRS ROI labor force.

During the peak year of operations at SRS under the PF-4 and MFFF Option, the value added from the direct economic output to the local economy in the form of final goods and services is estimated to be approximately $240 million, or about 1.1 percent of the projected personal income in the SRS ROI. Approximately $140 million of the value added to the local economy would be in the form of earnings of SRS employees.

Under the PF-4, H-Canyon/HB-Line. and MFFF Option, approximately 1,736 additional people would be directly employed by SRS operations at the K-Area immobilization capability, H-Canyon/HB-Line, WSB, K-Area storage, KIS, K-Area pit disassembly, and MFFF. Additional indirect employment of approximately 2,065 workers is expected in the SRS ROI during the peak year of operations. The total additional employment associated with operations under the Immobilization to DWPF Alternative with the PF-4, H-Canyon/HB-Line, and MFFF Option is estimated to represent approximately 1.4 percent of the projected SRS ROI labor force.

During the peak year of operations at SRS under the PF-4, H-Canyon/HB-Line, and MFFF Option, the value added from the direct economic output to the local economy in the form of final goods and services is estimated to be approximately $260 million, or about 1.2 percent of the projected personal income in the SRS ROI. Approximately $150 million of the value added to the local economy would be in the form of earnings of SRS employees.

Under both the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, all surplus plutonium activities at SRS would be completed by the end of 2038.

When compared with the No Action Alternative, the PF-4 and MFFF Option under the Immobilization to DWPF Alternative is expected to decrease the operational timeframe for surplus plutonium activities at SRS by approximately 13 years, while decreasing the total number of SRS worker-years needed over the life of the project by approximately 3,600 to 32,800. The total value added from the direct economic activity to the local economy in the form of final goods and services over the life of the project is estimated to be approximately $4.9 billion.

The PF-4, H-Canyon/HB-Line, and MFFF Option under the Immobilization to DWPF Alternative is expected to decrease the operational timeframe for surplus plutonium activities at SRS by approximately 13 years when compared to the No Action Alternative, while decreasing the total number of SRS worker-years needed over the life of the project by approximately 1,600 to 34,800. The total value added from the direct economic activity to the local economy in the form of final goods and services over the life of the project is estimated to be approximately $5.2 billion.

Under both the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, additional direct employment at PF-4 would peak at 253 workers annually starting in 2013. Another 256 indirect jobs are expected to be generated in the LANL ROI during this time. Peak employment related to this change in PF-4 operations is estimated to represent approximately 0.3 percent of the projected LANL ROI labor force.

During the peak year of pit disassembly and conversion operations at PF-4, it is estimated that the value added from the direct economic activity to the local economy would be approximately $32 million, or about 0.2 percent of the projected personal income of the LANL ROI. Approximately $22 million of the value added would be in the form of earnings of workers at PF-4. When compared to the No Action Alternative, the total worker-years needed at LANL over the life of the project would increase by 5,300 to 5,900. The total value added from the direct economic activity to the local economy in the LANL ROI in the form of final goods and services over the life of the project is estimated to be approximately $750 million.

4.1.3.1.3 MOX Fuel Alternative

Construction—There are multiple options for pit disassembly and conversion operations under the MOX Fuel Alternative. Two options include constructing a new PDCF at F-Area or constructing a new PDC at K-Area. Additionally, two options are being considered for pit disassembly and conversion whereby existing facilities at LANL and SRS would be modified to support pit disassembly and conversion activities. These options are expected to result in lower construction requirements compared to those under the PDCF and PDC Options (see Appendix F).

Socioeconomic impacts at SRS from construction under the PDCF Option would be the same as those for the PDCF Option under the No Action Alternative (Section 4.1.3.1.1). There would be no construction at LANL under the PDCF Option.

Construction employment at SRS under the PDC Option, is expected to peak in 2017. Approximately 741 people would be directly employed during the peak year of construction. Another 467 indirect jobs would be generated under this option. Total employment related to construction activities under the PDC Option is estimated to represent about 0.5 percent of the projected SRS ROI labor force. There would be no construction at LANL under the PDC Option.

During the peak year of construction under the PDC Option, the value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services is estimated to be approximately $68 million, and represent approximately 0.4 percent of the projected personal income in the SRS ROI. Approximately $45 million of the value added would be in the form of earnings of construction workers.

Under the PF-4 and MFFF Option, the only new construction at SRS would involve installation of metal oxidation furnaces in MFFF. Construction employment under the PF-4 and MFFF Option would peak during 2013 with direct employment of 275 workers. The direct employment would generate an additional 173 indirect jobs within the SRS ROI. Total employment at SRS related to construction activities under the PF-4 and MFFF Option is estimated to represent about 0.2 percent of the projected SRS ROI labor force.

During the peak year of construction activities, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $25 million, and represent approximately 0.1 percent of the projected personal income in the SRS ROI. It is estimated that approximately $17 million of the value added would be in the form of earnings of construction workers.

Under the PF-4, H-Canyon/HB-Line, and MFFF Option, the only new construction at SRS would involve minor modifications to the K-Area Complex and H-Canyon/HB-Line, and installation of metal oxidation furnaces in MFFF. Construction employment at H-Canyon/HB-Line, K-Area, and MFFF would peak in 2013 with direct employment of 285 workers. The direct employment would generate an additional 180 indirect jobs in the SRS ROI. Total employment related to construction under this option is estimated to represent about 0.2 percent of the projected SRS ROI labor force.

During the peak year of construction activities under the PF-4, H-Canyon/HB-Line, and MFFF Option, the value added from the direct economic activity to the local economy for the SRS ROI in the form of final goods and services is estimated to be approximately $26 million, and represent approximately 0.1 percent of the projected personal income in the SRS ROI. It is estimated that approximately $17 million of the value added would be in the form of earnings of construction workers.

Socioeconomic impacts from modification of PF-4 at LANL to support increased pit disassembly and conversion operations would be the same as those under the Immobilization to DWPF Alternative (Section 4.1.3.1.2).

Operations—Employment under the PDCF Option is expected to peak during 2026. Additional direct employment is estimated to peak at approximately 1,636 workers, generating an estimated 1,946 indirect jobs in the SRS ROI. The total additional employment associated with this alternative is estimated to represent approximately 1.3 percent of the projected SRS ROI labor force in the peak year of operations.

During the peak year of operations under the PDCF Option, the value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services is estimated to be approximately $250 million, and represent approximately 1.1 percent of projected personal income in the SRS ROI. Approximately $140 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium activities would be completed by the end of 2039. When compared with the No Action Alternative, the MOX Fuel Alternative under the PDCF Option is expected to decrease the operational timeframe for surplus plutonium activities by approximately 12 years, while increasing the total number of SRS worker-years needed over the life of the project by approximately 4,200 to 40,600. The total value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $6.1 billion.

The socioeconomic impacts from operations at LANL under the PDCF Option would be the same as those in Section 4.1.3.1.1 under the No Action Alternative.

Employment under the MOX Fuel Alternative with the PDC Option is expected to peak during 2021 Additional direct employment is estimated to peak at approximately 1,716 workers, generating an estimated 2,041 indirect jobs in the SRS ROI. The total additional employment associated with this alternative is estimated to represent approximately 1.4 percent of the projected SRS ROI labor force in the peak year of operations.

During the peak year of operations, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $260 million, and represent approximately 1.2 percent of projected personal income in the ROI in the peak year of operations. Approximately $150 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium activities would be completed by the end of 2039. When compared with the No Action Alternative, implementing the PDC Option under the MOX Fuel Alternative is expected to decrease the operational timeframe for surplus plutonium activities by approximately 12 years, while increasing the total number of SRS worker-years needed over the life of the project by approximately 4,760 to 41,100. The total value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $6.2 billion.

The socioeconomic impacts for this alternative from operations at LANL under the PDC Option would be the same as those in Section 4.1.3.1.1 for the PDCF Option under the No Action Alternative.

Under the PF-4 and MFFF Option, direct employment at SRS is expected to peak during 2016 at approximately 1,357 workers. The direct employment would generate an estimated 1,614 indirect jobs in the SRS ROI. The total additional employment at SRS associated with this alternative is estimated to represent approximately 1.2 percent of the projected SRS ROI labor force in the peak year of operations.

During the peak year of SRS operations under the PF-4 and MFFF Option, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $200 million, and represent approximately 1.1 percent of projected personal income in the SRS ROI in the peak year of operations. Approximately $120 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium activities under the PF-4 and MFFF Option would be completed by the end of 2039. When compared with the No Action Alternative, the PF-4 and MFFF Option under the MOX Fuel Alternative is expected to decrease the operational timeframe for surplus plutonium activities by approximately 12 years, while decreasing the total number of SRS worker-years needed over the life of the project by approximately 6,400 to 30,000. The total value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $4.5 billion.

The socioeconomic impacts from pit disassembly and conversion operations in PF-4 at LANL under the PF-4 and MFFF Option would be the same as those for this option under the Immobilization to DWPF Alternative (Section 4.1.3.1.2).

Under the PF-4, H-Canyon/HB-Line, and MFFF Option, direct employment at SRS is expected to peak during 2016 at approximately 1,397 workers. The direct employment would generate an estimated 1,662 indirect jobs in the SRS ROI. The total additional employment at SRS associated with this alternative is estimated to represent approximately 1.2 percent of the projected SRS ROI labor force in the peak year of operations.

During the peak year of SRS operations under the PF-4, H-Canyon/HB-Line, and MFFF Option, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $200 million, and represent approximately 1.1 percent of projected personal income in the SRS ROI in the peak year of operations. Approximately $120 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium disposition activities under the PF-4, H-Canyon/HB-Line, and MFFF Option would be completed by the end of 2039. When compared with the No Action Alternative, the PF-4, H-Canyon/HB-Line, and MFFF Option under the MOX Fuel Alternative is expected to decrease the operational timeframe for surplus plutonium activities by approximately 12 years, while decreasing the total number of SRS worker-years needed over the life of the project by approximately 5,000 to 31,400. The total value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $4.7 billion.

The socioeconomic impacts from pit disassembly and conversion operations in PF-4 at LANL under the PF-4, H-Canyon/HB-Line, and MFFF Option would be the same as those for this option under the Immobilization to DWPF Alternative (Section 4.1.3.1.2).

4.1.3.1.4 H-Canyon/HB-Line to DWPF Alternative

Construction—Similar to the MOX Fuel Alternative, there are multiple options for pit disassembly and conversion under the H-Canyon/HB-Line to DWPF Alternative. Options for pit disassembly and conversion at SRS include constructing a new PDCF at F-Area or constructing a new PDC at K-Area. Additionally, two options are being considered for pit disassembly and conversion whereby existing facilities at LANL and SRS would be modified to support pit disassembly and conversion activities. These options would result in lower construction requirements compared to those under the PDCF and PDC Options (see Appendix F).

The socioeconomic impacts at SRS and LANL from construction under the PDCF Option would be the same as those under the No Action Alternative (Section 4.1.3.1.1).

The socioeconomic impacts at SRS and LANL from construction under the PDC Option would be the same as those under the MOX Fuel Alternative (Section 4.1.3.1.3).

The socioeconomic impacts at SRS and LANL under the PF-4 and MFFF Option would be the same as those under the MOX Fuel Alternative (Section 4.1.3.1.3).

The socioeconomic impacts at SRS and LANL from construction under the PF-4, H-Canyon/HB-Line and MFFF Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

Operations—Employment under the PDCF Option is expected to peak during 2026. Additional direct employment is estimated to peak at approximately 1,676 workers, generating an estimated 1,993 indirect jobs in the SRS ROI. The total additional employment associated with this alternative is estimated to represent approximately 1.3 percent of the projected ROI labor force in the peak year of operations.

During the peak year of operations, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $250 million, and represent approximately 1.1 percent of projected personal income in the ROI in the peak year of operations. Approximately $140 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium activities would be completed by the end of 2038. When compared with the No Action Alternative, the PDCF Option under the H-Canyon/HB-Line to DWPF Alternative is expected to decrease the operational timeframe for surplus plutonium activities by approximately 13 years, while increasing the total number of SRS worker-years needed over the life of the project by approximately 1,900 to 38,300. The total value added from the direct economic activity to the local economy in the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $5.8 billion.

The socioeconomic impacts at LANL under the PDCF Option would be the same as those for the PDCF Option under the No Action Alternative (Section 4.1.3.1.1).

Employment under the PDC Option, is expected to peak during 2021. Additional direct employment is estimated to peak at approximately 1,667 workers, generating additional indirect employment in the SRS ROI of approximately 1,983. The total additional employment associated with this alternative is estimated to represent approximately 1.4 percent of the projected ROI labor force in the peak year of operations.

During the peak year of operations, the value added from the direct economic output to the local economy in the form of final goods and services would be approximately $250 million, or approximately 1.2 percent of projected personal income in the SRS ROI in the respective peak year of operations. Approximately $140 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium activities would be completed by the end of 2038. When compared with the No Action Alternative, the PDC Option under the H-Canyon/HB-Line to DWPF Alternative is expected to decrease the operational timeframe for surplus plutonium activities by approximately 13 years, while increasing the total number of SRS worker-years needed over the life of the project by approximately 2,400 to 38,800. The total value added from the direct economic activity to the local economy in the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $5.8 billion.

The socioeconomic impacts at LANL under the PDC Option would be the same as those for the PDC Option under the MOX Fuel Alternative (Section 4.1.3.1.3).

Employment at SRS under the PF-4 and MFFF Option is expected to peak during 2019. Additional direct employment is estimated to peak at approximately 1,342 workers, generating an estimated 1,430 indirect jobs in the SRS ROI. The total additional employment associated with this alternative is estimated to represent approximately 1.0 percent of the projected ROI labor force in the peak year of operations.

During the peak year of operations, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $180 million, and represent approximately 0.9 percent of projected personal income in the SRS ROI in the peak year of operations. Approximately $100 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium activities would be completed by the end of 2038. When compared with the No Action Alternative, the PF-4 and MFFF Option under the H-Canyon/HB-Line to DWPF Alternative is expected to decrease the operational timeframe for surplus plutonium activities by approximately 13 years, while decreasing the total number of SRS worker-years needed over the life of the project by approximately 8,700 to 27,700. The total value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $4.2 billion.

The socioeconomic impacts at LANL under the PF-4 and MFFF Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

Employment at SRS under the PF-4, H-Canyon/HB-Line, and MFFF Option is expected to peak during 2019. Additional direct employment is estimated to peak at approximately 1,242 workers, generating an estimated 1,596 indirect jobs in the SRS ROI. The total additional employment associated with this option is estimated to represent approximately 1.1 percent of the projected SRS ROI labor force in the peak year of operations.

During the peak year of operations, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $200 million, and represent approximately 1 percent of projected personal income in the SRS ROI. Approximately $120 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium disposition activities would be completed by the end of 2038. When compared with the No Action Alternative, the PF-4, H-Canyon/HB-Line, and MFFF Option under the H-Canyon/HB-Line to DWPF Alternative is expected to decrease the operational timeframe for surplus plutonium activities by approximately 13 years, while decreasing the total number of SRS worker-years needed over the life of the project by approximately 6,700 to 29,700. The total value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $4.5 billion.

The socioeconomic impacts at LANL under the PF-4, H-Canyon/HB-Line, and MFFF Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

4.1.3.1.5 WIPP Alternative

Construction—Similar to the MOX Fuel Alternative, there are multiple options for pit disassembly and conversion operations under the WIPP Alternative. Options for pit disassembly and conversion at SRS include constructing a new PDCF at F-Area or constructing a new PDC facility at K-Area. Additionally, options are being considered for pit disassembly and conversion whereby existing facilities at LANL and SRS would be modified to support pit disassembly and conversion activities. These options would result in lower construction requirements compared to those under the PDCF and PDC Options (see Appendix F).

The socioeconomic impacts at SRS and LANL from construction under the PDCF Option would be the same as those under the No Action Alternative (Section 4.1.3.1.1).

The socioeconomic impacts at SRS and LANL from construction under the PDC Option would be the same as those under the MOX Fuel Alternative (Section 4.1.3.1.3).

Construction employment at SRS under the PF-4 and MFFF Option would peak during 2013 with direct employment of 285 workers. The direct employment would generate an additional 180 indirect jobs within the SRS ROI. Total employment related to construction activities under the PF-4 and MFFF Option is estimated to represent about 0.19 percent of the projected SRS ROI labor force.

During the peak year of construction activities, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $26 million, and represent approximately 0.1 percent of the projected personal income in the SRS ROI. It is estimated that approximately $17 million of the value added would be in the form of earnings of construction workers.

The socioeconomic impacts at SRS from construction under the PF-4 and MFFF Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

Construction employment at SRS under the PF-4, H-Canyon/HB-Line, and MFFF Option would peak during 2013 with direct employment of 295 workers. The direct employment would generate an additional 186 indirect jobs within the SRS ROI. Total employment related to construction activities under the PF-4 H-Canyon/HB-Line, and MFFF Option is estimated to represent about 0.2 percent of the projected SRS ROI labor force.

During the peak year of construction activities, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $27 million, and represent approximately 0.15 percent of the projected personal income in the SRS ROI. It is estimated that approximately $18 million of the value added would be in the form of earnings of construction workers.

The socioeconomic impacts at LANL from construction under the PF-4, H-Canyon/HB-Line, and MFFF Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

Operations—Socioeconomic impacts during the peak year of operations under the PDCF Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

Surplus plutonium activities would be completed by the end of 2038. When compared with the No Action Alternative, the PDCF Option under the WIPP Alternative is expected to decrease the operational timeframe for surplus plutonium activities by approximately 13 years while increasing the total number of SRS worker-years needed over the life of the project by approximately 2,800 to 39,200. The total value added from the direct economic activity to the local economy in the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $5.9 billion.

Socioeconomic impacts during the peak year of operations under the PDC Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

Surplus plutonium activities would be completed by the end of 2038. When compared with the No Action Alternative, the WIPP Alternative under the PDC Option is expected to decrease the operational timeframe for surplus plutonium activities by approximately 13 years while increasing the total number of SRS worker-years needed over the life of the project by approximately 3,300 to 39,700. The total value added from the direct economic activity to the local economy in the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $6.0 billion.

Employment at SRS under the PF-4 and MFFF Option is expected to peak during 2016. Additional direct employment is estimated to peak at approximately 1,257 workers, generating an estimated 1,495 indirect jobs in the SRS ROI. The total additional employment associated with this alternative is estimated to represent approximately 1.1 percent of the projected SRS ROI labor force in the peak year of operations.

During the peak year of operations, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $190 million, and represent approximately 1 percent of projected personal income in the SRS ROI. Approximately $110 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium disposition activities would be completed by the end of 2038. When compared with the No Action Alternative, the PF-4 and MFFF Option is expected to decrease the operational timeframe for surplus plutonium activities by approximately 13 years, while decreasing the total number of SRS worker-years needed over the life of the project by approximately 7,700 to 28,700. The total value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $4.3 billion.

The socioeconomic impacts at SRS from construction under the PF-4 and MFFF Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

Employment at SRS under the PF-4, H-Canyon/HB-Line, and MFFF Option is expected to peak during 2016. Additional direct employment is estimated to peak at approximately 1,397 workers, generating an estimated 1,662 indirect jobs in the SRS ROI. The total additional employment associated with this alternative is estimated to represent approximately 1.2 percent of the projected SRS ROI labor force in the peak year of operations.

During the peak year of operations, the value added from the direct economic activity to the local economy in the form of final goods and services is estimated to be approximately $210 million, and represent approximately 1.1 percent of projected personal income in the SRS ROI. Approximately $120 million of the value added to the local economy would be in the form of earnings of SRS employees.

Surplus plutonium disposition activities would be completed by the end of 2038. When compared with the No Action Alternative, the PF-4, H-Canyon/HB-Line, and MFFF Option is expected to decrease the operational timeframe for surplus plutonium activities by approximately 13 years, while decreasing the total number of SRS worker-years needed over the life of the project by approximately 5,800 to 30,600. The total value added from the direct economic activity to the local economy of the SRS ROI in the form of final goods and services over the life of the project is estimated to be approximately $4.6 billion.

The socioeconomic impacts at LANL from construction under the PF-4, H-Canyon/HB-Line, and MFFF Option would be the same as those for this option under the MOX Fuel Alternative (Section 4.1.3.1.3).

4.1.3.2 Population and Housing

Population and housing impacts for each alternative were analyzed using an estimate of the potential for in-migration of workers under each alternative. The in-migration of workers was measured against the projected populations of the SRS and LANL ROIs. Impacts on housing availability were analyzed using the estimated impacts on the population.

4.1.3.2.1 No Action Alternative

The peak construction employment required under this alternative would represent approximately 0. 5 percent of the projected labor force. As discussed in Section 4.1.3.1.1, the total change in peak operations employment (direct plus indirect) associated with implementation of the No Action Alternative is estimated to represent about 1.3 percent of the projected SRS ROI labor force. The new jobs created at SRS due to surplus plutonium activities would help to offset any negative impacts generated from recent workforce reductions of approximately 1,240 employees (Pavey 2011). In 2011, the unemployment rate in the SRS ROI was approximately 9.1 percent (BLS 2012). Any in-migration of workers into the ROI due to implementing this alternative is expected to be small when compared to the projected population of the ROI. Furthermore, any in-migration would be well within the historical trends of population growth in this area. Due to the low potential for impacts on the population, impacts on the availability of housing under this alternative are expected to be small.

Operations at LANL under the No Action Alternative would represent 0.1 percent of the projected labor force of the LANL ROI. Employees engaged in pit disassembly and conversion activities at PF-4 would be drawn from the existing LANL workforce and would help to offset any negative impacts generated from recent announcements of workforce reductions at LANL (LANL 2012d). No in-migration of workers is expected under this alternative. Therefore, no impacts on populations and the availability of housing are expected within the LANL ROI under the No Action Alternative.

4.1.3.2.2 Immobilization to DWPF Alternative

The peak construction employment at SRS under this alternative is estimated to represent less than about 0.6 percent of the projected labor force of the SRS ROI. As discussed in Section 4.1.3.1.2, the total change in peak operations employment at SRS under any of the pit disassembly and conversion options is estimated to represent approximately 1.6 percent of the projected ROI labor force. The new jobs created at SRS due to surplus plutonium activities would help to offset any negative impacts generated from recent workforce reductions of approximately 1,240 employees (Pavey 2011). Any in-migration of workers into the ROI due to implementing this alternative is expected to be small when compared to the projected population of the ROI. Furthermore, any in-migration would be well within the historical trends of population growth in this area. Due to the low potential for impacts on the population, impacts on the availability of housing under this alternative are expected to be small.

The potential socioeconomic impacts at LANL on population and housing under the PDCF Option would be the same as those in Section 4.1.3.2.1 under the No Action Alternative.

Under the pit disassembly and conversion options that involve modification of PF-4 at LANL and increased pit disassembly and conversion activities, increased employment to support PF-4 operations would represent approximately 0.3 percent of the projected LANL ROI labor force. The peak construction employment required for modification of PF-4 would represent approximately 0.04 percent of the projected LANL ROI labor force. The additional employment to support increased pit disassembly and conversion operations would help to offset any negative impacts generated from an expected workforce reduction at LANL (LANL 2012d). Little to no in-migration of workers is expected to support modification and operations of PF-4, as these employees would be drawn from the existing LANL workforce. Impacts on the availability of housing under this alternative in the area surrounding LANL are expected to be minimal.

4.1.3.2.3 MOX Fuel Alternative

Potential impacts on population and housing in the SRS and LANL ROIs under the MOX Fuel Alternative would be less than those under the Immobilization to DWPF Alternative (Section 4.1.3.2.2), due to the smaller potential for changes to employment.

4.1.3.2.4 H-Canyon/HB-Line to DWPF Alternative

Potential impacts on population and housing under the H-Canyon/HB-Line to DWPF Alternative would be less than those under the Immobilization to DWPF Alternative (Section 4.1.3.2.2), due to the smaller potential for changes in employment.

4.1.3.2.5 WIPP Alternative

Potential impacts on population and housing under the WIPP Alternative would be less than those under the Immobilization to DWPF Alternative (Section 4.1.3.2.2), due to the smaller potential for changes in employment.

4.1.3.3 Traffic

Factors that could influence the level of service of the local transportation system include additional commuter traffic due to changes in employment, an increased number of industrial vehicles due to shipments of nuclear materials to and from SRS and LANL, transportation of MOX fuel to existing domestic commercial nuclear power reactors, transportation of waste shipments, and transportation of construction materials. It was assumed that materials transportation could occur 365 days a year; therefore, the annual shipments were calculated to represent potential impacts on peak average annual daily traffic. It was also assumed that daily commuter traffic would include only direct employees, because indirect employment could occur anywhere throughout the four-county ROIs and would not necessarily affect transportation corridors to and from the site. Transportation of materials and wastes would likely take place during off-peak hours; however, it was assumed that the shipments could be on the road during the peak morning or afternoon commute. This results in traffic impacts likely being overestimated. The estimated number of vehicles traveling to and from SRS was adjusted to account for the impacts of recent workforce reductions of approximately 1,240 employees.

Peak transportation impacts would vary, depending on the pit disassembly and conversion option under each of the alternatives. Under all alternatives, traffic impacts at SRS would be the greatest under the PDCF or PDC Options, because these options result in the largest employment levels at SRS. When the estimated baseline vehicles traveling to and from SRS under the PDCF Option are accounted for, cumulative peak traffic impacts would occur between 2017 and 2018 under all alternatives except under the Immobilization to DWPF Alternative; in this event, cumulative peak traffic volumes would occur during 2026. This increased number of vehicles would not be of sufficient magnitude to adversely affect the level of service of roads in the SRS ROI. Local traffic under all of the alternatives and the flow of commuters into SRS during peak driving times are expected to remain largely unchanged. The largest potential increase would be less than about 3 percent related to SRS traffic under the MOX Fuel and WIPP Alternatives. There would be no need for enhancements to the local transportation system surrounding SRS due to surplus plutonium activities under any alternative.

Under the action alternatives, optional modification and operation of PF-4 at LANL to support increased pit disassembly and conversion operations would have the potential to increase the daily number of vehicles commuting to and from LANL on local roads by up to 192. This peak would occur in 2015 when modification and operation of PF-4 would be happening concurrently. After completion of modifications at PF-4, the increased daily number of vehicles on local roads from PF-4 operations is estimated to be 169. When compared to the baseline of an estimated 8,983 vehicles commuting to and from LANL, this small increase in the number of vehicles would not be of sufficient magnitude to adversely affect the level of service of roads in the LANL ROI.

4.1.4 Waste Management

This section analyzes impacts on waste management facilities for the alternatives and pit disassembly and conversion options. Waste generation quantities are presented in the aggregate for each alternative for the pit disassembly and conversion options. Quantities of waste from individual facilities are presented in Appendix F for pit disassembly and conversion facilities, Appendix G for plutonium disposition facilities, and Appendix H for principal plutonium support facilities. Waste types include TRU and mixed TRU waste (analyzed collectively), solid LLW, solid MLLW, solid hazardous waste, solid nonhazardous waste, liquid LLW, and liquid nonhazardous waste. All solid waste quantities presented in this section are containerized and ready for secure storage, onsite disposal, or transportation for offsite disposal taking into account appropriate packaging efficiencies.

As described in Appendix I, the use of a 40 percent MOX fuel core in domestic commercial nuclear power reactors is not expected to change the annual volumes of LLW, MLLW, hazardous waste, and nonhazardous waste that currently occur due to the use of 100 percent LEU fuel core. It is expected, however, that use of a 40 percent MOX fuel core would increase the amount of used fuel that would be generated in a TVA reactor by about 8 to 10 percent compared to that from a 100 percent LEU core, and in a generic reactor by about 2 to 16 percent. Used MOX fuel would be managed in the same manner as LEU used fuel, and the additional used fuel is not expected to affect used fuel management at the reactor sites (TVA 2012). Therefore, the impacts of the alternatives from irradiation of MOX fuel at domestic commercial nuclear power reactors are not discussed further in this section.

Waste management facilities at SRS and LANL are described in Chapter 3, Sections 3.1.10 and 3.2.10, respectively. Waste management impacts are evaluated as a percentage of a site's treatment, storage, or disposal capacity. For LANL, impacts are evaluated for solid LLW, solid MLLW, solid hazardous waste, and solid nonhazardous waste as a percentage increase in existing waste generation rates as reported for 2009. These capacities or current generation rates are discussed in detail in Chapter 3 and are summarized in **Tables 4–12** and **4–13** for SRS and LANL, respectively.

Table 4–12 Summary of Waste Management Capacities at the Savannah River Site

Waste Type	*Annual Capacity*	*Disposition Method*	*Impact Criteria*
Transuranic	13,200 cubic meters	Onsite storage pads	As a percent of storage capacity
Solid LLW	37,000 cubic meters [a]	Onsite disposal slits or engineered trenches	As a percent of disposal capacity
Solid MLLW	296 cubic meters [b]	Onsite storage pads	As a percent of storage capacity
Solid HW	296 cubic meters [b]	Onsite storage pads	As a percent of storage capacity
Solid Non-HW	4,200,000 cubic meters	Regional municipal landfill disposal	As a percent of permitted disposal capacity
Liquid LLW	590,000,000 liters	Onsite F/H-Area Effluent Treatment Project	As a percent of treatment capacity
Liquid Non-HW	1,500,000,000 liters	Onsite Central Sanitary Wastewater Treatment Facility	As a percent of treatment capacity

HW = hazardous waste; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste.

[a] As of February 2012, the estimated unused disposal capacity remaining is approximately 23,000 cubic meters for the slit trenches and 14,000 cubic meters for the engineered trenches.

[b] Pad 26-E is permitted to store a maximum of 296 cubic meters in aggregate for solid MLLW and solid hazardous waste.

Note: To convert cubic meters to cubic feet, multiply by 35.314; liters to gallons, multiply by 0.26418.

Source: Chapter 3, Section 3.1.10.

Table 4–13 Summary of Waste Management Capacities at Los Alamos National Laboratory

Waste Type	*Annual Capacity or Generation Rate*	*Disposition Method*	*Impact Criteria* [a]
Transuranic	79,900 drum equivalents (16,000 cubic meters) [b]	Onsite storage pads	As a percent of storage capacity
Solid LLW	3,772 cubic meters	Offsite disposal at NNSS	As a percent increase of existing generation rates
Solid MLLW	13.5 cubic meters	Offsite commercial disposal	As a percent increase of existing generation rates
Solid HW	1,723 metric tons	Offsite commercial disposal	As a percent increase of existing generation rates
Solid Non-HW	2,562 metric tons	Offsite commercial landfill disposal	As a percent increase of existing generation rates
Liquid LLW	4,000,000 liters	Onsite Radioactive Liquid Waste Treatment Facility	As a percent of treatment capacity
Liquid Non-HW	840,000,000 liters	Onsite Sanitary Wastewater System	As a percent of treatment capacity

Drum equivalent = one 55-gallon drum; HW = hazardous waste; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NNSS = Nevada National Security Site.

[a] Impact criteria for solid LLW, solid MLLW, solid hazardous waste, and solid nonhazardous waste are calculated as a percent increase over generation rates reported in 2009; impact criteria for other wastes are calculated as a percent of onsite storage or treatment capacity.

[b] One 55-gallon drum contains approximately 0.2 cubic meters of waste.

Note: To convert cubic meters to cubic feet, multiply by 35.314; liters to gallons, multiply by 0.26418; metric tons to tons, multiply by 1.1023.

Source: Chapter 3, Section 3.2.10.

TRU waste would be generated at SRS and LANL under all alternatives, as discussed in the following subsections. TRU waste generated from surplus plutonium disposition activities would potentially use a large percentage of the WIPP excess disposal capacity. Decisions about disposal of any significant quantities of TRU waste would be made within the context of the needs of the entire DOE complex. It should also be noted that TRU waste generation would extend to 2036 for the No Action Alternative and up to 2039 for the action alternatives. It was assumed for analysis in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b) that TRU waste would be received at WIPP over about a 35-year period, through approximately 2033. Because the total quantity of TRU waste that may be disposed of at WIPP is statutorily established by the Waste Isolation Pilot Plant Land Withdrawal Act, the actual operating period for WIPP will depend on the volumes of TRU waste that may be disposed of at WIPP by all DOE waste generators. Waste minimization efforts across the DOE complex could extend the WIPP operating period. It is assumed for analysis purposes in this *SPD Supplemental EIS* that WIPP would be available for the duration of the surplus plutonium activities under each alternative.

The total WIPP capacity for TRU waste disposal is set at 175,600 cubic meters (6.2 million cubic feet) pursuant to the Waste Isolation Pilot Plant Land Withdrawal Act, or 168,485 cubic meters (5.95 million cubic feet) of contact-handled TRU waste (DOE 2008k:16). Estimates in the *Annual Transuranic Waste Inventory Report – 2011* indicate that approximately 148,800 cubic meters (5.25 million cubic feet) of contact-handled TRU waste would be disposed of at WIPP (emplaced volume plus anticipated volume) (DOE 2011k: Table C–1), approximately 19,700 cubic meters (696,000 cubic feet) less than the contact-handled TRU waste permitted capacity. Therefore, approximately 19,700 cubic meters (696,000 cubic feet) of unsubscribed contact-handled TRU waste capacity could support the waste generated by other missions, such as the actions analyzed in this *SPD Supplemental EIS*.

TRU waste generation estimates in the following subsections do not include any reduction in volume that could be realized due to implementation of waste minimization practices. For example, it is possible that compaction could be performed or plutonium could be recycled as part of MFFF operations; additional technical reviews would be needed to determine the viability of these approaches.

Tables 4–14 and **4–15** present peak annual waste generation rates expected for construction or modifications of various facilities under the alternatives and pit disassembly and conversion options at SRS and LANL, respectively. **Tables 4–16** and **4–17** present the total waste quantities expected during the entire construction phase at SRS and LANL, respectively.

Tables 4–18 and **4–19** present peak annual waste generation rates projected from operations at various facilities under the alternatives and pit disassembly and conversion options, at SRS and LANL, respectively. **Tables 4–20** and **4–21** present the total waste quantities expected during the entire operations phase at SRS and LANL, respectively.

These tables present waste generation for site-specific activities under each alternative for purposes of evaluating impacts at SRS and LANL separately. To compare or evaluate the total waste generation between alternatives, the values in the tables for SRS and LANL are additive. For example, to determine total waste volumes generated under an alternative, the values in Table 4–14 would need to be added to Table 4–15. The same applies to the values in Tables 4–16 and 4–17, Tables 4–18 and 4–19, and Tables 4–20 and 4–21.

Table 4–14 Peak Annual Construction Waste Generation at the Savannah River Site

Waste Type	*Pit Disassembly and Conversion Option*	*Alternative*				
		No Action	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
TRU Waste (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	negligible	negligible	5 (<0.1)	negligible	5 ***(<0.1)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	5 (<0.1)	negligible	5 ***(<0.1)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	negligible	5 (<0.1)	negligible	5 ***(<0.1)***
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	12 ***(0.1)***	17 ***(0.1)***	12 ***(0.1)***	17 ***(0.1)***
Solid LLW (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	negligible	420 ***(1.1)***	negligible	negligible	negligible
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	1,300 ***(3.5)***	1,300 ***(3.5)***	1,300 ***(3.5)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	420 ***(1.1)***	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	440 ***(1.2)***	21 ***(<0.1)***	21 ***(<0.1)***	21 ***(<0.1)***
Solid MLLW (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	negligible	17 ***(5.7)***	negligible	negligible	negligible
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	19 ***(6.4)***	19 ***(6.4)***	19 ***(6.4)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	17 ***(5.7)***	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	17 ***(5.7)***	negligible	negligible	negligible
Solid HW (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	6 ***(1.9)***	23 ***(7.6)***	6 ***(1.9)***	6 ***(1.9)***	6 ***(1.9)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	820 ***(280)***	820 ***(280)***	820 ***(280)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	17 ***(5.7)***	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	17 ***(5.7)***	negligible	negligible	negligible
Solid Non-HW (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	130 ***(<0.1)***	550 ***(<0.1)***	130 ***(<0.1)***	130 ***(<0.1)***	130 ***(<0.1)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	860 ***(<0.1)***	860 ***(<0.1)***	860 ***(<0.1)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	420 ***(<0.1)***	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	420 ***(<0.1)***	negligible	negligible	negligible
Liquid LLW (liters/yr)	PDCF ***(Percent of SRS Capacity)***	negligible	negligible	negligible	negligible	negligible
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	negligible	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	negligible	negligible	negligible	negligible
Liquid Non-HW (liters/yr)	PDCF ***(Percent of SRS Capacity)***	1,500,000 ***(0.1)***	1,500,000 ***(0.1)***	1,500,000 ***(0.1)***	1,500,000 ***(0.1)***	1,500,000 ***(0.1)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	negligible	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	negligible	negligible	negligible	negligible

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; HW = hazardous waste; LLW = low-level radioactive waste; MFFF = Mixed Oxide Fuel Fabrication Facility; MLLW = mixed low-level radioactive waste; m^3 = cubic meters; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; TRU = transuranic; WIPP = Waste Isolation Pilot Plant; yr = year.

Note: Values are rounded to two significant figures. To convert cubic meters to cubic yards, multiply by 1.308.

Source: Appendix F, Section F.4; Appendix G, Section G.4.

Table 4–15 Peak Annual Construction Waste Generation at Los Alamos National Laboratory

Waste Type	*Pit Disassembly and Conversion Option* [a]	*Alternative*				
		No Action [b]	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
TRU Waste (m^3/yr)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF ***(Percent of LANL Capacity)***	N/A	2.4 ***(<0.1)***	2.4 ***(<0.1)***	2.4 ***(<0.1)***	2.4 ***(<0.1)***
Solid LLW (m^3/yr)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	4.6 ***(0.12)***	4.6 ***(0.12)***	4.6 ***(0.12)***	4.6 ***(0.12)***
Solid MLLW (m^3/yr)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	7 ***(52)***	7 ***(52)***	7 ***(52)***	7 ***(52)***
Solid HW (m^3/yr)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	negligible	negligible	negligible	negligible
Solid Non-HW (m^3/yr)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	negligible	negligible	negligible	negligible
Liquid LLW (liters/yr)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF ***(Percent of LANL Capacity)***	N/A	negligible	negligible	negligible	negligible
Liquid Non-HW (liters/yr)	PF-4 and MFFF; and PF-4, HC/HBL, and MFF ***(Percent of LANL Capacity)***	N/A	negligible	negligible	negligible	negligible

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; HW = hazardous waste; LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; MFFF = Mixed Oxide Fuel Fabrication Facility; MLLW = mixed low-level radioactive waste; MOX = mixed oxide; m^3 = cubic meters; N/A = not applicable; PF-4 = Plutonium Facility; TRU = transuranic; WIPP = Waste Isolation Pilot Plant; yr = year.

[a] There is no waste generation from construction or modification of facilities at LANL under the PDCF and PDC Options.

[b] There is no waste generation from construction or modification of facilities at LANL under the No Action Alternative.

Note: Values are rounded to two significant figures. To convert cubic meters to cubic yards, multiply by 1.308.

Source: Appendix F, Section F.4; Appendix G, Section G.4.

Table 4–16 Total Construction Waste Generation at the Savannah River Site

Waste Type	*Pit Disassembly and Conversion Option*	*Alternative*				
		No Action	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
TRU Waste (m^3)	PDCF	negligible	negligible	10	negligible	10
	PDC	N/A	N/A	10	negligible	10
	PF-4 and MFFF	N/A	negligible	10	negligible	10
	PF-4, HC/HBL, and MFFF	N/A	23	33	23	33
Solid LLW (m^3)	PDCF	negligible	2,500	negligible	negligible	negligible
	PDC	N/A	N/A	12,000	12,000	12,000
	PF-4 and MFFF	N/A	2,500	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF	N/A	2,500	41	41	41
Solid MLLW (m^3)	PDCF	negligible	100	negligible	negligible	negligible
	PDC	N/A	N/A	210	210	210
	PF-4 and MFFF	N/A	100	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF	N/A	100	negligible	negligible	negligible
Solid HW (m^3)	PDCF	56	160	56	56	56
	PDC	N/A	N/A	7,000	7,000	7,000
	PF-4 and MFFF	N/A	100	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF	N/A	100	negligible	negligible	negligible

Waste Type	*Pit Disassembly and Conversion Option*	*Alternative*				
		No Action	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
Solid Non-HW (m^3)	PDCF	1,300	3,800	1,300	1,300	1,300
	PDC	N/A	N/A	6,800	6,800	6,800
	PF-4 and MFFF	N/A	2,500	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF	N/A	2,500	negligible	negligible	negligible
Liquid LLW (liters)	PDCF	negligible	negligible	negligible	negligible	negligible
	PDC	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF	N/A	negligible	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF	N/A	negligible	negligible	negligible	negligible
Liquid Non-HW (liters)	PDCF	15,000,000	15,000,000	15,000,000	15,000,000	15,000,000
	PDC	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF	N/A	negligible	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF	N/A	negligible	negligible	negligible	negligible

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; HW = hazardous waste; LLW = low-level radioactive waste; MFFF = Mixed Oxide Fuel Fabrication Facility; MLLW = mixed low-level radioactive waste; m^3 = cubic meters; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.
Note: Values are rounded to two significant figures. To convert cubic meters to cubic yards, multiply by 1.308.
Source: Appendix F, Section F.4; Appendix G, Section G.4.

Table 4–17 Total Construction Waste Generation at Los Alamos National Laboratory

Waste Type	*Pit Disassembly and Conversion Option* [a]	*Alternative*				
		No Action [a]	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
TRU Waste (m^3)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF	N/A	19	19	19	19
Solid LLW (m^3)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF	N/A	37	37	37	37
Solid MLLW (m^3)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF	N/A	56	56	56	56
Solid HW (m^3)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF	N/A	negligible	negligible	negligible	negligible
Solid Non-HW (m^3)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF	N/A	negligible	negligible	negligible	negligible
Liquid LLW (liters)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF	N/A	negligible	negligible	negligible	negligible
Liquid Non-HW (liters)	PF-4 and MFFF; and PF-4, HC/HBL, and MFFF	N/A	negligible	negligible	negligible	negligible

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; HW = hazardous waste; LLW = low-level radioactive waste; MFFF = Mixed Oxide Fuel Fabrication Facility; MLLW = mixed low-level radioactive waste; m^3 = cubic meters; MOX = mixed oxide; N/A = not applicable; PF-4 = Plutonium Facility; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

[a] There is no waste generation from construction or modification of facilities at LANL under the No Action Alternative, or under the PDCF and PDC Options under any of the action alternatives.

Note: Values are rounded to two significant figures. To convert cubic meters to cubic yards, multiply by 1.308.
Source: Appendix F, Section F.4; Appendix G, Section G.4.

Table 4–18 Peak Annual Operations Waste Generation at the Savannah River Site

Waste Type	***Pit Disassembly and Conversion Option***	***Alternative***				
		No Action	***Immobilization to DWPF***	***MOX Fuel***	***HC/HBL to DWPF***	***WIPP***
TRU Waste (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	640 ***(4.9)***	1,100 ***(8.3)***	1,000 ***(7.8)***	750 ***(5.7)***	1,300 ***(9.9)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	1,000 ***(7.8)***	750 ***(5.7)***	1,300 ***(9.9)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	930 ***(7.0)***	860 ***(6.5)***	580 ***(4.4)***	1,100 ***(8.6)***
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	1,100 ***(8.3)***	880 ***(6.7)***	600 ***(4.6)***	1,300 ***(9.9)***
Solid LLW (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	1,800 ***(4.8)***	2,000 ***(5.5)***	3,300 ***(8.8)***	3,200 ***(8.5)***	1,900 ***(5.0)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	3,300 ***(8.8)***	3,200 ***(8.5)***	1,900 ***(5.0)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	1,100 ***(2.9)***	2,300 ***(6.2)***	2,200 ***(6.0)***	910 ***(2.4)***
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	2,500 ***(6.9)***	2,400 ***(6.4)***	2,300 ***(6.2)***	2,400 ***(6.4)***
Solid MLLW (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	negligible	80 ***(27)***	2.4 ***(0.8)***	2.4 ***(0.8)***	negligible
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	2.4 ***(0.8)***	2.4 ***(0.8)***	negligible
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	80 ***(27)***	2.4 ***(0.8)***	2.4 ***(0.8)***	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	82 ***(28)***	2.4 ***(0.8)***	2.4 ***(0.8)***	2.4 ***(0.8)***
Solid HW (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	0.7 ***(0.2)***	80 ***(27)***	0.7 ***(0.2)***	0.7 ***(0.2)***	0.7 ***(0.2)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	0.7 ***(0.2)***	0.7 ***(0.2)***	0.7 ***(0.2)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	80 ***(27)***	0.6 ***(0.2)***	0.6 ***(0.2)***	0.6 ***(0.2)***
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	80 ***(27)***	0.6 ***(0.2)***	0.6 ***(0.2)***	0.6 ***(0.2)***
Solid Non-HW (m^3/yr)	PDCF ***(Percent of SRS Capacity)***	3,300 ***(<0.1)***	3,400 ***(<0.1)***	200,000 ***(4.8)***	200,000 ***(4.8)***	3,300 ***(<0.1)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	200,000 ***(4.8)***	200,000 ***(4.8)***	3,300 ***(<0.1)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	1,400 ***(<0.1)***	200,000 ***(4.8)***	200,000 ***(4.8)***	1,300 ***(<0.1)***
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	200,000 ***(4.8)***	200,000 ***(4.8)***	200,000 ***(4.8)***	200,000 ***(4.8)***
Liquid LLW (liters/yr)	PDCF ***(Percent of SRS Capacity)***	9,800,000 ***(1.7)***	9,800,000 ***(1.7)***	9,800,000 ***(1.7)***	9,800,000 ***(1.7)***	9,800,000 ***(1.7)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	9,700,000 ***(1.6)***	9,700,000 ***(1.6)***	9,700,000 ***(1.6)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	9,700,000 ***(1.6)***	9,700,000 ***(1.6)***	9,700,000 ***(1.6)***	9,700,000 ***(1.6)***
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	9,700,000 ***(1.6)***	9,700,000 ***(1.6)***	9,700,000 ***(1.6)***	9,700,000 ***(1.6)***
Liquid Non-HW (liters/yr)	PDCF ***(Percent of SRS Capacity)***	380,000,000 ***(25)***	380,000,000 ***(25)***	380,000,000 ***(25)***	380,000,000 ***(25)***	380,000,000 ***(25)***
	PDC ***(Percent of SRS Capacity)***	N/A	N/A	380,000,000 ***(25)***	380,000,000 ***(25)***	380,000,000 ***(25)***
	PF-4 and MFFF ***(Percent of SRS Capacity)***	N/A	350,000,000 ***(23)***	350,000,000 ***(23)***	350,000,000 ***(23)***	350,000,000 ***(23)***
	PF-4, HC/HBL, and MFFF ***(Percent of SRS Capacity)***	N/A	350,000,000 ***(23)***	350,000,000 ***(23)***	350,000,000 ***(23)***	350,000,000 ***(23)***

Waste Type	Pit Disassembly and Conversion Option	Alternative				
		No Action	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; HW = hazardous waste; LLW = low-level radioactive waste; MFFF = Mixed Oxide Fuel Fabrication Facility; MLLW = mixed low-level radioactive waste; m^3 = cubic meters; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; TRU = transuranic; WIPP = Waste Isolation Pilot Plant; yr = year.
Note: Values are rounded to two significant figures. To convert cubic meters to cubic yards, multiply by 1.308.
Source: Appendix F, Section F.4; Appendix G, Section G.4; Appendix H, Sections H.1.4 and H.2.

Table 4–19 Peak Annual Operations Waste Generation at Los Alamos National Laboratory

Waste Type	*Pit Disassembly and Conversion Option* [a]	*Alternative*				
		No Action	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
TRU Waste (m^3/yr)	PDCF ***(Percent of LANL Capacity)***	10 ***(<0.1)***	10 ***(<0.1)***	10 ***(<0.1)***	10 ***(<0.1)***	10 ***(<0.1)***
	PDC ***(Percent of LANL Capacity)***	N/A	N/A	10 ***(<0.1)***	10 ***(<0.1)***	10 ***(<0.1)***
	PF-4 and MFFF ***(Percent of LANL Capacity)***	N/A	55 ***(0.34)***	55 ***(0.34)***	55 ***(0.34)***	55 ***(0.34)***
	PF-4, HC/HBL, and MFFF ***(Percent of LANL Capacity)***	N/A	55 ***(0.34)***	55 ***(0.34)***	55 ***(0.34)***	55 ***(0.34)***
Solid LLW (m^3/yr)	PDCF ***(Percent of 2009 LANL Generation Rate)***	29 ***(0.8)***	29 ***(0.8)***	29 ***(0.8)***	29 ***(0.8)***	29 ***(0.8)***
	PDC ***(Percent of 2009 LANL Generation Rate)***	N/A	N/A	29 ***(0.8)***	29 ***(0.8)***	29 ***(0.8)***
	PF-4 and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	180 ***(4.8)***	180 ***(4.8)***	180 ***(4.8)***	180 ***(4.8)***
	PF-4, HC/HBL, and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	180 ***(4.8)***	180 ***(4.8)***	180 ***(4.8)***	180 ***(4.8)***
Solid MLLW (m^3/yr)	PDCF ***(Percent of 2009 LANL Generation Rate)***	0.3 ***(2.2)***	0.3 ***(2.2)***	0.3 ***(2.2)***	0.3 ***(2.2)***	0.3 ***(2.2)***
	PDC ***(Percent of 2009 LANL Generation Rate)***	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	negligible	1.4 ***(10)***	1.4 ***(10)***	1.4 ***(10)***
	PF-4, HC/HBL, and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	negligible	1.4 ***(10)***	1.4 ***(10)***	1.4 ***(10)***
Solid HW (m^3/yr)	PDCF ***(Percent of 2009 LANL Generation Rate)***	negligible	negligible	negligible	negligible	negligible
	PDC ***(Percent of 2009 LANL Generation Rate)***	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	negligible	0.2 ***(<0.1)***	0.2 ***(<0.1)***	0.2 ***(<0.1)***
	PF-4, HC/HBL, and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	negligible	0.2 ***(<0.1)***	0.2 ***(<0.1)***	0.2 ***(<0.1)***
Solid Non-HW (m^3/yr)	PDCF ***(Percent of 2009 LANL Generation Rate)***	negligible	negligible	negligible	negligible	negligible
	PDCF ***(Percent of 2009 LANL Generation Rate)***	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	negligible	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of 2009 LANL Generation Rate)***	N/A	negligible	negligible	negligible	negligible
Liquid LLW (liters/yr)	PDCF ***(Percent of LANL Capacity)***	570 ***(<0.1)***	570 ***(<0.1)***	570 ***(<0.1)***	570 ***(<0.1)***	570 ***(<0.1)***
	PDC ***(Percent of LANL Capacity)***	N/A	N/A	570 ***(<0.1)***	570 ***(<0.1)***	570 ***(<0.1)***
	PF-4 and MFFF ***(Percent of LANL Capacity)***	N/A	3,200 ***(0.1)***	3,200 ***(0.1)***	3,200 ***(0.1)***	3,200 ***(0.1)***
	PF-4, HC/HBL, and MFFF ***(Percent of LANL Capacity)***	N/A	3,200 ***(0.1)***	3,200 ***(0.1)***	3,200 ***(0.1)***	3,200 ***(0.1)***

Waste Type	***Pit Disassembly and Conversion Option*** [a]	***Alternative***				
		No Action	***Immobilization to DWPF***	***MOX Fuel***	***HC/HBL to DWPF***	***WIPP***
Liquid Non-HW (liters/yr)	PDCF ***(Percent of LANL Capacity)***	negligible	negligible	negligible	negligible	negligible
	PDC ***(Percent of LANL Capacity)***	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF ***(Percent of LANL Capacity)***	N/A	negligible	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF ***(Percent of LANL Capacity)***	N/A	negligible	negligible	negligible	negligible

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; HW = hazardous waste; LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; MFFF = Mixed Oxide Fuel Fabrication Facility; MLLW = mixed low-level radioactive waste; m^3 = cubic meters; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; TRU = transuranic; WIPP = Waste Isolation Pilot Plant; yr = year.

[a] Waste generated under each pit disassembly and conversion option would be the same across all action alternatives, except that the PDC Option for pit disassembly and conversion does not occur under the Immobilization to DWPF Alternative.

Note: Values are rounded to two significant figures. To convert cubic meters to cubic yards, multiply by 1.308.

Source: Appendix F, Section F.4; Appendix G, Section G.4; Appendix H, Sections H.1.4 and H.2.

Table 4–20 Total Operations Waste Generation at the Savannah River Site

Waste Type	***Pit Disassembly and Conversion Option***	***Alternative***				
		No Action	***Immobilization to DWPF***	***MOX Fuel***	***HC/HBL to DWPF***	***WIPP***
TRU Waste (m^3)	PDCF	5,900	12,000	12,000	8,300	16,000
	PDC	N/A	N/A	12,000	8,500	16,000
	PF-4 and MFFF	N/A	10,000	9,900	6,700	14,000
	PF-4, HC/HBL, and MFFF	N/A	12,000	11,000	7,100	16,000
Solid LLW (m^3)	PDCF	16,000	22,000	30,000	37,000	20,000
	PDC	N/A	N/A	29,000	37,000	21,000
	PF-4 and MFFF	N/A	12,000	20,000	27,000	11,000
	PF-4, HC/HBL, and MFFF	N/A	33,000	32,000	30,000	32,000
Solid MLLW (m^3)	PDCF	negligible	800	14	31	negligible
	PDC	N/A	N/A	14	31	negligible
	PF-4 and MFFF	N/A	800	14	31	negligible
	PF-4, HC/HBL, and MFFF	N/A	830	34	34	34
Solid HW (m^3)	PDCF	10	810	8	8	7
	PDC	N/A	N/A	8	8	7
	PF-4 and MFFF	N/A	810	7	7	6
	PF-4, HC/HBL, and MFFF	N/A	810	7	7	6
Solid Non-HW (m^3)	PDCF	29,000	36,000	1,200,000	2,600,000	35,000
	PDC	N/A	N/A	1,200,000	2,600,000	37,000
	PF-4 and MFFF	N/A	16,000	1,200,000	2,600,000	15,000
	PF-4, HC/HBL, and MFFF	N/A	2,800,000	2,800,000	2,800,000	2,800,000
Liquid LLW (liters)	PDCF	94,000,000	115,000,000	130,000,000	100,000,000	115,000,000
	PDC	N/A	N/A	130,000,000	100,000,000	114,000,000
	PF-4 and MFFF	N/A	114,000,000	130,000,000	100,000,000	114,000,000
	PF-4, HC/HBL, and MFFF	N/A	114,000,000	130,000,000	100,000,000	114,000,000
Liquid Non-HW (liters)	PDCF	3,600,000,000	4,400,000,000	4,800,000,000	4,400,000,000	4,400,000,000
	PDC	N/A	N/A	4,900,000,000	4,400,000,000	4,400,000,000
	PF-4 and MFFF	N/A	4,100,000,000	4,500,000,000	4,100,000,000	4,100,000,000
	PF-4, HC/HBL, and MFFF	N/A	4,100,000,000	4,500,000,000	4,100,000,000	4,100,000,000

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; HW = hazardous waste; LLW = low-level radioactive waste; MFFF = Mixed Oxide Fuel Fabrication Facility; MLLW = mixed low-level radioactive waste; m^3 = cubic meters; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

Note: Values are rounded to two significant figures. To convert cubic meters to cubic yards, multiply by 1.308.

Source: Appendix F, Section F.4; Appendix G, Section G.4; Appendix H, Sections H.1.4 and H.2.

Table 4–21 Total Operations Waste Generation at Los Alamos National Laboratory

Waste Type	*Pit Disassembly and Conversion Option*	*Alternative*				
		No Action [a]	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
TRU Waste (m^3)	PDCF	70	70	70	70	70
	PDC	N/A	N/A	70	70	70
	PF-4 and MFFF	N/A	1,200	1,200	1,200	1,200
	PF-4, HC/HBL, and MFFF	N/A	1,200	1,200	1,200	1,200
Solid LLW (m^3)	PDCF	200	200	200	200	200
	PDC	N/A	N/A	200	200	200
	PF-4 and MFFF	N/A	4,000	4,000	4,000	4,000
	PF-4, HC/HBL, and MFFF	N/A	4,000	4,000	4,000	4,000
Solid MLLW (m^3)	PDCF	2	2	2	2	2
	PDC	N/A	N/A	2	2	2
	PF-4 and MFFF	N/A	31	31	31	31
	PF-4, HC/HBL, and MFFF	N/A	31	31	31	31
Solid HW (m^3)	PDCF	negligible	negligible	negligible	negligible	negligible
	PDC	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF	N/A	4	4	4	4
	PF-4, HC/HBL, and MFFF	N/A	4	4	4	4
Solid Non-HW (m^3)	PDCF	negligible	negligible	negligible	negligible	negligible
	PDC	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF	N/A	negligible	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF	N/A	negligible	negligible	negligible	negligible
Liquid LLW (liters)	PDCF	4,000	4,000	4,000	4,000	4,000
	PDC	N/A	N/A	4,000	4,000	4,000
	PF-4 and MFFF	N/A	70,000	70,000	70,000	70,000
	PF-4, HC/HBL, and MFFF	N/A	70,000	70,000	70,000	70,000
Liquid Non-HW (liters)	PDCF	negligible	negligible	negligible	negligible	negligible
	PDC	N/A	N/A	negligible	negligible	negligible
	PF-4 and MFFF	N/A	negligible	negligible	negligible	negligible
	PF-4, HC/HBL, and MFFF	N/A	negligible	negligible	negligible	negligible

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; HW = hazardous waste; LLW = low-level radioactive waste; MFFF = Mixed Oxide Fuel Fabrication Facility; MLLW = mixed low-level radioactive waste; m^3 = cubic meters; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

[a] No Action includes conversion up to 2 metric tons (2.2 tons) of plutonium at PF-4.

Note: Values are rounded to two significant figures. To convert cubic meters to cubic yards, multiply by 1.308.

Source: Appendix F, Section F.4; Appendix G, Section G.4; Appendix H, Sections H.1.4 and H.2.

4.1.4.1 No Action Alternative

Construction at SRS—Under the No Action Alternative, it is not expected that TRU waste, solid or liquid LLW, or solid MLLW would be generated during construction of PDCF. If generated, however, these wastes would be managed in accordance with site practices and applicable Federal and state regulations. Solid hazardous and nonhazardous waste and liquid nonhazardous waste would be generated in small quantities.

The estimated peak annual generation of 6 cubic meters (7.8 cubic yards) of solid hazardous waste would represent approximately 1.9 percent of SRS existing storage capacity. This waste is not expected to have significant impacts on the SRS hazardous waste management system because this waste stream could be transported to offsite treatment, storage, and disposal facilities, as needed, so that onsite storage would not be exceeded. Hazardous waste would be packaged in U.S. Department of Transportation- (DOT-) approved containers and shipped off site to permitted recycling or treatment, storage, and disposal facilities.

Nonhazardous solid waste generated from construction would be recycled or packaged in conformance with standard industrial practice and shipped to the Three Rivers Regional Landfill or the Construction and Demolition Debris Landfill, both on site. Nonhazardous solid wastes generated from construction activities would be minimal and would have negligible impacts on waste management facilities.

Although it is likely that most liquid sanitary waste would be managed using portable toilets, it is conservatively assumed that all nonhazardous liquid wastes generated during construction would be managed at the Central Sanitary Wastewater Treatment Facility (CSWTF). Generation of nonhazardous liquid waste during construction activities would be minimal and would have negligible impacts on waste management facilities.

Construction at LANL—Under the No Action Alternative, no construction waste would be generated at LANL.

Operations at SRS—Under the No Action Alternative, operation of PDCF, MFFF and WSB is considered. Support operations, such as plutonium storage and surveillance in K-Area and TRU waste staging in E-Area, were also considered but would generate negligible amounts of waste when compared to other operations. Waste types that would be generated at SRS include TRU waste, solid LLW, solid hazardous waste, solid nonhazardous waste, liquid LLW, and liquid nonhazardous waste.

TRU waste generated at MFFF would consist of cladding, filters, convenience cans, and other miscellaneous wastes (NRC 2005a:4-33). WSB would receive high-activity/mixed high-activity waste and concentrated liquids generated by PDCF and MFFF operations for treatment. The WSB-generated TRU waste and mixed TRU waste would result from processing and solidifying the high-activity/mixed high-activity waste and concentrated liquids and would include job control waste (WSRC 2008a). TRU waste would be transferred to E-Area for staging and subsequently transported to WIPP. A peak of approximately 640 cubic meters (840 cubic yards) of TRU waste would be generated annually under the No Action Alternative, representing approximately 4.9 percent of the SRS TRU storage capacity. Considering the operational timeframes for these facilities, it is estimated that up to 5,900 cubic meters (7,700 cubic yards) of TRU waste could be generated at SRS, representing approximately 30 percent of the unsubscribed WIPP disposal capacity.

A peak of approximately 1,800 cubic meters (2,400 cubic yards) of solid LLW per year would be generated and would represent 4.8 percent of SRS disposal capacity. This impact is considered minor because low-activity waste vaults could be used as necessary to augment SRS capabilities for management of LLW. A peak of approximately 9,800,000 liters (2,600,000 gallons) of liquid LLW per year would be generated and would be sent to the F/H-Area Effluent Treatment Project. This quantity would represent 1.7 percent of the permitted treatment capacity.

It was conservatively assumed that all nonhazardous liquid wastes generated during operation of the surplus plutonium facilities would be managed at CSWTF. A peak of approximately 380 million liters (100 million gallons) per year would be generated and would represent 25 percent of the capacity of this treatment facility, with the majority being generated by MFFF operations and piped directly to CSWTF. Based on Chapter 3, Section 3.1.9, CSWTF currently operates at about 65 percent of capacity; therefore, wastewater from MFFF operations would not exceed the maximum capacity of this facility, although there may be very little capacity remaining to support other activities.

Minimal quantities of solid hazardous and nonhazardous waste would be generated and would have negligible impacts on waste management capacities at SRS.

Operations at LANL—Under the No Action Alternative, 2 metric tons (2.2 tons) of plutonium in pits would be converted to plutonium oxide. Operation of PF-4 at LANL is expected to generate a peak of approximately 10 cubic meters (13 cubic yards) of TRU waste per year. Approximately 29 cubic meters (38 cubic yards) of solid LLW would be generated, as well as minimal quantities of liquid LLW; these waste quantities are expected to have negligible impacts on waste management capacities.

4.1.4.2 Immobilization to DWPF Alternative

Construction at SRS—Construction of the K-Area immobilization capability is considered as well as facilities that would be required under each pit disassembly and conversion option, as described in Appendix F. Modification of DWPF is also considered; however, any required modifications would be minimal and negligible amounts of waste would be generated. Liquid LLW would not be generated during construction under the Immobilization to DWPF Alternative.

TRU waste generation is expected under the PF-4, H-Canyon/HB-Line, and MFFF Option. Approximately 12 cubic meters (16 cubic yards) annually and 23 cubic meters (30 cubic yards) total TRU waste would be generated. These amounts would have negligible impacts on storage capacity and represent a negligible amount of the unsubscribed WIPP disposal capacity.

Under the pit disassembly and conversion options, peak annual generation of solid LLW would range from 420 cubic meters (550 cubic yards) to 440 cubic meters (580 cubic yards), representing 1.1 to 1.2 percent of the SRS capacity. This impact is considered minor because low-activity waste vaults could be used as necessary to augment SRS capabilities for management of LLW.

Peak annual generation of solid MLLW would be 17 cubic meters (22 cubic yards) for all pit disassembly and conversion options, representing 5.7 percent of SRS storage capacity. Peak annual generation of solid hazardous waste would range from 17 cubic meters (22 cubic yards) to 23 cubic meters (30 cubic yards), representing 5.7 to 7.6 percent of SRS storage capacity. MLLW and hazardous waste would be shipped off site for treatment and disposal as necessary to meet storage space needs; therefore, there would not be any significant impacts from waste storage facilities.

Nonhazardous solid waste generated from construction would be recycled or packaged in conformance with standard industrial practice and shipped to the Three Rivers Regional Landfill or the Construction and Demolition Debris Landfill, both on site. Nonhazardous solid wastes generated from construction activities would be minimal and would have negligible impacts on waste management facilities.

Although it is likely that most liquid sanitary waste would be managed using portable toilets, it is conservatively assumed that all nonhazardous liquid wastes generated during construction would be managed at CSWTF. Generation of nonhazardous liquid waste during construction activities would be minimal and would have negligible impacts on waste management facilities.

Construction at LANL—Construction activities would only occur at LANL under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option. Waste generation would include TRU waste, solid LLW, and solid MLLW. Minimal amounts of TRU waste and solid LLW would be generated annually and would have negligible impacts on waste management capacities. Solid MLLW, although also generated in minimal quantities, would increase by 52 percent over rates generated at LANL during 2009.

Operations at SRS—Under the Immobilization to DWPF Alternative, operations of the K-Area immobilization capability, DWPF, MFFF, WSB, and various pit disassembly and conversion facilities, depending on the option implemented, are considered. Support operations, such as plutonium storage and surveillance in K-Area, and TRU waste staging in E-Area, were also considered but their operation would generate negligible amounts of waste when compared to other operations.

Approximately 790 can-in-canisters from the K-Area immobilization capability would be processed at DWPF. Due to displaced HLW, this would result in generation of approximately 95 additional canisters of vitrified HLW. GWSBs currently have the capacity to store up to 4,590 canisters and additional buildings could be constructed to expand the storage capacity to 10,000 canisters (DOE 1982:3-43;

SRNS 2012; SRR 2009); therefore, there would be no significant impacts from the generation and storage of HLW canisters under this alternative.

Peak annual generation of TRU waste would range from 930 cubic meters (1,200 cubic yards) to 1,100 cubic meters (1,400 cubic yards) per year, representing 7.0 to 8.3 percent of SRS storage capacity. The K-Area immobilization capability would generate solid TRU waste primarily consisting of empty inner plutonium storage cans, pin cans, fuel pins, convenience cans, failed bagless transfer cans, weld stubs not classified as LLW, lead-lined gloves, HEPA filters, and contaminated equipment. Considering the operational timeframes for the facilities associated with the PF-4, H-Canyon/HB-Line, and MFFF Option under the Immobilization to DWPF Alternative, it is estimated that up to 12,000 cubic meters (15,700 cubic yards) of TRU waste could be generated at SRS, representing approximately 61 percent of the unsubscribed WIPP disposal capacity.

Peak annual generation of solid LLW waste would range from 1,100 cubic meters (1,400 cubic yards) to 2,500 cubic meters (3,300 cubic yards) per year, representing 2.9 to 6.9 percent of SRS disposal capacity. This impact is considered minor because low-activity waste vaults could be used as necessary to augment SRS capabilities for management of LLW.

Peak annual generation of solid MLLW would range from 80 cubic meters (105 cubic yards) to 82 cubic meters (110 cubic yards), representing 27 to 28 percent of SRS storage capacity. Peak annual generation of solid hazardous waste would be approximately 80 cubic meters (105 cubic yards), representing 27 percent of SRS storage capacity. MLLW and hazardous waste would be generated at the K-Area immobilization capability and DWPF. Examples of MLLW and hazardous waste include lead-lined gloves, decontamination chemicals, fluorescent light bulbs, batteries, and other miscellaneous items (WSRC 2008a). Small quantities of hazardous waste would also be generated at the other plutonium facilities addressed under this alternative. This waste would include liquids such as spent cleaning solutions, oils, hydraulic fluids, antifreeze solutions, paints and chemicals, and rags or wipes contaminated with these materials (WSRC 2008a). MLLW and hazardous waste would be shipped off site for treatment and disposal as necessary to meet storage space needs; therefore, there would be no significant impacts on waste storage facilities.

Peak annual generation of solid nonhazardous waste would be minimal with associated negligible impacts with the exception of the PF-4, H-Canyon/HB-Line, and MFFF Option, where some pit disassembly and conversion would take place. In this case, as much as 200,000 cubic meters (260,000 cubic yards) could be generated per year, representing 4.8 percent of SRS capacity.

A peak of approximately 9,700,000 to 9,800,000 liters (2,560,000 to 2,590,000 gallons) of liquid LLW waste per year would be generated and would be sent to the F/H-Area Effluent Treatment Project under all pit disassembly and conversion options. This quantity would represent 1.6 to 1.7 percent of the permitted treatment capacity.

It was conservatively assumed that all nonhazardous liquid wastes generated during the operation of surplus plutonium facilities would be managed at CSWTF. A peak of approximately 350 to 380 million liters (92 to 100 million gallons) per year would be generated under all pit disassembly and conversion options and would represent 23 to 25 percent of the capacity of this treatment facility, with the majority being generated by MFFF operations and piped directly to CSWTF. Based on information in Chapter 3, Section 3.1.9, CSWTF currently operates at about 65 percent of capacity; therefore, wastewater from MFFF operations would not exceed the maximum capacity of this facility, although there may be very little capacity remaining to support other activities.

Operations at LANL—Operation of PF-4 at LANL is considered. Operation of PF-4 is expected to generate TRU waste, solid LLW, and liquid LLW. Similar to the No Action Alternative, under the PDCF Option, operation of PF-4 at LANL would generate a peak of approximately 10 cubic meters (13 cubic yards) of TRU waste and 29 cubic meters (38 cubic yards) of solid LLW per year, representing a negligible amount and 0.8 percent of the LANL capacity, respectively. However, under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option, operation of PF-4 at LANL would generate approximately 55 cubic meters (72 cubic yards) of TRU waste and 180 cubic meters (240 cubic yards) of solid LLW per year, representing 0.34 and 4.8 percent of LANL capacity, respectively. Minimal quantities of liquid LLW would be generated.

4.1.4.3 MOX Fuel Alternative

Construction at SRS—Under the MOX Fuel Alternative, construction waste would be limited to that associated with construction and/or modification of facilities for pit disassembly and conversion activities, as described in Appendix F. Modification of K-Area and H-Canyon/HB-Line is also considered under one pit disassembly and conversion option; however, any required modifications would be minimal and negligible amounts of waste would be generated.

TRU waste generation is only expected under the PF-4, H-Canyon/HB-Line, and MFFF Option. Approximately 17 cubic meters (22 cubic yards) annually and 33 cubic meters (43 cubic yards) total TRU waste would be generated and these amounts would represent negligible impacts on storage capacity and a negligible amount of the unsubscribed WIPP disposal capacity. Additionally, minimal amounts of solid LLW would be generated under this option; however, no other waste types would be generated.

Peak annual waste generation under the PDCF Option would only result from construction of PDCF; and therefore, would be similar to those construction impacts discussed under the No Action Alternative in Section 4.1.4.1.

Under the PDC Option, solid LLW, solid MLLW, solid hazardous waste, and solid nonhazardous waste would be generated. The peak annual generation rate of solid LLW would be 1,300 cubic meters (1,700 cubic yards), representing 3.5 percent of SRS disposal capacity. This impact is considered minor because low-activity waste vaults could be used as necessary to augment SRS capabilities for management of LLW. Peak annual generation of solid MLLW would be 19 cubic meters (25 cubic yards), representing 6.4 percent of SRS storage capacity. Peak annual generation of solid hazardous waste would be 820 cubic meters (1,100 cubic yards), representing about 280 percent of SRS storage capacity. MLLW and hazardous waste would be shipped off site for treatment and disposal as necessary to meet storage space needs; therefore, there would not be any significant impacts on waste storage facilities. Offsite shipments of hazardous waste would need to be expedited to avoid exceeding the SRS storage capacity. Peak annual generation of solid nonhazardous waste would be 860 cubic meters (1,100 cubic yards) per year.

Minimal construction waste generation would be associated with the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option.

Construction at LANL—Construction activities would only occur at LANL under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option. Waste generation would include TRU waste, solid LLW, and solid MLLW. Minimal amounts of TRU waste and solid LLW would be generated annually and would have negligible impacts on waste management capacities. Solid MLLW, although also generated in minimal quantities, would increase by 52 percent over rates generated at LANL during 2009.

Operations at SRS—Under the MOX Fuel Alternative, operation of H-Canyon/HB-Line, DWPF, MFFF, WBS, and various pit disassembly and conversion facilities are considered. Support operations, such as plutonium storage and surveillance in K-Area and TRU waste staging in E-Area, were also considered but their operation would generate negligible amounts of waste when compared to other operations. DWPF operations would not be impacted.

Peak annual generation of TRU waste would range from 860 cubic meters (1,100 cubic yards) to 1,000 cubic meters (1,300 cubic yards) per year, representing 6.5 to 7.8 percent of the SRS storage capacity. Considering the operational timeframes for the facilities under the PDCF or PDC Options, it is estimated that up to 12,000 cubic meters (16,000 cubic yards) of TRU waste could be generated at SRS, representing approximately 61 percent of the unsubscribed WIPP disposal capacity.

As discussed in Chapter 2, Section 2.2.4, part of the non-pit plutonium includes unirradiated Fast Flux Test Facility (FFTF) fuel. It is assumed for the previously mentioned TRU waste volume estimates and associated impacts that FFTF fuel and non-pit plutonium would be packaged in pipe overpack containers (POCs) for disposal at WIPP. A POC is assumed to contain 175 fissile gram equivalents (FGE) of plutonium. If FFTF fuel is not repackaged into POCs and is instead transported to WIPP using the transportation packages within which it is currently stored, the number of POCs would decrease. In addition, the number of POCs would decrease if non-pit plutonium were packaged in criticality control containers (CCCs), which could each potentially hold about 380 FGE. If both of these approaches were to be taken, the total TRU waste volume could be reduced from approximately 12,000 cubic meters (16,000 cubic yards) to approximately 9,800 cubic meters (13,000 cubic yards). This reduced TRU waste volume would represent about 50 percent of the unsubscribed WIPP disposal capacity.

Peak annual generation of solid LLW waste would range from 2,300 cubic meters (3,000 cubic yards) to 3,300 cubic meters (4,300 cubic yards) per year, representing 6.2 to 8.8 percent of SRS disposal capacity. This impact is considered minor because low-activity waste vaults could be used as necessary to augment SRS capabilities for management of LLW.

Peak annual generation of solid MLLW would be 2.4 cubic meters (3.1 cubic yards), representing 0.8 of SRS storage capacity. Peak annual generation of solid hazardous waste would range from 0.6 cubic meters (0.8 cubic yards) to 0.7 cubic meters (0.9 cubic yards), representing less than 1 percent of SRS storage capacity.

Peak annual generation of solid nonhazardous waste would be 200,000 cubic meters (260,000 cubic yards), representing 4.8 percent of SRS disposal capacity.

A peak of approximately 9,700,000 to 9,800,000 liters (2,560,000 to 2,590,000 gallons) of liquid LLW waste per year would be generated and would be sent to the F/H-Area Effluent Treatment Project under all pit disassembly and conversion options. This quantity would represent 1.6 to 1.7 percent of the permitted treatment capacity.

It was conservatively assumed that all nonhazardous liquid wastes generated during the operation of surplus plutonium facilities would be managed at CSWTF. A peak of approximately 350 to 380 million liters (92 to 100 million gallons) per year would be generated under all pit disassembly and conversion options and would represent 23 to 25 percent of the capacity of this treatment facility, with the majority being generated by MFFF operations and piped directly to CSWTF. Based on information in Chapter 3, Section 3.1.9, CSWTF currently operates at about 65 percent of capacity; therefore, wastewater from MFFF operations would not exceed the maximum capacity of this facility, although there may be very little capacity remaining to support other activities.

Operations at LANL—Under the MOX Fuel Alternative, waste generated from operations of PF-4 and associated impacts at LANL would be similar to those in Section 4.1.4.2 under the Immobilization to DWPF Alternative.

4.1.4.4 H-Canyon/HB-Line to DWPF Alternative

Construction at SRS—Under the H-Canyon/HB-Line to DWPF Alternative, construction generated waste and associated impacts at SRS would be similar to those in Section 4.1.4.3 under the MOX Fuel Alternative.

Construction at LANL—Under the H-Canyon/HB-Line to DWPF Alternative, construction generated waste and associated impacts at LANL would be similar to those in Section 4.1.4.3 under the MOX Fuel Alternative.

Operations at SRS—Under the H-Canyon/HB-Line to DWPF Alternative, operation of H-Canyon/HB-Line, DWPF, MFFF, WSB, and various pit disassembly and conversion facilities, depending on the option implemented, are considered. Other supporting operations, such as plutonium storage and surveillance in K-Area and TRU waste staging in E-Area, were also considered but would generate negligible amounts of waste when compared to other operations.

Up to 48 additional vitrified glass canisters would be generated at DWPF due to processing 6 metric tons (6.6 tons) of surplus plutonium at H-Canyon/HB-Line for DWPF vitrification, although these additional canisters would not significantly impact its existing operation. This assumes that there would be no credit for using gadolinium as a neutron poison at DWPF (see Appendix B, Section B.1.4.1). If gadolinium is credited, then approximately 20 canisters would be generated (SRNS 2012). GWSBs currently have the capacity to store up to 4,590 canisters and additional buildings could be constructed to expand the storage capacity to 10,000 canisters (DOE 1982:3-43; SRNS 2012; SRR 2009); therefore, there would be no significant impacts from the generation and storage of HLW canisters under this alternative.

Peak annual generation of TRU waste would range from 580 cubic meters (760 cubic yards) to 750 cubic meters (980 cubic yards) per year, representing 4.4 to 5.7 percent of SRS storage capacity. Considering the operational timeframes for the facilities associated with the H-Canyon/HB-Line to DWPF Alternative under the PDC Option, it is estimated that up to 8,500 cubic meters (11,000 cubic yards) of TRU waste could be generated at SRS, representing approximately 43 percent of the unsubscribed WIPP disposal capacity.

Annual generation rates of all other waste types considered from operations would be similar to those in Section 4.1.4.3 under the MOX Fuel Alternative. These include solid LLW, solid MLLW, solid hazardous waste, solid nonhazardous waste, liquid LLW, and liquid nonhazardous waste.

Operations at LANL—Under the H-Canyon/HB-Line to DWPF Alternative, waste generated from operations of PF-4 and associated impacts at LANL would be similar to those in Section 4.1.4.2 under the Immobilization to DWPF Alternative.

4.1.4.5 WIPP Alternative

Construction at SRS—Under the WIPP Alternative, construction-generated waste and associated impacts at SRS would be similar to those in Section 4.1.4.3 under the MOX Fuel Alternative, with the exception of TRU waste. Very small quantities of TRU waste would be generated and would be associated with modifications to H-Canyon/HB-Line; however, these quantities would have negligible impacts on SRS waste storage capacities.

Construction at LANL—Under the WIPP Alternative, construction-generated waste and associated impacts at LANL would be similar to those in Section 4.1.4.3 under the MOX Fuel Alternative.

Operations at SRS—Under the WIPP Alternative, operation of H-Canyon/HB-Line, MFFF, WSB, and various pit disassembly and conversion facilities is considered, depending on the option implemented. Other supporting operations such as plutonium storage and surveillance in K-Area and TRU waste staging in E-Area, were also considered but would generate negligible amounts of waste when compared to other operations.

Peak annual generation of TRU waste would range from 1,100 cubic meters (1,400 cubic yards) to 1,300 cubic meters (1,700 cubic yards) per year, representing 8.6 to 9.9 percent of the SRS storage capacity. Considering the operational timeframes for the facilities associated with the WIPP Alternative under the PF-4, H-Canyon/HB-Line, and MFFF Option, it is estimated that up to 16,000 cubic meters (21,000 cubic yards) of TRU waste could be generated at SRS, representing approximately 81 percent of the unsubscribed WIPP disposal capacity.

As discussed in Chapter 2, the non-pit plutonium includes unirradiated FFTF fuel. It is assumed for the previously mentioned TRU waste volume estimates and associated impacts that FFTF fuel and non-pit plutonium would be packaged in POCs for disposal at WIPP. A POC is assumed to contain 175 FGE of plutonium. If FFTF fuel is not repackaged into POCs and is instead transported to WIPP using the transportation packages within which it is currently stored, the number of POCs would decrease. In addition, the number of POCs would decrease if non-pit plutonium were packaged in CCCs, which could each potentially hold about 380 FGE. If both of these approaches were to be taken, the total TRU waste volume could be reduced from approximately 16,000 cubic meters (21,000 cubic yards) to approximately 11,000 cubic meters (14,000 cubic yards). This reduced TRU waste volume would represent 56 percent of the unsubscribed WIPP disposal capacity.

Peak annual generation of solid LLW waste would range from 910 cubic meters (1,200 cubic yards) to 2,400 cubic meters (3,100 cubic yards) per year, representing 2.4 to 6.4 percent of the SRS disposal capacity. This impact is considered minor because low-activity waste vaults could be used as necessary to augment SRS capabilities for management of LLW.

Peak annual generation of solid MLLW would be 2.4 cubic meters (3.1 cubic yards) under the PF-4, H-Canyon/HB-Line, and MFFF Option, representing 0.8 percent of SRS storage capacity. Under all other pit disassembly and conversion options, the annual generation of solid MLLW would be negligible.

Peak annual generation of solid nonhazardous waste would range from 1,300 cubic meters (1,700 cubic yards) to 200,000 cubic meters (260,000 cubic yards), representing a negligible amount to 4.8 percent of the SRS disposal capacity.

Annual generation rates of solid hazardous waste, liquid LLW, and liquid nonhazardous waste considered from operations would be similar those discussed in Section 4.1.4.3 under the MOX Fuel Alternative.

Operations at LANL—Under the WIPP Alternative, wastes generated from operations of PF-4 and associated impacts at LANL would be similar to those in Section 4.1.4.2 under the Immobilization to DWPF Alternative.

4.1.5 Transportation

For transportation, both radiological and nonradiological impacts would result from shipment of radioactive materials and waste. Only nonradiological impacts would result from shipment of nonradioactive wastes and construction materials. Radiological impacts are those associated with the effects from low levels of radiation emitted during incident-free transportation and from the accidental release of radioactive materials, and are expressed as additional LCFs. Nonradiological impacts are independent of the nature of the cargo being transported, and are expressed as fatal traffic accidents resulting only from the physical forces that accidents could impart to humans.

Appendix E contains a more detailed description of the transportation analysis and results. Increases in nonradiological pollutants from traffic emissions are discussed in Section 4.1.1, Air Quality.

Onsite shipment of radioactive materials and wastes at SRS would not affect members of the public because roads between SRS processing areas are closed to the public; therefore, shipments would only affect onsite workers. Shipment of TRU waste, LLW, and MLLW to E-Area is currently conducted as part of site operations with no discernible impacts on noninvolved workers. The transport of radioactive materials and wastes under the alternatives is not expected to significantly increase the risk to these workers. As shown in this section, the risks from incident-free transport of radioactive waste and materials off site over long distances (hundreds to thousands of kilometers) are very small; therefore, the risks from transporting radioactive waste and materials on site, where distances would be less than 20 kilometers (12 miles) and sometimes less than 5 kilometers (3 miles), would be even smaller. For NNSA Secure Transportation Asset (STA) shipments, onsite roads would be closed during transport, further limiting the risk of noninvolved worker exposure. All involved workers (i.e., drivers and escorts) would be monitored and the maximum annual dose to a transportation worker would be administratively limited to 2 rem (10 CFR Part 835). The potential for a trained radiation worker to develop a fatal latent cancer from the maximum annual exposure is 0.0012 LCFs; therefore, an individual transportation worker is not expected to develop a lifetime latent fatal cancer from exposure during these activities. Impacts associated with accidents during onsite transport of radioactive materials and wastes would be less than the impacts assessed for the bounding accident analyses for the plutonium facilities (see Section 4.1.2.2), and less than the impacts for offsite transports because of the much shorter distance traveled on site and because of onsite security measures and lower vehicle speeds. Because of these reasons, onsite transport of radioactive materials and wastes is not analyzed further in this *SPD Supplemental EIS*.

Methodology and Assumptions

Shipping packages containing radioactive materials emit low levels of radiation; the amount of radiation depends on the kind and amount of transported materials. DOT regulations require that shipping packages containing radioactive materials have sufficient radiation shielding to limit the radiation dose rate to 10 millirem per hour at a distance of 2 meters (6.6 feet) from the transporter. For incident-free transportation, the potential human health impacts of the radiation field surrounding the transportation packages were estimated for transportation workers and the general population along the route (termed off-traffic or off-link), as well as for people sharing the route (termed in-traffic or on-link), at rest areas, and at other stops along the route. The RADTRAN 6 [Radioactive Material Transportation Risk Assessment] computer code (SNL 2009) was used to estimate the impacts on transportation workers and population along the route, as well as the impacts on an MEI (e.g., a person stuck in traffic, a gas station attendant, an inspector).

Transportation accidents involving radioactive materials present both nonradiological and radiological risks to workers and the public. Nonradiological impacts of transportation accidents include traffic accident fatalities. Radioactive material would be released during transportation accidents only when the package carrying the material is subjected to forces that exceed the package design standard. Only a severe fire and/or a powerful collision, both events of extremely low probability, could lead to a transportation package of the type used to transport radioactive material being damaged to the extent that there could be a significant release of radioactive material to the environment.

The radiological impact of a specific accident is expressed in terms of probabilistic risk (i.e., dose-risk), which is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences (i.e., dose). The overall radiological risk is obtained by summing the individual radiological risks from all reasonably conceivable accidents. The analysis of accident risks takes into account a spectrum of accident severities ranging from high-probability accidents of low severity (e.g., a fender bender) to hypothetical high-severity accidents having low probabilities of occurrence.

In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive materials and wastes, this *SPD Supplemental EIS* assesses the highest consequences of a maximum reasonably foreseeable accident having a radioactive release frequency greater than 1×10^{-7} (1 chance in 10 million) per year in an urban or suburban population area along the route. This latter analysis used the RISKIND [Risks and Consequences of Radioactive Material Transport] computer code, Version 2.0, to estimate doses to individuals and populations (Yuan et al. 1995). The results of this analysis are presented in Appendix E, Section E.7.

Incident-free radiological health impacts are expressed in terms of additional LCFs. Radiological health impacts from accidents are also expressed as additional LCFs, and nonradiological accident risk as additional immediate (traffic) fatalities. LCFs associated with radiological exposure were estimated by multiplying the occupational (worker) and public dose by a dose conversion factor of 0.0006 LCFs per rem or person-rem of exposure (DOE 2003b). The health impacts associated with shipment of radioactive materials and wastes were calculated assuming that all packages would be transported by escorted commercial truck or NNSA STA.

In determining transportation risks, per-shipment risk factors were calculated for incident-free and accident conditions using the RADTRAN 6 code (SNL 2009) in conjunction with the Transportation Routing Analysis Geographic Information System (TRAGIS) code (Johnson and Michelhaugh 2003), which was used to identify transportation routes in accordance with DOT regulations and other parameters. The TRAGIS program currently provides population density estimates along the routes based on the 2000 U.S. Census for determining population radiological risk factors. For incident-free operations, the affected population includes individuals living within 800 meters (0.5 miles) of each side of the road or rail line. For accident conditions, the affected population includes individuals living within

80 kilometers (50 miles) of the accident, and the MEI was assumed to be a receptor located 100 meters (330 feet) directly downwind from the accident. Additional details on the analytical approach and on modeling and parameter selections are provided in Appendix E. The estimated population for which dose is calculated was increased by comparing 2010 and 2000 census data and assuming the rate of population growth in this time period continues through the year 2020.

Accident and fatality rates for commercial truck transports are used for determining traffic accident fatalities (Saricks and Tompkins 1999). Statistics specific to STA shipments, which would be used for shipment of special nuclear material, are also used for escorted commercial truck shipments (see Appendix B, Section B.6.2). The methodology for obtaining and using accident and fatality rates is provided in Appendix E, Section E.6.2, Accident Rates.

For each alternative, transportation impacts were evaluated for the transport of the following (as applicable to each alternative):

- pits and assorted materials from Pantex near Amarillo, Texas, to SRS and LANL
- plutonium materials from LANL to SRS
- TRU waste from SRS and LANL to WIPP
- unirradiated MOX fuel from SRS to the Browns Ferry Nuclear Plant near Athens, Alabama; the Sequoyah Nuclear Plant near Soddy-Daisy, Tennessee; and one or more generic commercial nuclear power reactors assumed for analysis purposes to be located in the northwestern United States
- highly enriched uranium from SRS and LANL to the Y–12 National Security Complex at the Oak Ridge Reservation in Tennessee
- pieces and parts of pits from SRS to LANL at Los Alamos, New Mexico
- LLW and MLLW from SRS and LANL to the Nevada National Security Site near Las Vegas, Nevada
- depleted uranium hexafluoride from the Portsmouth Gaseous Diffusion Plant at Piketon, Ohio, to AREVA at Richland, Washington
- depleted uranium oxide and depleted uranyl nitrate hexahydrate from AREVA at Richland, Washington, to SRS
- hazardous waste from SRS and LANL to an offsite treatment, storage, and disposal facility, which, for analysis purposes, would be located in Waynoka, Oklahoma (nonradiological impacts only)[7]

Route characteristics are determined for shipments to assess incident-free and transportation accident impacts related to radioactive material and waste shipments. The number of shipments associated with the transport of plutonium metal pits, highly enriched uranium, and pieces and parts of pits are determined by proportionally scaling the number of shipments analyzed in the *SPD EIS* based on the amount of material being transported for this *SPD Supplemental EIS*. The numbers of shipments associated with the transport of MOX fuel, depleted uranium, and wastes are determined using up-to-date information (as compared to the *SPD EIS*) regarding the types of transport packages to be used and forecasted generation rates. The composition of transportation packages for different radioactive materials is estimated using unclassified information that provides a conservative estimate that would be reflective of the material or waste being transported. All shipments were assumed to be conducted by truck. Transport of plutonium materials and other classified materials was assumed to be conducted by STA (see Appendix E, Section E.2.4, for more information regarding STA vehicle requirements). Truck routes between specific origination and destination sites are analyzed, as shown in Appendix E, Figures E–2 and E–3. Tables E–6

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[7] *Of the offsite treatment, storage, and disposal facilities used for management of SRS hazardous waste, this site would represent one of the longer waste transportation distances.*

through E–10 in Appendix E summarize the assumed destinations and estimated number of truck shipments for each type of radioactive waste or nuclear material.

Summary of Impacts

Table 4–22 summarizes transportation impacts under each alternative for shipments of radioactive materials and waste. The accident impacts presented in this table are those that could result from all reasonably conceivable impacts during transport of radioactive materials and waste. The impacts associated with transport of unirradiated MOX fuel to commercial nuclear power reactors are shown in **Table 4–23**. These impacts are also presented in Appendix E, Section E.7, and Appendix I, Sections I.1.2.5 and I.2.2.5, and are not expected to be substantially different from the impacts of shipping LEU from the fuel supplier to the reactor sites. **Table 4–24** shows the impacts from transporting construction materials and hazardous wastes related to construction and operations (summarizing the information in Tables E–13 and E–14). The results in Tables 4–22 through 4–24 are discussed further in Sections 4.1.5.1 through 4.1.5.5. Route-specific impacts are presented in Appendix E, Tables E–6 through E–10.

Table 4–22 Risks of Transporting Radioactive Materials and Waste Under Each Alternative [a, b]

			Incident-Free				*Accident*	
			Crew		*Population*			
Pit Disassembly and Conversion Option	*Number of Shipments*	*One-way Kilometers Traveled (million)*	*Dose (person-rem)*	*Risk* [c]	*Dose (person-rem)*	*Risk* [c]	*Radiological Risk* [c]	*Non-radiological Risk* [c]
No Action Alternative								
PDCF	3,300	8.8	230	0.1	150	0.09	0.00007	0.4
Immobilization to DWPF Alternative								
PDCF	4,300	11	300	0.2	200	0.1	0.00007	0.5
PDC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF-4 and MFFF [d]	4,800	10	250	0.2	160	0.1	0.00009	0.5
PF-4, HC/HBL, and MFFF [e]	4,700	10	270	0.2	170	0.1	0.00008	0.5
MOX Fuel Alternative								
PDCF	4,300	11	310	0.2	200	0.1	0.00009	0.6
PDCF with packaging option [f]	4,100	11	280	0.2	190	0.1	0.00009	0.5
PDC	4,400	11	310	0.2	210	0.1	0.00009	0.6
PDC with packaging option [f]	4,100	11	290	0.2	190	0.1	0.00009	0.5
PF-4 and MFFF [d]	4,800	10	260	0.2	170	0.1	0.0001	0.5
PF-4 and MFFF with packaging option [d, f]	4,600	9.6	230	0.1	150	0.09	0.0001	0.5
PF-4, HC/HBL, and MFFF [e]	4,800	10	270	0.2	170	0.1	0.0001	0.5
PF-4, HC/HBL, and MFFF with packaging option [e, f]	4,500	9.8	250	0.1	160	0.1	0.0001	0.5
H-Canyon/HB-Line to DWPF Alternative								
PDCF	3,900	10	260	0.2	180	0.1	0.00008	0.5
PDC	3,900	10	270	0.2	180	0.1	0.00008	0.5
PF-4 and MFFF [d]	4,400	9.1	210	0.1	140	0.09	0.0001	0.4
PF-4, HC/HBL, and MFFF [e]	4,400	9.4	230	0.1	150	0.09	0.0001	0.5
WIPP Alternative								
PDCF	5,100	13	370	0.2	230	0.1	0.00008	0.7
PDCF with packaging option [f]	4,400	11	310	0.2	200	0.1	0.00008	0.6
PDC	5,100	13	380	0.2	240	0.1	0.00008	0.7
PDC with packaging option [f]	4,400	11	310	0.2	200	0.1	0.00008	0.6
PF-4 and MFFF [d]	5,700	12	330	0.2	200	0.1	0.0001	0.6

			Incident-Free				Accident	
			Crew		Population			
Pit Disassembly and Conversion Option	Number of Shipments	One-way Kilometers Traveled (million)	Dose (person-rem)	Risk [c]	Dose (person-rem)	Risk [c]	Radiological Risk [c]	Non-radiological Risk [c]
PF-4 and MFFF with packaging option [d, f]	5,000	11	270	0.2	170	0.1	0.0001	0.5
PF-4, HC/HBL, and MFFF [e]	5,500	12	340	0.2	200	0.1	0.0001	0.6
PF-4, HC/HBL, and MFFF with packaging option [e, f]	4,800	11	270	0.2	170	0.1	0.0001	0.5

DWPF = Defense Waste Processing Facility; HC/HBL= H-Canyon/HB-Line; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; WIPP = Waste Isolation Pilot Plant.

[a] The total impacts for each alternative include transportation due to construction and operations activities.

[b] Impacts in this table do not include impacts from transporting unirradiated MOX fuel to commercial nuclear power reactors. See Table 4–23 for these impacts.

[c] Risk is expressed in terms of LCFs, assuming a factor of 0.0006 LCFs per person-rem (DOE 2003b), except for nonradiological risk, where it refers to the number of traffic accident fatalities. Accident radiological dose-risk can be calculated by dividing the indicated risk values by 0.0006 (DOE 2003b). Radiological risk is representative of one-way travel, whereas nonradiological risk is representative of two-way travel.

[d] Under this option, pits would be disassembled at PF-4 at LANL. Pits disassembled at LANL would be converted to an oxide at LANL or using H-Canyon/HB-Line or metal oxidation furnaces installed at MFFF at SRS.

[e] Under this option, pits would be disassembled at PF-4 at LANL or at K-Area at SRS. Pits disassembled at LANL would be converted to an oxide at LANL or SRS. Pits disassembled at K-Area would be converted to an oxide at SRS at H-Canyon/HB-Line.

[f] For shipments to WIPP using CCCs and HUFPs, non-pit plutonium would be packaged in CCCs rather than POCs for shipment to WIPP for disposal as TRU waste, reducing the number of shipments, and HUFPs would be used to transport unirradiated FFTF fuel to WIPP for disposal as TRU waste, rather than repackaging the fuel in POCs. This option is only applicable to the MOX Fuel and WIPP Alternatives.

Note: To convert kilometers to miles, multiply by 0.62137; metric tons to tons, multiply by 1.1023.

Table 4–23 Risks of Transporting Unirradiated Mixed Oxide Fuel Under Each Alternative

			Incident-Free				Accident	
			Crew		Population			
Unirradiated MOX Fuel Transport Option	Number of Shipments	One-way Kilometers Traveled (million)	Dose (person-rem)	Risk [a]	Dose (person-rem)	Risk [a]	Radiological Risk [c]	Non-radiological Risk [a]
No Action Alternative								
To TVA reactors	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
To generic reactors	3,400	15	150	0.09	280	0.2	0.000002	0.3
Immobilization to DWPF Alternative								
To TVA reactors	2,100	1.5	15	0.009	24	0.01	0.0000003	0.03
To generic reactors	3,400	15	150	0.09	280	0.2	0.000002	0.3
MOX Fuel Alternative								
To TVA reactors	2,900	2.0	20	0.01	32	0.02	0.0000004	0.04
To generic reactors	4,500	20	190	0.1	370	0.2	0.000002	0.4
H-Canyon/HB-Line to DWPF Alternative								
To TVA reactors	2,600	1.8	18	0.01	29	0.02	0.0000004	0.03
To generic reactors	4,100	18	180	0.1	340	0.2	0.000002	0.4
WIPP Alternative								
To TVA reactors	2,600	1.8	18	0.01	29	0.02	0.0000004	0.03
To generic reactors	4,100	18	180	0.1	340	0.2	0.000002	0.4

DWPF = Defense Waste Processing Facility; N/A = not applicable; MOX = mixed oxide; TVA = Tennessee Valley Authority; WIPP = Waste Isolation Pilot Plant.

[a] Risk is expressed in terms of LCFs, assuming a factor of 0.0006 LCFs per person-rem (DOE 2003b), except for nonradiological risk, where it refers to the number of traffic accident fatalities. Accident radiological dose-risk can be calculated by dividing the indicated risk values by 0.0006 (DOE 2003b). Radiological risk is representative of one-way travel, whereas nonradiological risk is representative of two-way travel.

Note: To convert kilometers to miles, multiply by 0.62137; metric tons to tons, multiply by 1.1023.

Table 4–24 Estimated Impacts from Hazardous Waste and Construction Material Transport

Pit Disassembly and Conversion Option	*Number of Shipments*	*Total Distance Traveled (two-way kilometers)*	*Number of Accidents*	*Traffic Fatality Risk*
No Action Alternative				
PDCF	42,000	4,300,000	3.3	0.2
Immobilization to DWPF Alternative				
PDCF	43,000	4,600,000	3.5	0.2
PDC	N/A	N/A	N/A	N/A
PF-4 and MFFF [a]	1,300	370,000	0.23	0.01
PF-4, HC/HBL, and MFFF [b]	1,300	390,000	0.25	0.01
MOX Fuel Alternative				
PDCF	42,000	4,300,000	3.3	0.2
PDC	43,000	6,100,000	4.3	0.2
PF-4 and MFFF [a]	4	16,000	0.009	0.0004
PF-4, HC/HBL, and MFFF [b]	5	20,000	0.011	0.0005
H-Canyon/HB-Line to DWPF Alternative				
PDCF	42,000	4,300,000	3.3	0.2
PDC	43,000	6,100,000	4.3	0.2
PF-4 and MFFF [a]	4	16,000	0.009	0.0004
PF-4, HC/HBL, and MFFF [b]	5	20,000	0.011	0.0005
WIPP Alternative				
PDCF	42,000	4,300,000	3.3	0.2
PDC	43,000	6,100,000	4.3	0.2
PF-4 and MFFF [a]	4	16,000	0.009	0.0004
PF-4, HC/HBL, and MFFF [b]	4	16,000	0.009	0.0004

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; MFFF = Mixed Oxide Fuel Fabrication Facility; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Under this option, pits would be disassembled at PF-4 at LANL. Pits disassembled at LANL would be converted to an oxide at LANL or using H-Canyon/HB-Line or metal oxidation furnaces installed in MFFF at SRS.

[b] Under this option, pits could be disassembled at PF-4 at LANL or at K-Area at SRS. Pits disassembled at LANL would be converted to an oxide at LANL or SRS. Pits disassembled at K-Area would be converted to an oxide at SRS at H-Canyon/HB-Line.

Note: To convert kilometers to miles, multiply by 0.62137; metric tons to tons, multiply by 1.1023.

Transportation impacts under the MOX Fuel and WIPP Alternatives are shown in Table 4–22 for two different options: the base option presents impacts associated with non-pit plutonium materials being transported to WIPP in POCs; the packaging option presents impacts associated with non-pit plutonium materials being transported to WIPP in CCCs and FFTF fuel in Hanford Unirradiated Fuel Packages (HUFPs). FFTF fuel is currently stored at SRS in HUFPs. For these alternatives, if HUFPs and CCCs (which can hold a higher content of plutonium than POCs), respectively, are used for transport of FFTF fuel and non-pit plutonium as TRU waste to WIPP, there would be a reduction in transportation risks from incident-free transport. There would be a negligible increase in radiological accident risks, with the accident risks for either option being about 1×10^{-6} LCFs under the WIPP Alternative, or about 1 chance in 1 million.

For all alternatives, transportation impacts were determined assuming that unirradiated MOX fuel would be transported using NNSA STAs to TVA and generic commercial nuclear power plant sites, for which each shipment would consist of 2 MOX fuel assemblies transported in a Type B package. DOE is, however, considering shipment of up to 5 Type B packages per shipment containing pressurized-water reactor fuel assemblies or 7 Type B packages per shipment containing boiling-water reactor fuel assemblies, assuming use of escorted commercial trucks under NNSA's Secure Transportation Asset Program. If this MOX fuel shipment program is implemented, it is expected that radiological impacts on transport crew members would increase by a small amount, as addressed in detail in Appendix I, Sections I.1.2.5 and I.2.2.5, while incident-free radiological impacts on the population along the transport routes would decrease. Under either scenario, no LCFs would be expected among the transport crew and general population. The radiological risks to the population from all projected accidents would decrease if escorted commercial trucks were used because fewer shipments would be required, as would nonradiological traffic fatality risks. Possible impacts from a maximum reasonably foreseeable accident involving shipment of unirradiated MOX fuel would be unchanged.

4.1.5.1 No Action Alternative

Under this alternative, there would be about 3,300 truck shipments of radioactive materials and wastes associated with the single pit disassembly and conversion option, and 3,400 truck shipments of unirradiated MOX fuel to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the impacts of transporting radioactive materials and wastes would be less than those under the action alternatives because the additional 13.1 metric tons (14.4 tons) of surplus plutonium would not be processed.

Crew – Transport of radioactive materials, waste, and unirradiated MOX fuel likely would not result in any LCFs among crew members.

Public – The cumulative dose to the general population likely would not result in LCFs from transport of radioactive materials and waste, or from transport of unirradiated MOX fuel to generic commercial nuclear power reactors.

Impacts of Transportation Accidents

As described previously, two sets of analyses were performed for the evaluation of radiological transportation accident impacts: impacts of maximum reasonably foreseeable accidents (accidents having radioactive release probabilities greater than 1×10^{-7} [1 chance in 10 million] per year), and impacts of all conceivable accidents (total transportation accidents).

For maximum reasonably foreseeable transportation accidents probabilities were calculated for all route segments (i.e., rural, suburban, and urban), and maximum consequences were determined for those route shipments having a likelihood-of-release frequency exceeding 1 in 10 million per year. For radioactive materials and waste, the maximum reasonably foreseeable transportation accident having the highest consequence would involve truck transport of depleted uranium hexafluoride from the Portsmouth Gaseous Diffusion Plant at Piketon, Ohio, to AREVA at Richland, Washington, in 48G containers (see Appendix E, Table E–12). These shipments would occur over about 23 years.

The maximum reasonably foreseeable probability of a truck accident involving this material would be up to 2.1×10^{-7} per year in a suburban area, or approximately 1 chance in 5 million each year. The consequences of the truck transport accident in terms of population dose would be about 750 person-rem, resulting in no additional LCFs among the exposed population.

For unirradiated MOX fuel shipped to generic commerical nuclear power reactors, the maximum reasonably foreseeable probability of a truck accident involving this material would be up to 3.3×10^{-6} per year in a suburban area, or approximately 1 chance in 300,000 each year. The consequences of the truck transport accident in terms of population dose would be about 4.0 person-rem. If such an accident were to occur, the projected exposure likely would not result in an LCF (0.002) among the exposed population.

Estimates of total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of material or waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options likely would not result in any LCFs. Transport of radioactive materials and wastes and unirradiated MOX fuel could result in a nonradiological fatality due to a traffic accident.

Impacts of Construction Materials and Hazardous Waste Transport

Impacts from transporting construction materials to SRS and hazardous wastes to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.5.2 Immobilization to DWPF Alternative

For the pit disassembly and conversion options addressed under this alternative, there would be up to about 4,800 truck shipments of radioactive materials and waste (not including shipments of unirradiated MOX fuel). This is an increase over the total number of shipments under the No Action Alternative due to an increase in the amount of plutonium material to be transported to SRS for processing, and the resulting transport of additional products and wastes. For transport of unirradiated MOX fuel, there would be up to about 2,100 shipments to TVA reactors, or up to about 3,400 shipments to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the impacts of transporting radioactive materials and wastes would be slightly greater than those under the No Action Alternative.

Crew – Transport of radioactive materials and waste and unirradiated MOX fuel likely would not result in any LCFs among crew members.

Public – The cumulative dose to the general population likely would not result in LCFs from transport of radioactive materials and waste associated with any of the pit disassembly and conversion options, or from transport of unirradiated MOX fuel to TVA reactors or to generic commercial nuclear power reactors.

Impacts of Transportation Accidents

For radioactive materials and waste shipped under any of the pit disassembly and conversion options, or unirradiated MOX fuel shipped to TVA reactors or generic commercial nuclear power reactors, the maximum reasonably foreseeable offsite truck transportation accident having the highest consequence would involve the transport of plutonium oxide powder from LANL to SRS. The maximum reasonably foreseeable probability of a truck accident involving this material would be up to 2.0×10^{-7} per year in a suburban area, or approximately 1 chance in 5 million each year. The consequences of the truck transport accident in terms of population dose would be about 6,300 person-rem, resulting in up to 4 LCF (3.8) among the exposed population.

Estimates of total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of material and waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options, likely would not result in any LCFs. Transport activities under this alternative could result in a nonradiological fatality due to a traffic accident.

Impacts of Construction Materials and Hazardous Waste Transport

The impacts of transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.5.3 MOX Fuel Alternative

Under this alternative, there would be up to about 4,800 truck shipments of radioactive materials and waste associated with the pit disassembly and conversion options. For the transport of unirradiated MOX fuel, there would be up to about 2,900 shipments to TVA reactors, or up to about 4,500 shipments to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the radiation doses and resulting risks to crew members and to the public would be about the same as those under the Immobilization to DWPF Alternative (Section 4.1.5.2).

Crew – Transport of radioactive materials and waste and unirradiated MOX fuel likely would not result in any LCFs among crew members.

If surplus plutonium were transported to WIPP in CCCs and FFTF fuel were transported to WIPP in HUFPs rather than POCs, the number of shipments of radioactive materials and waste would be reduced, reducing the radiation dose to the crew, but not enough to significantly reduce the risk of an LCF.

Public – The cumulative dose to the general population would not result in LCFs from transport of radioactive materials and waste associated with the pit disassembly and conversion options, or from transport of unirradiated MOX fuel to TVA reactors or to generic commercial nuclear power reactors.

If surplus plutonium were transported to WIPP in CCCs and FFTF fuel were transported to WIPP in HUFPs rather than POCs, the number of shipments of radioactive materials and waste would be reduced, reducing the radiation dose to the public, but not enough to significantly reduce the risk of an LCF.

Impacts of Transportation Accidents

For radioactive materials and waste shipped under any of the pit disassembly and conversion options, or unirradiated MOX fuel shipped to TVA reactors or generic commercial nuclear power reactors, the maximum reasonably foreseeable offsite truck transportation accident having the highest consequence would be the same as that under the Immobilization to DWPF Alternative (Section 4.1.5.2).

Estimates of total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of material or waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options would not result in any LCFs. Transport activities under this alternative could result in a nonradiological fatality due to a traffic accident.

Impacts of Construction Materials and Hazardous Waste Transport

The impacts of transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.5.4 H-Canyon/HB-Line to DWPF Alternative

Under this alternative, up to about 4,400 truck shipments of radioactive materials and wastes would occur under the pit disassembly and conversion options. For transport of unirradiated MOX fuel, there would be up to about 2,600 shipments to TVA reactors, or up to about 4,100 shipments to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the radiation doses and resulting risks to crew members and to the public would be comparable to those under the Immobilization to DWPF Alternative (Section 4.1.5.2) and MOX Fuel Alternative (Section 4.1.5.3).

Crew – Transport of radioactive materials and waste and unirradiated MOX fuel likely would not result in any LCFs among crew members.

Public – The cumulative dose to the general population likely would not result in LCFs from transport of radioactive materials and waste associated with the pit disassembly and conversion options, or from transport of unirradiated MOX fuel to TVA reactors or to generic commercial nuclear power reactors.

Impacts of Transportation Accidents

For radioactive materials and waste shipped under any of the pit disassembly and conversion options, or unirradiated MOX fuel shipped to TVA reactors or generic commercial nuclear power reactors, the maximum reasonably foreseeable offsite truck transportation accident having the highest consequence would be the same as that under the Immobilization to DWPF Alternative (Section 4.1.5.2).

Estimates of the total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of material or waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options, likely would not result in any LCFs. Transport activities under this alternative could result in a nonradiological fatality due to a traffic accident.

Impacts of Construction Materials and Hazardous Waste Transport

The impacts of transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.5.5 WIPP Alternative

Under the pit disassembly and conversion options, up to about 5,700 truck shipments of radioactive materials and wastes would occur (not including shipments of unirradiated MOX fuel). This represents about a 30 percent increase over the H-Canyon/HB-Line to DWPF Alternative, primarily due to the shipment of 6 metric tons (6.6 tons) of surplus plutonium to WIPP for disposal as TRU waste. For the transport of unirradiated MOX fuel, there would be about 2,600 shipments to TVA reactors, and up to about 4,100 shipments to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the radiation doses and resulting risks to crew members and the public would be higher than those under the Immobilization to DWPF, MOX Fuel, and H-Canyon/HB-Line to DWPF Alternatives (Sections 4.1.5.2, 4.1.5.3, and 4.1.5.4, respectively).

Crew – Transport of radioactive materials and waste and unirradiated MOX fuel likely would not result in any LCFs among crew members.

If surplus plutonium were transported to WIPP in CCCs and FFTF fuel were transported to WIPP in HUFPs rather than POCs, the number of shipments of radioactive materials and waste would be reduced, reducing the radiation dose to the crew, but not enough to significantly reduce the risk of an LCF.

Public – The cumulative dose to the general population would likely not result in LCFs from transport of radioactive materials and waste associated with the pit disassembly and conversion options, or from transport of unirradiated MOX fuel to generic commercial nuclear power reactors.

If surplus plutonium were transported to WIPP in CCCs and FFTF fuel were transported to WIPP in HUFPs rather than POCs, the number of shipments to WIPP would be reduced, reducing the radiation dose to the public, but not enough to significantly reduce the risk of an LCF.

Impacts of Transportation Accidents

For radioactive materials and waste shipped under any of the pit disassembly and conversion options, or unirradiated MOX fuel shipped to TVA reactors or generic commercial nuclear power reactors, the maximum reasonably foreseeable offsite truck transportation accident having the highest consequence would be the same as that under the Immobilization to DWPF Alternative (Section 4.1.5.2).

Estimates of the total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of materials or waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options, likely would not result in LCFs. Transport activities under this alternative could result in a nonradiological traffic fatality due to a traffic accident, with this risk being larger than that for the other alternatives because of the larger number of shipments.

Impacts of Construction Materials and Hazardous Waste Transport

The impacts of transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.6 Environmental Justice

Estimates of entire populations and minority and low-income subsets of populations in the vicinity of SRS and LANL have been projected to the year 2020 (see Chapter 3, Sections 3.1.11 and 3.2.11). Consistent with the human health analysis, impacts were analyzed on the potentially affected populations within 50 miles (80 kilometers) of the facilities at SRS and LANL that could be engaged in surplus plutonium activities. In addition, impacts on populations in close proximity were analyzed at radial distances of 5, 10, and 20 miles (8, 16, and 32 kilometers) in support of this environmental justice analysis. However, no populations reside within 5 miles (8 kilometers) of the proposed facilities at SRS.

Regarding LANL, a special pathways receptor analysis was performed in support of the 2008 *LANL SWEIS*. In this analysis, it was determined that a special pathways receptor who consumed increased amounts of fish, deer, and elk from the areas surrounding LANL, drank surface water and Indian tea (Cota), and consumed other potentially contaminated foodstuffs, could receive an additional dose of up to 4.5 millirem per year from these special pathways (see Appendix C, Section C.1.4, of the 2008 *LANL SWEIS* [DOE 2008f]). Normal operation of the proposed pit disassembly and conversion at PF-4 is not expected to increase the doses from these special pathways, which are dominated by biological uptake of legacy contamination. Therefore, if the MEI associated with this *SPD Supplemental EIS* were also assumed to be a special pathways receptor, the maximum dose would be up to 4.6 millirem per year (4.5 millirem associated with special pathways and about 0.081 millirem associated with normal operations from pit disassembly and conversion at PF-4, assuming pit disassembly and conversion of 35 metric tons [38.6 tons] of plutonium – see Table 4–4). This dose is low; it would represent an increase of about 1 percent above the approximately 480 millirem that a person residing near LANL would normally receive annually from natural background radiation. In terms of increased risk of a fatal cancer from the special pathways dose plus the dose from pit disassembly and conversion at PF-4, it would represent an annual estimated risk of 3×10^{-6}, or about 1 chance in 330,000.

As described in Section 4.1.2.1 and Appendix I, the use of a 40 percent MOX fuel core in commercial nuclear power reactors is not expected to substantially change the environmental impacts that currently occur at commercial nuclear power reactors due to the use of a 100 percent LEU fuel core. Therefore, there would be no disproportionately high and adverse impacts on minority and low-income populations in the vicinities of the commercial nuclear power reactors addressed in this *SPD Supplemental EIS*.

4.1.6.1 No Action Alternative

Construction—As discussed in Section 4.1.2.1.1, there would be no radiological risk to the public from construction activities at SRS and there would be no construction at LANL. Construction of PDCF at F-Area would occur in generally uncontaminated areas, resulting in no construction-related radiological impacts on the general population. Therefore, there would be no disproportionately high and adverse impacts on minority or low-income populations due to construction activities under the No Action Alternative.

Operations—As discussed in Sections 4.1.2.1.1 and 4.1.5.1, routine operations under the No Action Alternative would pose no significant health risks to the public. **Table 4–25** shows the impacts on the total and subset populations within 10, 20, and 50 miles (16, 32, and 80 kilometers) of the proposed surplus plutonium facilities at SRS under the No Action Alternative. Within the 10-mile (16-kilometer) radius, the only minority subgroup with an average individual dose higher than the corresponding nonminority individual is an individual of the Hispanic population. This individual would receive an annual dose that is about 0.0002 millirem higher than that of the average nonminority individual. However, this difference represents a negligible increased risk to the exposed individual of developing a latent fatal cancer of 1×10^{-10}, or 1 chance in 10 billion, annually. Within the 20-mile (32-kilometer) radius, the average individual of each subpopulation would receive the same annual dose and the doses are very small. Within the 50-mile (80-kilometer) radius, the average minority individual, and the average Black or African-American individual would each receive an annual dose that is about 0.00001 millirem higher than that of the average nonminority individual. However, this difference is so small it represents no appreciable change in the risk to the exposed individual of developing a latent fatal cancer.

Table 4–25 Comparison of Annual Doses to an Average Individual of the Total Minority, Hispanic, Black or African-American, and Low-Income Populations Near the Savannah River Site in 2020 under the No Action Alternative (millirem)

Population Group	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Average individual	0.0029	0.0013	0.00062
Nonminority individual	0.0029	0.0013	0.00062
Minority individual	0.0029	0.0013	0.00062
Hispanic individual [a]	0.0031	0.0013	0.00060
Black or African-American individual [b]	0.0029	0.0013	0.00063
Non-low-income individual	0.0029	0.0013	0.00061
Low-income individual	0.0029	0.0013	0.00064

[a] The Hispanic population includes all Hispanic persons regardless of race.
[b] Includes persons of Hispanic or Latino origin.
Note: To convert miles to kilometers, multiply by 1.6093.

Doses to persons living below the poverty level are also presented in Table 4–25. The average annual dose to an individual, whether below or above the poverty level, would be the same for persons living within 10 and 20 miles (16 and 32 kilometers) of SRS. The average low-income individual living within 50 miles (80 kilometers) of SRS would receive an annual dose that is about 0.00003 millirem higher than that of the average non-low-income individual. However, this difference is so small it represents no appreciable change in the risk to the exposed individual of developing a latent fatal cancer.

Therefore, operations under the No Action Alternative would not result in disproportionately high and adverse impacts on minority or low-income populations residing near SRS.

Table 4–26 shows the impacts on the total and subset populations within 5, 10, 20, and 50 miles (8, 16, 32, and 80 kilometers) of PF-4 at LANL under the No Action Alternative. Within the 5-mile (8-kilometer) radius, an average minority individual, an average Hispanic individual, and an average American Indian individual would each receive a dose about 0.0001 millirem higher than that to the average nonminority individual. However, this difference represents a negligible increased risk to the exposed individual of developing a latent fatal cancer (6×10^{-11}, or 1 chance in approximately 17 billion, annually). Within the 10-mile (16-kilometer) radius, an average individual of the Hispanic population would receive a dose that is about 0.00003 millirem higher than that of the average nonminority individual. However, this difference represents a negligible increased risk to the exposed individual of developing a latent fatal cancer (2×10^{-11}, or 1 chance in approximately 50 billion, annually). Within the 20- and 50-mile (32- and 80-kilometer) radii, the average dose to the nonminority individual would exceed the average dose to an individual of each subpopulation.

Doses to persons living below the poverty level are also presented in Table 4–26. Within the 5-mile (8-kilometer) radius, the average low-income individual would receive a dose that is about 0.00007 millirem higher than that to the average non-low-income individual. However, this difference represents a negligible increased risk to the exposed individual of developing a latent fatal cancer of 4×10^{-11}, or 1 chance in approximately 25 billion, annually. Within the 10-, 20-, and 50-mile (16-, 32-, and 80-kilometer) radii, the dose to the average non-low-income individual would not exceed that to the average low-income individual.

Therefore, operations under the No Action Alternative would not result in disproportionately high and adverse impacts on minority or low-income populations residing near LANL.

Table 4–26 Comparison of Annual Doses to an Average Individual of the Total Minority, Hispanic, American Indian, and Low-Income Populations Near Los Alamos National Laboratory in 2020 under the No Action Alternative (millirem)

Population Group	*Within 5 miles*	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Average individual	0.00093	0.00068	0.00028	0.000057
Nonminority individual	0.00090	0.00068	0.00045	0.000068
Minority individual	0.0010	0.00068	0.00018	0.000048
Hispanic individual [a]	0.0010	0.00071	0.00015	0.000044
American Indian individual [b]	0.0010	0.00036	0.00013	0.000041
Non-low-income individual	0.00093	0.00069	0.00030	0.000059
Low-income individual	0.0010	0.00060	0.00012	0.000042

[a] The Hispanic population includes all Hispanic persons regardless of race.

[b] Includes persons of Hispanic or Latino origin.

Note: To convert miles to kilometers, multiply by 1.6093.

4.1.6.2 Immobilization to DWPF Alternative

Construction—As discussed in Section 4.1.2.1.2, impacts from construction of PDCF at F-Area would be the same as those under the No Action Alternative (Section 4.1.2.1.1). No additional radiological risks to the general population from optional modification of the K-Area Complex and H-Canyon/HB-Line, and MFFF at SRS, and PF-4 at LANL, are expected. In addition, no additional radiological risk to the general population from construction of the K-Area immobilization capability is expected and no radiological releases are expected to result from modification of DWPF. Therefore, there would be no disproportionately high and adverse impacts on minority or low-income populations due to construction activities under the Immobilization to DWPF Alternative.

Operations—As discussed in Sections 4.1.2.1.2 and 4.1.5.2, routine operations under the Immobilization to DWPF Alternative would pose no significant health risks to the public.

Table 4–27 shows the impacts on the total and subset populations within 10, 20, and 50 miles (16, 32, and 80 kilometers) of the facilities at SRS under the Immobilization to DWPF Alternative. The impacts under this alternative for the area surrounding SRS are greatest under the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion. Therefore, the impacts at SRS presented in this section are representative of the PF-4, H-Canyon/HB-Line, and MFFF Option.

Table 4–27 Comparison of Annual Doses to an Average Individual of the Total Minority, Hispanic, Black or African-American, and Low-Income Populations Near the Savannah River Site in 2020 under the Immobilization to DWPF Alternative (millirem)

Population Group	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Average individual	0.0036	0.0017	0.00082
Nonminority individual	0.0037	0.0017	0.00082
Minority individual	0.0037	0.0017	0.00083
Hispanic individual [a]	0.0039	0.0017	0.00080
Black or African-American individual [b]	0.0036	0.0017	0.00083
Non-low-income individual	0.0037	0.0017	0.00082
Low-income individual	0.0037	0.0017	0.00085

DWPF = Defense Waste Processing Facility.

[a] The Hispanic population includes all Hispanic persons regardless of race.

[b] Includes persons of Hispanic or Latino origin.

Note: To convert miles to kilometers, multiply by 1.6093.

Within the 10-mile (16-kilometer) radius, the annual dose to an average individual of the Hispanic population would be about 0.0002 millirem higher than that of the average nonminority individual. However, this difference represents a negligible increased risk to the exposed individual of developing a latent fatal cancer (1×10^{-10}, or about 1 chance in 10 billion, annually).

Within the 20-mile (32-kilometer) radius, the annual dose to an average individual of each population would receive the same very small annual dose.

Within the 50-mile (80-kilometer) radius, an average individual of the minority and Black or African-American populations would each receive an annual dose that is about 0.00001 millirem higher than that to the average nonminority individual. However, this difference is so small that it represents no appreciable change in the risk to the exposed individual of developing a latent fatal cancer.

Doses to persons living below the poverty level are also presented in Table 4–27. The average annual dose to an individual, whether below or above the poverty level, would be the same for persons living within 10 and 20 miles (16 and 32 kilometers) of SRS. Within the 50-mile (80-kilometer) radius, an average low-income individual would receive an annual dose that is about 0.0003 millirem higher than that to the average non-low-income individual. However, this difference represents a negligible increased risk to the exposed individual of developing a latent fatal cancer (2×10^{-11}, or about 1 chance in 50 billion, annually).

Therefore, operations under the Immobilization to DWPF Alternative would not result in disproportionately high and adverse impacts on minority or low-income populations residing near SRS.

Table 4–28 shows the impacts on the total and subset populations within 5, 10, 20, and 50 miles (8, 16, 32, and 80 kilometers) of PF-4 at LANL under the Immobilization to DWPF Alternative. The impacts at LANL would be the greatest under the two options where 35 metric tons (38.6 tons) of surplus plutonium are processed through PF-4. Therefore, the impacts at SRS presented in this section are representative of these options.

Table 4–28 Comparison of Annual Doses to an Average Individual of the Total Minority, Hispanic, American Indian, and Low-Income Populations Near Los Alamos National Laboratory in 2020 under the Immobilization to DWPF Alternative (millirem)

Population Group	*Within 5 miles*	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Average individual	0.0077	0.0057	0.0023	0.00047
Nonminority individual	0.0075	0.0057	0.0038	0.00057
Minority individual	0.0083	0.0057	0.0015	0.00040
Hispanic individual [a]	0.0085	0.0059	0.0012	0.00037
American Indian individual [b]	0.0081	0.0030	0.0011	0.00034
Non-low-income individual	0.0077	0.0057	0.0025	0.00049
Low-income individual	0.0082	0.0050	0.0010	0.00035

DWPF = Defense Waste Processing Facility.

[a] The Hispanic population includes all Hispanic persons regardless of race.

[b] Includes persons of Hispanic or Latino origin.

Note: To convert miles to kilometers, multiply by 1.6093.

For distances beyond 10 miles (16 kilometers), the average nonminority individual would receive a slightly higher annual dose from the proposed surplus plutonium disposition activities than a minority individual. An average individual of the minority, Hispanic, and American Indian populations within 5 miles (8 kilometers) of LANL would receive a slightly higher annual dose from these activities. Similarly, an average individual of the Hispanic populations within 10 miles (16 kilometers) of LANL would receive a slightly higher dose than that of an average nonminority individual. The greatest difference in annual doses would be to an average individual of the Hispanic population within 5 miles (8 kilometers) who would receive an annual dose that is about 0.001 millirem higher than that for the average nonminority individual. However, this difference represents a negligible increased risk to the exposed individual of developing a latent fatal cancer (6×10^{-10}, or about 1 chance in 1.7 billion, annually).

Doses to persons living below the poverty level are also presented in Table 4–28. The average annual dose to a non-low-income individual would be higher than that of a low-income individual living within 10, 20, and 50 miles (16, 32, and 80 kilometers) of LANL. The average low-income individual living within 5 miles (8 kilometers) of LANL would receive an annual dose that is about 0.0005 millirem higher than that to the average non-low-income individual. However, this difference is so small it represents no appreciable change in the risk to the exposed individual of developing a latent fatal cancer.

Therefore, operations under the Immobilization to DWPF Alternative would not result in disproportionately high and adverse impacts on minority or low-income populations residing near LANL.

4.1.6.3 MOX Fuel Alternative

Construction—Section 4.1.2.1.3 discusses radiological impacts on the public as a result of construction under the MOX Fuel Alternative. The impacts would be essentially the same as those under the No Action (Section 4.1.2.1.1) and Immobilization to DWPF (Section 4.1.2.1.2) Alternatives. In addition, there would be no additional radiological risk to the general population from construction of PDC if this pit disassembly and conversion option were selected.

Operations—As discussed in Sections 4.1.2.1.3 and 4.1.5.3, routine operations under the MOX Fuel Alternative would pose no significant health risks to the public. **Table 4–29** shows the impacts on the total and subset populations within 10, 20, and 50 miles (16, 32, and 80 kilometers) of the facilities at SRS under the MOX Fuel Alternative. The impacts under this alternative for the area surrounding SRS are greatest under the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion. Therefore, the impacts at SRS presented in this section are representative of the PF-4, H-Canyon/HB-Line, and MFFF Option.

Table 4–29 Comparison of Annual Doses to an Average Individual of the Total Minority, Hispanic, Black or African-American, and Low-Income Populations Near the Savannah River Site in 2020 under the MOX Fuel Alternative (millirem)

Population Group	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Average individual	0.0048	0.0023	0.0011
Nonminority individual	0.0048	0.0023	0.0011
Minority individual	0.0048	0.0023	0.0011
Hispanic individual [a]	0.0051	0.0023	0.0011
Black or African-American individual [b]	0.0048	0.0023	0.0011
Non-low-income individual	0.0048	0.0023	0.0011
Low-income individual	0.0049	0.0023	0.0012

MOX = mixed oxide.

[a] The Hispanic population includes all Hispanic persons regardless of race.

[b] Includes persons of Hispanic or Latino origin.

Note: To convert miles to kilometers, multiply by 1.6093.

For all distances, the average nonminority individual and minority individual residing near SRS would receive nearly the same annual dose and the doses are very small. The minority subgroup with the largest difference when compared to an average nonminority individual is a Hispanic individual living within 10 miles (16 kilometers) of SRS. This individual would receive an annual dose that is about 0.0003 millirem higher than that to the average nonminority individual. However, this difference represents a negligible increased risk to the exposed individual of developing a latent fatal cancer (2×10^{-10}, or about 1 chance in about 5 billion, annually).

Doses to persons living below the poverty level are also presented in Table 4–29. The average annual dose to an individual, whether below or above the poverty level, would be the same for persons living within 20 miles (32 kilometers) of SRS. The average low-income individual living within 10 and 50 miles (16 and 80 kilometers) of SRS would receive an annual dose which is about 0.0001 millirem higher than that to the average non-low-income individual. However, this difference is so small it represents no appreciable change in the risk to the exposed individual of developing a latent fatal cancer.

Therefore, operations under the MOX Fuel Alternative would not result in disproportionately high and adverse impacts on minority or low-income populations residing near SRS.

The doses to individuals in the LANL vicinity from surplus plutonium disposition activities at PF-4 under the MOX Fuel Alternative would be the same as those in Section 4.1.6.2 under the Immobilization to DWPF Alternative.

4.1.6.4 H-Canyon/HB-Line to DWPF Alternative

Construction—Section 4.1.2.1.4 discusses radiological impacts on the public as a result of construction under the H-Canyon/HB-Line to DWPF Alternative. The impacts are essentially the same as those under the MOX Fuel Alternative (Section 4.1.2.1.3).

Operations—As discussed in Sections 4.1.2.1.4 and 4.1.5.4, routine operations under the H-Canyon/HB-Line to DWPF Alternative would pose no significant health risks to the public. **Table 4–30** shows the impacts on the total and subset populations within 10, 20, and 50 miles (16, 32, and 80 kilometers) of the facilities at SRS under the H-Canyon/HB-Line to DWPF Alternative. The impacts under this alternative for the area surrounding SRS are greatest under the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion. Therefore, the impacts at SRS presented in this section are representative of the PF-4, H-Canyon/HB-Line, and MFFF Option.

Table 4–30 Comparison of Annual Doses to an Average Individual of the Total Minority, Hispanic, Black or African-American, and Low-Income Populations Near the Savannah River Site in 2020 under the H-Canyon/HB-Line to DWPF Alternative (millirem)

Population Group	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Average individual	0.0037	0.0017	0.00083
Nonminority individual	0.0037	0.0017	0.00083
Minority individual	0.0037	0.0017	0.00084
Hispanic individual [a]	0.0039	0.0017	0.00080
Black or African-American individual [b]	0.0037	0.0018	0.00084
Non-low-income individual	0.0037	0.0017	0.00082
Low-income individual	0.0037	0.00187	0.00086

DWPF = Defense Waste Processing Facility.

[a] The Hispanic population includes all Hispanic persons regardless of race.

[b] Includes persons of Hispanic or Latino origin.

Note: To convert miles to kilometers, multiply by 1.6093.

The annual dose to an average nonminority individual from surplus plutonium disposition activities at SRS would be nearly identical to the annual dose received by an average individual of all population subgroups at every radial distance, and would not result in any appreciable increase in risk of a fatal cancer from these doses for any individual.

Within the 10-mile (16-kilometer) radius, the dose to the average Hispanic individual would receive a dose that is about 0.0002 millirem higher than that to the average nonminority individual. However this difference is so small it represents a negligible increased risk to the exposed individual of developing a latent fatal cancer of about 1×10^{-10}, or about 1 chance in 10 billion.

Within the 20-mile (32-kilometer) radius, an average Black or African-American individual would receive a dose that is about 0.0001 millirem higher than that to the average nonminority individual. However this difference is so small it represents a negligible increased risk to the exposed individual of developing a latent fatal cancer of about 6×10^{-11}, or about 1 chance in 17 billion, annually.

Within the 50-mile (80-kilometer) radius, the dose to the average minority individual and the average Black or African-American individual would each receive a dose that is about 0.00001 millirem higher than that to the average nonminority individual. However this difference is so small it represents no appreciable change in the risk to the exposed individual of developing a latent fatal cancer.

Within the 10- and 20-mile (16- and 32-kilometer) radii, the dose to the average individual of the low-income population and the average individual of the non-low-income population would be the same, and the doses are very small.

Within the 50-mile (80-kilometer) radius, an average low-income individual would receive a dose that is about 0.0004 millirem higher than that to the average non-low-income individual. However, this difference is so small that it represents no appreciable change in the risk to the exposed individual of developing a latent fatal cancer.

The doses to individuals from surplus plutonium disposition activities at PF-4 at LANL under the H-Canyon/HB-Line to DWPF Alternative would be the same as those in Section 4.1.6.2 under the Immobilization to DWPF Alternative.

4.1.6.5 WIPP Alternative

Construction—Section 4.1.2.1.5 discusses radiological impacts on the public as a result of construction under the WIPP Alternative. The impacts are the same as those under the MOX Fuel Alternative (Section 4.1.2.1.3).

Operations—As discussed in Section 4.1.2.1.5 and 4.1.5.5, routine operations under the WIPP Alternative would pose no significant health risks to the public. **Table 4–31** shows the impacts on the total and subset populations within 10, 20, and 50 miles (16, 32, and 80 kilometers) of the facilities at SRS under the WIPP Alternative. The impacts under this alternative for the area surrounding SRS are greatest under the PF-4, H-Canyon/HB-Line, and MFFF Option. Therefore, the impacts at SRS presented in this section are representative of the PF-4, H-Canyon/HB-Line, and MFFF Option.

Table 4–31 Comparison of Annual Doses to an Average Individual of the Total Minority, Hispanic, Black or African-American, and Low-Income Populations Near the Savannah River Site in 2020 under the WIPP Alternative (millirem)

Population Group	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Average individual	0.0048	0.0023	0.0011
Nonminority individual	0.0048	0.0023	0.0011
Minority individual	0.0048	0.0023	0.0011
Hispanic individual [a]	0.0051	0.0023	0.0011
Black or African-American individual [b]	0.0048	0.0023	0.0011
Non-low-income individual	0.0048	0.0023	0.0011
Low-income individual	0.0048	0.0023	0.0012

WIPP = Waste Isolation Pilot Plant

[a] The Hispanic population includes all Hispanic persons regardless of race.

[b] Includes persons of Hispanic or Latino origin.

Note: To convert miles to kilometers, multiply by 1.6093.

The doses to individuals from surplus plutonium disposition activities at SRS under the WIPP Alternative would be nearly identical to those in Section 4.1.6.3 under the MOX Fuel Alternative, and would not result in any appreciable increase in risk of a fatal cancer from these doses for any individual regardless of whether they are a member of a minority or low-income population. Therefore, operations under the WIPP Alternative would not result in disproportionately high and adverse impacts on minority and low-income populations residing near SRS.

The doses to individuals in the LANL vicinity from pit disassembly and conversion at PF-4 under the WIPP Alternative would be the same as those in Section 4.1.6.2 under the Immobilization to DWPF Alternative.

4.1.7 Other Resource Areas

This section analyzes impacts at SRS and LANL under the *SPD Supplemental EIS* alternatives for land resources, geology and soils, water resources, noise, ecological resources, cultural resources, and infrastructure.

As described in Appendix I, the use of a 40 percent MOX fuel core in domestic commercial nuclear power reactors would not require any construction other than minor modifications within existing structures. The use of a 40 percent MOX fuel core is not expected to require nor impact geologic and soil materials. There would be no change in impacts on land resources, water resources, noise, ecological resources, cultural resources, and infrastructure that currently occur due to the use of a 100 percent LEU fuel core. Therefore, impacts on these resource areas from use of MOX fuel at commercial nuclear power reactors are not discussed further in this section.

4.1.7.1 Land Resources

This section describes impacts that *SPD Supplemental EIS* alternatives would have on land resources, including land use and visual resources. As described in Appendix H, no new construction is expected at the principal SRS and LANL plutonium support facilities. Therefore, impacts on land use and visual resources from plutonium support activities at SRS and LANL are not discussed further in this section.

4.1.7.1.1 Land Use

Impacts on the land are generally related to construction with little or no impacts associated with operations. Therefore, this section only describes the impacts associated with construction of PDCF at F-Area, PDC at K-Area, and the K-Area immobilization capability at SRS, and the impacts associated with modifications to the existing PF-4 at LANL under two pit disassembly and conversion options. **Table 4–32** summarizes the land disturbed under the alternatives and options.

Table 4–32 Land Disturbed Under the *SPD Supplemental EIS* Alternatives for Each Pit Disassembly and Conversion Option

Pit Disassembly and Conversion Option	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
PDCF	At SRS, 50 acres of previously disturbed land in F-Area to construct PDCF	At SRS, 50 acres of previously disturbed land in F-Area to construct PDCF, and 2 acres of previously disturbed land in K-Area to construct the immobilization capability.	Same as No Action	Same as No Action [a]	Same as No Action
PDC	N/A	N/A	At SRS, 25 acres of previously disturbed land, and 5 acres of newly disturbed land, in K-Area to construct PDC. [b]	Same as MOX Fuel [a]	Same as MOX Fuel
PF-4 and MFFF	N/A	At SRS, 2 acres of previously disturbed land in K-Area to construct the immobilization capability. At LANL, less than 2 acres at TA-55 at LANL for modification of PF-4.[c]	At SRS, no additional land disturbance. At LANL, less than 2 acres at TA-55 at LANL for modification of PF-4.[c]	Same as MOX Fuel [a]	Same as MOX Fuel
PF-4, HC/HBL, and MFFF	N/A	At SRS, 2 acres of previously disturbed land in K-Area to construct the immobilization capability. At LANL, less than 2 acres at TA-55 at LANL for modification of PF-4.[c]	At SRS, no additional land disturbance. At LANL, less than 2 acres at TA-55 at LANL for modification of PF-4.	Same as MOX Fuel [a]	Same as MOX Fuel

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF = Plutonium Facility; SRS = Savannah River Site; TA = Technical Area; WIPP = Waste Isolation Pilot Plant.

[a] A transfer bypass line may be installed around a diversion box at the H-Area tank farm on land that is already disturbed.

[b] It is expected that a sanitary tie-in connecting K-Area to a lift station at C-Area would be constructed on previously disturbed land (Reddick 2010).

[c] A site for a construction trailer and construction parking has not been selected, but preference would be given to previously disturbed land.

Note: To convert acres to hectares, multiply by 0.40469.

Source: LANL 2012a; SRNS 2012; WSRC 2008a.

4.1.7.1.1.1 No Action Alternative

PDCF would be located within F-Area at SRS in the same general area as that analyzed in the *SPD EIS* (DOE 1999b). The area required to construct this facility, which has been cleared in expectation of construction, would be about 50 acres (20 hectares), including a laydown area. Once completed, PDCF would encompass less than 23 acres (9.3 hectares). Because the use of land for construction of PDCF would be consistent with the current heavy industrial nature of F-Area and would be consistent with the goals of the Industrial Core (see Chapter 3, Section 3.1.1.1), there would be minimal impacts on existing land use.

4.1.7.1.1.2 Immobilization to DWPF Alternative

PDCF Option. Similar to the No Action Alternative, PDCF would be constructed at SRS with impacts as described in Section 4.1.7.1.1.1. Also under this alternative, a number of new structures would be constructed within the built-up portion of K-Area at SRS to support a new plutonium immobilization capability. These structures, which would occupy approximately 2 acres (0.8 hectares), include a chiller building, cooling towers, office space, a sand filter, a fan house, and an exhaust stack. Because construction would take place within the built-up portion of K-Area, there would be no change in land use.

PF-4 and MFFF Option. At SRS and as noted under the PDCF Option, 2 acres (0.8 hectares) of previously disturbed land at K-Area would be required to support immobilization with no impacts on land use. At LANL, pit disassembly and conversion would take place within PF-4. Modifications to PF-4 would take place within the existing structure; however, less than 2 acres (0.8 hectares) would be needed for a temporary trailer and construction parking. Although a site has not been identified for these facilities, preference would be given to previously disturbed land. The project would go through the LANL Permit Requirements Identification process, and compliance requirements would be identified and implemented.

PF-4, H-Canyon/HB-Line, and MFFF Option. At SRS and LANL, land use impacts would be the same as those under the PF-4 and MFFF Option.

4.1.7.1.1.3 MOX Fuel Alternative

PDCF Option. At SRS and similar to the No Action Alternative, PDCF would be constructed within F-Area with impacts as described in Section 4.1.7.1.1.1.

PDC Option. At SRS, construction of PDC would take place within K-Area. In total, construction would require about 30 acres (12 hectares) of land of which 25 acres (10 hectares) are presently disturbed by existing facilities or are cleared. The remaining 5 acres (2 hectares) are wooded. This area could be cleared for a warehouse and/or parking. The total project footprint following construction would be about 18 acres (7.3 hectares) (SRNS 2012). The impacts of clearing 210 acres (85 hectares) around the K-Area Complex, including the 5 acres (2 hectares) proposed under this option, were addressed in the *Environmental Assessment for the Safeguards and Security Upgrades for Storage of Plutonium Materials at the Savannah River Site* (DOE 2005d). That assessment resulted in a Finding of No Significant Impact (DOE 2005e). An additional activity planned under this option is construction of a 2-mile (3.2-kilometer) sanitary tie-in connecting K-Area to a lift station at C-Area. Although the exact route is undetermined at this time, it would likely use existing easements; thus, it is not expected to alter current land use. This would be verified prior to construction through the SRS site use process (Reddick 2010).

PF-4 and MFFF Option. At LANL, pit disassembly and conversion would take place within PF-4. As noted in Section 4.1.7.1.1.2, 2 acres (0.8 hectares) would be needed at LANL for a temporary trailer and construction parking under this option. While a site has not been identified, preference would be given to previously disturbed land. The project would go through the LANL Permit Requirements Identification process, and compliance requirements would be identified and implemented.

PF-4, H-Canyon/HB-Line, and MFFF Option. At LANL, impacts associated with modification of PF-4 to support pit disassembly and conversion would be as described in this section for the PF-4 and MFFF Option.

4.1.7.1.1.4 H-Canyon/HB-Line to DWPF Alternative

PDCF Option. At SRS and similar to the No Action Alternative, PDCF would be constructed within F-Area with impacts as described in Section 4.1.7.1.1.1.

A transfer bypass line may be installed around a diversion box at the H-Area tank farm on land that is already disturbed and used for industrial purposes. This action would have no impacts on land use within H-Area.

PDC Option. At SRS, impacts on land use from construction of PDC and a planned sanitary tie-in connecting K-Area to a lift station at C-Area, would be the same as those addressed in Section 4.1.7.1.1.3 for the PDC Option under the MOX Fuel Alternative. Also, if a transfer bypass line were installed at the H-Area tank farm, there would be no impacts on land use.

PF-4 and MFFF Option. At SRS and as addressed under the PDCF Option in this section, construction of a transfer bypass line (if needed) at H-Area would have no impacts on land use. At LANL, impacts associated with modification of PF-4 to enhance LANL's pit disassembly and conversion capability would be the same as those for the PF-4 and MFFF Option under the MOX Fuel Alternative (Section 4.1.7.1.1.3).

PF-4, H-Canyon/HB-Line, and MFFF Option. At SRS and as addressed under the PDCF Option in this section, construction of a transfer bypass line (if needed) at H-Area would have no impacts on land use. At LANL, impacts associated with modification of PF-4 to enhance LANL's pit disassembly and conversion capability would be the same as those for the PF-4 and MFFF Option under the MOX Fuel Alternative (Section 4.1.7.1.1.3).

4.1.7.1.1.5 WIPP Alternative

PDCF Option. At SRS, PDCF would be constructed with impacts as described in Section 4.1.7.1.1.1 under the No Action Alternative.

PDC Option. At SRS, impacts on land use from construction of PDC and a planned sanitary tie-in connecting K-Area to a lift station at C-Area, would be the same as those in Section 4.1.7.1.1.3 for the PDC Option under the MOX Fuel Alternative.

PF-4 and MFFF Option. At LANL, impacts associated with modification of PF-4 to enhance LANL's pit disassembly and conversion capability would be the same as those in Section 4.1.7.1.1.3 for the PF-4 and MFFF Option under the MOX Fuel Alternative.

PF-4, H-Canyon/HB-Line, and MFFF Option. At LANL, impacts associated with modification of PF-4 to enhance LANL's pit disassembly and conversion capability would be the same as those in Section 4.1.7.1.1.3 for the PF-4, H-Canyon/HB-Line, and MFFF Option under the MOX Fuel Alternative.

4.1.7.1.2 Visual Resources

Impacts on visual resources at SRS and LANL are addressed in this section. Impacts are related to construction of new facilities or modifications to existing facilities that may affect visual resources. Therefore, this section only describes impacts associated with possible construction of PDCF at F-Area, PDC at K-Area, and the K-Area immobilization capability at SRS, and impacts associated with modifications to PF-4 at LANL that would occur under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option. Modification activities occurring inside existing buildings (e.g., minor modifications to H-Canyon/HB-Line to support preparation of non-pit plutonium for WIPP disposal under the WIPP Alternative) are expected to have little impact on visual resources and, therefore, are not discussed. Principal support facilities at SRS and LANL are also not discussed because there would be no new construction at these facilities.

4.1.7.1.2.1 No Action Alternative

At SRS, PDCF would be built within F-Area with construction occurring within a cleared area immediately adjacent to existing industrial facilities. Thus, the appearance of new facilities would be consistent with the industrialized character of the area. Therefore, the Visual Resource Management (VRM) Class IV designation applicable to F-Area would not change.

4.1.7.1.2.2 Immobilization to DWPF Alternative

PDCF Option. At SRS and similar to the No Action Alternative, PDCF would be constructed within F-Area with impacts as described in Section 4.1.7.1.2.1. Also under this alternative, a number of new structures requiring 2 acres (0.8 hectares) would be constructed within the built-up portion of K-Area to support a new plutonium immobilization capability. Because the appearance of these new facilities would be consistent with the industrialized character of the area, there would be no change to the visual environment. Therefore, the VRM Class IV designation applicable to K-Area would not change.

PF-4 and MFFF Option. At SRS and as noted in this section under the PDCF Option, 2 acres (0.8 hectares) of previously disturbed land at K-Area would be required to support immobilization with no impacts on the visual environment. At LANL, modifications to PF-4 to provide an enhanced pit disassembly and conversion capability would take place within the existing structure; however, less than 2 acres (0.8 hectares) would be needed for a temporary trailer and construction parking. Although a site has not been identified for these facilities, preference would be given to previously disturbed land. The project would go through the LANL Permit Requirements Identification process, and compliance requirements would be identified and implemented. Thus, although visual impacts cannot be determined at this time, the visual environment would be considered during the site permitting process. At SRS and LANL, because the appearance of these new and modified structures would be consistent with the industrialized character of the areas where they would be or are located, there would be no change to the visual environment at either site.

PF-4, H-Canyon/HB-Line, and MFFF Option. At SRS and as noted in this section under the PDCF Option, 2 acres (0.8 hectares) of previously disturbed land at K-Area would be required to support immobilization with no impacts on the visual environment. At LANL, visual impacts associated with modification of PF-4 would be the same as those described in this section under the PF-4 and MFFF Option.

4.1.7.1.2.3 MOX Fuel Alternative

PDCF Option. At SRS, PDCF would be constructed within F-Area with visual impacts as described in Section 4.1.7.1.2.1 under the No Action Alternative.

PDC Option. At SRS and as noted in Section 4.1.7.1.1.3 under the PDC Option, with the exception of a warehouse and/or parking lot, construction would take place within the developed portion of K-Area. Because development would be compatible with the industrial appearance of K-Area, there would be no change to its Class IV VRM designation. The warehouse and/or parking lot would remove 5 acres (2 hectares) of woodland located on the east side of the complex. However, this acreage is part of the 210 acres (85 hectares) of woodland to be removed as part of the safeguards and security measures to be implemented at K-Area. The removal of this acreage was evaluated in the *Environmental Assessment for the Safeguards and Security Upgrades for Storage of Plutonium Materials at the Savannah River Site* (DOE 2005d) for which a Finding of No Significant Impact was issued (DOE 2005e). An additional activity planned under this option is construction of a 2-mile (3.2-kilometer) sanitary tie-in connecting K-Area to a lift station at C-Area. Although the exact route is undetermined at this time, it would likely use existing easements; thus, it is not expected to impact visual resources at SRS. This would be verified prior to construction through the SRS site use process (Reddick 2010).

PF-4 and MFFF Option. At LANL, visual impacts from modification of PF-4 would be the same as described for the PF-4 and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.1.2.2).

PF-4, H-Canyon/HB-Line, and MFFF Option. At LANL, visual impacts associated with modification of PF-4 would be the same as described for the PF-4, H-Canyon/HB-Line, and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.1.2.2).

4.1.7.1.2.4 H-Canyon/HB-Line to DWPF Alternative

PDCF Option. At SRS and similar to the No Action Alternative, PDCF would be constructed within F-Area with visual impacts as described in Section 4.1.7.1.2.1. Construction of a transfer bypass line around a diversion box at the H-Area tank farm (if required) would not impact visual resources since this action would take place on land that is already disturbed.

PDC Option. At SRS, impacts on visual resources from construction of PDC at K-Area and a planned sanitary tie-in connecting K-Area to a lift station at C-Area would be the same as those addressed in Section 4.1.7.1.2.3 under the MOX Fuel Alternative. Additionally, construction of a transfer bypass line (if needed) around a diversion box in the H-Area tank farm would not impact visual resources.

PF-4 and MFFF Option. At SRS, construction of a transfer bypass line (if needed) around a diversion box in the H-Area tank farm would not impact visual resources. At LANL, visual impacts associated with modification of PF-4 would be the same as described for the PF-4 and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.1.2.2).

PF-4, H-Canyon/HB-Line, and MFFF Option. At SRS, construction of a transfer bypass line (if needed) around a diversion box in the H-Area tank farm would not impact visual resources. At LANL, visual impacts associated with modification of PF-4 would be the same as described for the PF-4, H-Canyon/HB-Line, and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.1.2.2).

4.1.7.1.2.5 WIPP Alternative

PDCF Option. At SRS and similar to the No Action Alternative, PDCF would be constructed with impacts as described in Section 4.1.7.1.2.1 under the No Action Alternative.

PDC Option. At SRS, impacts on visual resources from construction of PDC, and a planned sanitary tie-in connecting K-Area to a lift station at C-Area, would be the same as those for the PDC Option in Section 4.1.7.1.2.3 under the MOX Fuel Alternative.

PF-4 and MFFF Option. At LANL, visual impacts associated with modification of PF-4 would be the same as those for the PF-4 and MFFF Option in Section 4.1.7.1.2.2 under the Immobilization to DWPF Alternative.

PF-4, H-Canyon/HB-Line, and MFFF Option. At LANL, visual impacts associated with modification of PF-4 would be the same as those for the PF-4, H-Canyon/HB-Line, and MFFF Option in Section 4.1.7.1.2.2 under the Immobilization to DWPF Alternative.

4.1.7.2 Geology and Soils

Impacts on geology and soils can occur from disturbance of geologic and soil materials during land clearing, grading, and excavation activities, and the use of geologic and soils materials during facility construction and operations. Disturbance of geologic and soil materials includes excavating rock and soil, soil mixing, soil compaction, and covering building foundations, parking lots, roadways, and fill materials. Geologic and soil materials used as fill during building and road construction include crushed stone, sand, gravel, and soil.

Construction of PDCF at F-Area, PDC at K-Area, and the K-Area immobilization capability at SRS, and modification of PF-4 at LANL, have the potential to affect geology and soils by disturbance of the land surface and by the use of geologic and soil materials. As described in Section 4.1.7.1.1, these facilities would disturb approximately 50 acres (20 hectares), 30 acres (12 hectares), 2 acres (0.8 hectares), and 2 acres (0.8 hectares), respectively. Land disturbance would not occur at the other facilities addressed in this *SPD Supplemental EIS*, including principal support facilities.

Table 4–33 summarizes the geologic and soil materials used during construction for the alternatives and pit disassembly and conversion options evaluated in this *SPD Supplemental EIS*. As described in Appendix H, no new construction is expected, and little or no geologic and soils materials would be needed, for any of the principal plutonium support facilities located at SRS or LANL. Therefore, impacts on geology and soils from these activities are not discussed further in this section.

Table 4–33 Comparison of Geologic and Soil Materials Used During Construction

Geologic and Soil Materials	***Pit Disassembly and Conversion Option***	***Alternative***				
		No Action	***Immobilization to DWPF***	***MOX Fuel***	***HC/HBL to DWPF***	***WIPP***
Crushed stone, sand, and gravel (tons)	PDCF [a]	190,000 (SRS)	190,000 (SRS)	190,000 (SRS)	190,000 (SRS)	190,000 (SRS)
	PDC [a]	N/A	N/A	530,000 (SRS)	530,000 (SRS)	530,000 (SRS)
	PF-4 and MFFF	N/A	1,200 (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)
	PF-4, HC/HBL, and MFFF	N/A	1,200 (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)
Soil (cubic yards)	PDCF [a]	130,000 (SRS)	140,000 (SRS)	130,000 (SRS)	130,000 (SRS)	130,000 (SRS)
	PDC [a]	N/A	N/A	13,000 (SRS)	13,000 (SRS)	13,000 (SRS)
	PF-4 and MFFF	N/A	9,500 (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)
	PF-4, HC/HBL, and MFFF	N/A	9,500 (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)	minimal (SRS) minimal (LANL)

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; LANL = Los Alamos National Laboratory; MOX = mixed oxide; MFFF = Mixed Oxide Fuel Fabrication Facility; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] Under the PDCF and PDC Options, no construction or facility modifications would be needed to enable pit disassembly and conversion of 2 metric tons (2.2 tons) of plutonium at PF-4, with no need for geologic and soils materials at LANL.

Note: Values are rounded to two significant figures. To convert tons to metric tons, multiply by 0.90718; cubic yards to cubic meters, multiply by 0.76456.

Source: Appendix F, Section F.7.2; Appendix G, Section G.7.2.

4.1.7.2.1 No Action Alternative

Construction—As described in Section 4.1.7.1.1.1, construction of PDCF at F-Area at SRS would disturb a total of 50 acres (20 hectares) of previously disturbed land. During construction, best management practices (BMPs), such as silt fences, straw bales, geotextile fabrics, and revegetation, would be used to control erosion. The South Carolina Department of Health and Environmental Control (SCDHEC) requires a Stormwater Pollution Prevention Plan (SWPPP) under the South Carolina National Pollutant Discharge Elimination System (NPDES) General Permit for stormwater discharges from construction activities (Permit Number SCR100000) (NRC 2005a:4-24, 5-2). Because this area has already been disturbed, a limited area of soils would be disturbed at any one time, and BMPs would be used to limit soil erosion, minimal impacts on geology and soils are expected.

Table 4–33 presents the geologic and soil materials used during construction of facilities under the No Action Alternative. Sources of construction materials would include crushed stone, sand, and gravel supplied by regional commercial operations; soils from SRS borrow pits; and soils stockpiled during construction site excavation. The total quantities of these materials would represent small percentages of regionally plentiful resources (USGS 2011a:12.1, 2011b:43.2), and are unlikely to adversely impact SRS geology and soil resources.

Operations—Continued storage of surplus plutonium at K-Area and operation of surplus plutonium facilities would involve no ground disturbance and little or no use of local geologic and soils materials and, therefore, would have no impacts on SRS and LANL geology and soils.

4.1.7.2.2 Immobilization to DWPF Alternative

Construction—As described in Section 4.1.7.1.1.2, construction would disturb a total of 2 to 52 acres (0.8 to 21 hectares) at SRS and up to 2 acres (0.8 hectares) at LANL. As described for the No Action Alternative (Section 4.1.7.2.1), the use of SWPPPs and construction site BMPs would likely result in minimal impacts on SRS and LANL geology and soils.

Table 4–33 presents the geologic materials used during construction of facilities under this alternative. As described for the No Action Alternative, the use of these materials is unlikely to have adverse impacts on SRS and LANL geology and soils.

Operations—Operation of facilities under this alternative would involve no ground-disturbing activities and little or no use of local geologic and soils materials and, therefore, would result in minimal impacts on SRS and LANL geology and soils.

4.1.7.2.3 MOX Fuel Alternative

Construction—As described in Section 4.1.7.1.1.3, construction would disturb up to 50 acres (20 hectares) at SRS and up to 2 acres (0.8 hectares) at LANL. As described for the No Action Alternative, the use of SWPPPs and construction site BMPs would likely result in minimal impacts on SRS and LANL geology and soils.

Table 4–33 presents the geologic materials used during construction of facilities under this alternative. As described for the No Action Alternative, the use of these materials is unlikely to have adverse impacts on SRS and LANL geology and soils.

Operations—Operation of facilities under this alternative would involve no ground-disturbing activities and little or no use of local geologic and soils materials and, therefore, would result in minimal impacts on SRS and LANL geology and soils.

4.1.7.2.4 H-Canyon/HB-Line to DWPF Alternative

The areas of land disturbed and the amounts of geologic and soil materials used would be the same as those under the MOX Fuel Alternative (Section 4.1.7.2.3). Therefore, impacts on geology and soils would be the same.

4.1.7.2.5 WIPP Alternative

The areas of land disturbed and the amounts of geologic and soil materials used would be the same as those under the MOX Fuel Alternative (Section 4.1.7.2.3). Therefore, impacts on geology and soils would be the same.

4.1.7.3 Water Resources

Environmental impacts on water resources under each alternative are herein compared. Environmental impacts would be considered significant if they resulted in:

- Degradation or impairment of water resource quantity or quality (introduction of chemical materials or sediments into the water column) that violates Federal and/or state regulations, quality standards, or existing permits or SWPPPs
- Changes to affected area surface and/or subsurface drainage features that alter waterway courses, system recharge, drainage patterns, and/or exceed the capacity of existing stormwater management systems
- Increases in water supply consumption that may compromise the capacity and/or availability of the water system to meet intended or future needs

No new construction is expected for the principal plutonium support facilities at SRS and LANL (see Appendix H), with no greater than minimal impacts on water resources. Hence, impacts from these activities are not further addressed in this section.

4.1.7.3.1 Surface Water

Surface water resources of concern include rivers, smaller streams, impoundments (lakes, ponds, sloughs, etc.), and springs associated with SRS and/or LANL. Surface water features are discussed in Chapter 3, Sections 3.1.3.1 and 3.2.3.1.

4.1.7.3.1.1 No Action Alternative

Construction—At SRS, construction of PDCF at F-Area may have impacts on surface waters associated with the discharge of stormwater runoff and sediments; however, compliance with the existing South Carolina NPDES General Permit (SCR100000) to develop and implement an SWPPP for PDCF construction would limit the extent and duration of impacts. The SWPPP would identify site-specific BMPs designed to minimize impacts from runoff, soil erosion, sedimentation, and construction-related accidental chemical spills and nonhazardous effluent releases (see Appendix F, Section F.7.3.1.1). There would be no direct release of contaminated effluent during PDCF construction. No long-term changes to stream channel morphology, aquatic habitats, or flow regimes are expected, and the availability of surface water for downstream users would not be limited (WSRC 2008a).

Operations—At SRS, operational nonhazardous wastewater and stormwater runoff from PDCF, MFFF, and plutonium support facilities would be discharged at permitted outfalls and concentrations of regulated pollutants would be at safe levels below NPDES permitted limits (WGI 2005b:129-149; WSRC 2008a); thus, it is expected that potential impacts on surface water quality would be minimal. Surface water sources would not be used to supply water for facility operations; therefore, no decrease in surface water levels or flows is expected. At LANL, nonhazardous wastewater and stormwater runoff from PF-4 and plutonium support facilities would be discharged at permitted outfalls in accordance with NPDES permitted limits (DOE 2008f), with minimal impacts on surface water quality. Surface water sources would not be used to supply water for facility operations.

4.1.7.3.1.2 Immobilization to DWPF Alternative

Construction—

PDCF Option. PDCF construction requirements and resultant impacts on surface water resources would be the same as those under the No Action Alternative (Section 4.1.7.3.1.1). Construction in K-Area to support plutonium immobilization would disturb approximately 2 acres (0.8 hectares) of land. The effects of construction activities on surface water are expected to be minor and short-term. An SWPPP would be developed prior to construction to guide the installation and maintenance of BMPs to minimize the amount of sediment in runoff to surface waters. The management and discharge of construction site runoff would be in compliance with existing stormwater permits (WSRC 2008a). Minor modifications of existing structures at DWPF at S-Area to support vitrification and immobilization of plutonium would have no impacts on surface waters; no additional GWSBs would be required. In the event a buried transfer line is required at the H-Area tank farm, construction BMPs would be used, resulting in minimal potential for surface water impacts (SRNS 2012).

PF-4 and MFFF Option. At SRS, impacts from construction of the K-Area immobilization capability would be the same as those under the PDCF Option, as would impacts from modification of DWPF and from optional installation of a transfer line at the H-Area tank farm. Modification of capabilities at MFFF to support plutonium conversion would be internal to the structure (SRNS 2012), with no potential for erosion or sediment loss that could impact surface waters.

At LANL, modifications to the existing PF-4 in TA-55 would disturb approximately 2 acres (0.8 hectares) of land; this disturbance is expected to have only minor short-term impacts and no long-term impacts on surface water resources. Prior to construction, the LANL Permit Requirements Identification process would be initiated to review and update permit requirements and subject matter experts would be consulted to ensure that appropriate soil erosion, sediment, and runoff control measures are installed and maintained during site construction to prevent and mitigate the potential for surface water impacts (LANL 2012a). There would be no direct release of contaminated effluent during construction.

PF-4, H-Canyon/HB-Line, and MFFF Option. At SRS, impacts from construction of the K-Area immobilization capability would be the same as those under the PDCF Option, as would impacts from modification of DWPF and from optional installation of a transfer line at the H-Area tank farm. Impacts from modification of capabilities at MFFF to support plutonium conversion would be the same as those under the PF-4 and MFFF Option. Modification of equipment within the K-Area Complex and H-Canyon/HB-Line to support pit disassembly and conversion would be similarly within existing structures with no potential for erosion or sediment loss that could impact surface waters. At LANL, impacts would be the same as those discussed in this section under the PF-4 and MFFF Option.

Operations—Under all pit disassembly and conversion options, the potential for surface water impacts would be minimal from operation of PDCF, H-Canyon/HB-Line, the K-Area immobilization capability and pit disassembly capability, MFFF, DWPF, GWSBs, or plutonium support facilities at SRS, and from operation of PF-4 and plutonium support facilities at LANL. Wastewater and stormwater runoff would be managed and discharged in compliance with existing regulations and facility permits that require pollutant concentrations to be limited to safe levels. No decreases in SRS or LANL surface water flows are expected.

4.1.7.3.1.3 MOX Fuel Alternative

Construction—

PDCF Option. At SRS, PDCF construction requirements and resultant impacts on surface water resources would be the same as those under the No Action Alternative (Section 4.1.7.3.1.1). Modifications to H-Canyon/HB-Line to support preparation of some non-pit plutonium for WIPP disposal would occur within the existing structure, with no impacts on surface water resources.

PDC Option. At SRS, construction of PDC at K-Area would disturb approximately 30 acres (12 hectares) and may result in minor, short-term impacts on surface water quality. As required for PDCF construction, an SWPPP would be developed and implemented to prevent and mitigate potential surface water impacts. To meet SCDHEC requirements, the site would be divided into four drainage areas having four stormwater retention basins and outfalls (SRNS 2012). There would be no direct release of contaminated effluent during construction. No long-term changes to stream channel morphology, aquatic habitats, or flow regimes are expected; and the availability of surface water for downstream users would not be limited (WSRC 2008a). Control measures to minimize erosion and sediment loss would be implemented during construction of a planned sanitary tie-in connecting K-Area to a lift station at C-Area, with minimal impacts on surface water resources.

PF-4 and MFFF Option. At SRS, modifications to MFFF to install metal oxidation furnaces would occur within the structure with no additional impacts on surface water resources. At LANL, impacts on surface water resources would be minimal as discussed for the PF-4 and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.3.1.2).

PF-4, H-Canyon/HB-Line, and MFFF Option. At SRS, modification of capabilities at MFFF to support plutonium conversion would be internal to the structure (SRNS 2012), with no potential for erosion or sediment loss that could impact surface waters. Modification of equipment within the K-Area Complex and H-Canyon/HB-Line to support pit disassembly and conversion would be similarly within existing structures with no potential for erosion or sediment loss that could impact surface waters. At LANL, impacts on surface water resources would be minimal as discussed for the PF-4 and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.3.1.2).

Operations—Under all pit disassembly and conversion options, the potential for surface water impacts would be minimal from operation of PDCF, PDC, H-Canyon/HB-Line, MFFF, DWPF, GWSBs, or plutonium support facilities at SRS, and from operation of PF-4 and plutonium support facilities at LANL. Wastewater and stormwater runoff would be managed and discharged in compliance with existing regulations and facility permits that require pollutant concentrations to be limited to safe levels. No decreases in SRS or LANL surface water flows are expected.

4.1.7.3.1.4 H-Canyon/HB-Line to DWPF Alternative

Construction—

PDCF Option. At SRS, PDCF construction requirements and resultant impacts on surface water resources would be the same as those under the No Action Alternative (Section 4.1.7.3.1.1). Modifications to H-Canyon/HB-Line to support preparation of non-pit plutonium for dissolution with subsequent vitrification at DWPF would occur within the existing structure, with no impacts on surface water resources.

PDC Option. At SRS, impacts from construction of PDC and installation of a planned sanitary tie-in connecting K-Area to a lift station at C-Area would be the same as those discussed for this option under the MOX Fuel Alternative (Section 4.1.7.3.1.3). Modifications to H-Canyon/HB-Line to support preparation of non-pit plutonium for dissolution with subsequent vitrification at DWPF would occur within the existing structure, with no impacts on surface water resources.

PF-4 and MFFF Option. At SRS, modifications to H-Canyon/HB-Line to support preparation of non-pit plutonium for dissolution with subsequent vitrification at DWPF would occur within the existing structure, with no impacts on surface water resources. Modifications to MFFF to install metal oxidation furnaces would occur within the structure, with no additional impacts on surface water resources. At LANL, impacts on surface water resources would be minimal as discussed for the PF-4 and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.3.1.2).

PF-4, H-Canyon/HB-Line, and MFFF Option. At SRS, modification of capabilities at MFFF to support plutonium conversion would be internal to the structure (SRNS 2012), with no potential for erosion or sediment loss that could impact surface waters. Modification of equipment within the K-Area Complex and H-Canyon/HB-Line to support pit disassembly and conversion, or for dissolution of non-pit plutonium with subsequent vitrification at DWPF, would be similarly within existing structures with no potential for erosion or sediment loss that could impact surface waters. At LANL, impacts on surface water resources would be minimal as discussed for the PF-4 and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.3.1.2).

Operations—Potential surface water impacts from SRS and LANL facility operations would be the same as those under the MOX Fuel Alternative (Section 4.1.7.3.1.3).

4.1.7.3.1.5 WIPP Alternative

PDCF Option – At SRS, PDCF construction requirements and resultant impacts on surface water resources would be the same as those under the No Action Alternative (Section 4.1.7.3.1.1). Modifications to H-Canyon/HB-Line to support preparation of non-pit plutonium for disposal at WIPP would occur within the existing structure, with no impacts on surface water resources.

PDC Option – At SRS, impacts from construction of PDC at K-Area and installation of a planned sanitary tie-in connecting K-Area to a lift station at C-Area would be the same as those discussed for this option under the MOX Fuel Alternative (Section 4.1.7.3.1.3). Modifications to H-Canyon/HB-Line to support preparation of non-pit plutonium for disposal at WIPP would occur within the existing structure, with no impacts on surface water resources.

PF-4 and MFFF Option. At SRS, modifications to H-Canyon/HB-Line to support preparation of non-pit plutonium for disposal at WIPP would occur within the existing structure, with no impacts on surface water resources. Modifications to MFFF to install metal oxidation furnaces would also occur within the structure with no additional impacts on surface water resources. At LANL, impacts on surface water resources would be minimal as discussed for the PF-4 and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.3.1.2).

PF-4, H-Canyon/HB-Line, and MFFF Option. At SRS, modification of capabilities at MFFF to support plutonium conversion would be internal to the structure, with no potential for erosion or sediment loss that could impact surface waters. Modification of equipment within the K-Area Complex and

H-Canyon/HB-Line to support pit disassembly and conversion, or to prepare non-pit plutonium for disposal at WIPP, would be similarly within existing structures with no potential for erosion or sediment loss that could impact surface waters. At LANL, impacts on surface water resources would be minimal as discussed for the PF-4 and MFFF Option under the Immobilization to DWPF Alternative (Section 4.1.7.3.1.2).

Operation—Potential surface water impacts from SRS and LANL facility operations would be the same as those under the MOX Fuel Alternative (Section 4.1.7.3.1.3).

4.1.7.3.2 Groundwater

This section analyzes impacts on groundwater resources resulting from facility construction and/or modification and operations under each alternative. Groundwater features of concern include near-surface groundwater associated with water tables and aquifers (see Chapter 3, Sections 3.1.3.2 and 3.2.3.2). Water supply describes the utility systems used to access water resources and distribute potable and nonpotable water to support site processes and personnel.

SRS water supply sources for domestic, sanitary, and process water include groundwater and river water; groundwater is the source of potable water for SRS (NRC 2005a:3-11). The LANL water supply is drawn from the regional aquifer (LANL 2005: 2-103).

4.1.7.3.2.1 No Action Alternative

Construction—Construction of PDCF would require less than 1 percent of SRS's available water capacity (see Section 4.1.7.7.1) with no long-term impacts expected on the SRS water supply. Potential impacts on groundwater quality would be minimized by implementation of an SWPPP for facility construction as described in Section 4.1.7.3.1.1. Short of direct connectivity to groundwater afforded by well heads, karst features, springs, or other recharge features, pollution of groundwater would most likely occur from the infiltration and permeation of contaminated stormwater runoff and chemical materials from accidental spills into and through the soil and into the underlying groundwater. The management of surface water runoff and prevention of accidental spills and effluent releases addressed by SWPPPs would not only minimize potential impacts on surface waters but also reduce the potential for contaminating near-surface water tables or aquifers.

Operation—Operations under this alternative would require about 2 percent of the available water capacity at SRS and less than 1 percent of the available water capacity at LANL (see Section 4.1.7.7.1). No long-term impacts are expected on the available capacity at either SRS or LANL. No impacts on groundwater quality are expected from facility operations, because no direct discharge of liquid effluents to groundwater during facility operation is expected. In addition, because all regulated industrial wastewater and stormwater runoff would be discharged at safe levels well below NPDES permitted limits, impacts on groundwater would be minimized for the same reasons as those discussed above for facility construction (DOE 2008f; WGI 2005b:129-149; WSRC 2008a).

4.1.7.3.2.2 Immobilization to DWPF Alternative

Construction—At SRS, construction activities would require less than 1 percent of SRS's available water capacity under any of the pit disassembly and conversion options (see Section 4.1.7.7.2). Construction would have no long-term impacts on SRS available capacity. Because no liquid effluents would be directly discharged to groundwater during construction (WSRC 2008a), no impacts on groundwater quality are expected.

At LANL, there would be no long-term impacts on LANL water supply available capacity or adverse effects on groundwater quality. Modifications to PF-4 under two pit disassembly conversion options would require less than 1 percent of LANL's available water capacity. Implementation of the Permit Requirements Identification process as described in Section 4.1.7.3.1.2 would minimize potential impacts on surface water quality; this is because pollution of groundwater would most likely occur from the infiltration and permeation of contaminated stormwater runoff and chemical materials from accidental spills into and through the soil and into the underlying groundwater. The management of surface water runoff and prevention of accidental spills and effluent releases would not only minimize potential impacts on surface waters but also reduce the potential for contaminating near-surface water tables or aquifers. In addition, the extent of alluvium and intermediate perched groundwater and hundreds of feet of underlying dry bedrock would restrict the volumetric recharge contribution to the regional aquifer (DOE 2011g:3-35; LANL 2011d:5-4).

Operation—Operations are expected to require about 2 percent of SRS's available water capacity and 1 percent of LANL's available water capacity (see Section 4.1.7.7.2). As under the No Action Alternative (Section 4.1.7.3.2.1), no impacts on groundwater quality are expected from operations because there would be no direct discharge of liquid effluents to groundwater at either site and all regulated industrial wastewater and stormwater runoff would be discharged at safe levels well below NPDES permitted limits. Thus, no long-term impacts on SRS or LANL available capacity and quality are expected.

4.1.7.3.2.3 MOX Fuel Alternative

Construction—At SRS, construction activities would require less than 1 percent of SRS's available water capacity under any of the pit disassembly and conversion options (see Section 4.1.7.7.3), with no long-term impacts on SRS available capacity. Because no liquid effluents would be directly discharged to groundwater during construction (WSRC 2008a) no impacts on groundwater quality are expected.

At LANL, water use for optional modification of PF-4 would be the same as that under the Immobilization to DWPF Alternative (Section 4.1.7.3.2.2), with no long-term impacts on LANL water supply available capacity or adverse effects on groundwater quality.

Operations—Operations are expected to require up to 2 percent of SRS's available water capacity and 1 percent of LANL's available water capacity (see Section 4.1.7.7.3). As under the Immobilization to DWPF Alternative (Section 4.1.7.3.2.2), no long-term impacts on SRS or LANL available capacity or groundwater quality are expected.

4.1.7.3.2.4 H-Canyon/HB-Line to DWPF Alternative

Construction—The water needed for plutonium facility construction at SRS and LANL is the same as that for the MOX Fuel Alternative (see Sections 4.1.7.3.2.3 and 4.1.7.7.3), with no long-term impacts expected on available capacity or groundwater quality.

Operations— The water needed for plutonium facility operations at SRS and LANL is the same as that for the MOX Fuel Alternative (see Sections 4.1.7.3.2.3 and 4.1.7.7.3), with no long-term impacts expected on available capacity or groundwater quality.

4.1.7.3.2.5 WIPP Alternative

Construction—The water needed for plutonium facility construction at SRS and LANL is the same as that for the MOX Fuel Alternative (see Sections 4.1.7.3.2.3 and 4.1.7.7.3), with no long-term impacts expected on available capacity or groundwater quality.

Operations— The water needed for plutonium facility operations at SRS and LANL is the same as that for the MOX Fuel Alternative (see Sections 4.1.7.3.2.3 and 4.1.7.7.3), with no long-term impacts expected on available capacity or groundwater quality.

4.1.7.4 Noise

Activities under the alternatives would result in noise from vehicles, construction equipment, and facility operations. The change in noise levels was considered for construction and operation of the plutonium facilities.

4.1.7.4.1 No Action Alternative

Construction—Construction noise associated with this alternative would be similar to that described in the *SPD EIS* for construction of PDCF (DOE 1999b). Noise sources during construction of PDCF at SRS would include bulldozers, graders, dump trucks, and other vehicles. Impacts from onsite noise sources would be small, and construction traffic noise impacts would be unlikely to result in increased public annoyance (DOE 1999b:4-52). Any change in traffic noise associated with construction would occur on site and along offsite local and regional transportation routes.

Operations—At SRS, noise sources during operation of MFFF, PDCF, and WSB could include diesel generators, cooling systems, vents, motors, material-handling equipment, and trucks and employee vehicles. Given the distances to site boundaries (about 5.4 miles [8.7 kilometers] from F-Area, for example), noise from facility operations is not expected to result in public annoyance. Non-traffic noise sources are far enough away from offsite areas that the contribution to offsite noise levels would be small. Noise from traffic associated with the operation of facilities is expected to increase by less than 1 decibel as a result of the increase in staffing under this alternative. Some noise sources could have onsite noise impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats. Some change in the noise levels to which noninvolved workers are exposed could occur. At LANL, there would be no change in current planned operations at PF-4, and thus no change in noise impacts. At SRS and LANL, appropriate noise control measures would be implemented under DOE Order 440.1B, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees*, to protect worker hearing.

4.1.7.4.2 Immobilization to DWPF Alternative

Construction—At SRS, construction noise impacts under this alternative would be similar to those under the No Action Alternative (Section 4.1.7.4.1). At LANL, noise impacts from optional modifications to PF-4 at LANL would be minor (LANL 2012a).

Operations—At SRS, noise impacts due to operation of facilities would be similar to those under the No Action Alternative. At LANL, additional activities under two pit disassembly and conversion options would take place within the existing PF-4, and there would be little to no change in noise from equipment such as diesel generators; the only change in noise impacts is expected to result from additional trucks and employee vehicles. These impacts are expected to be minor. As under the No Action Alternative (Section 4.1.7.4.1), at SRS and LANL, appropriate noise control measures would be implemented under DOE Order 440.1B to protect worker hearing.

4.1.7.4.3 MOX Fuel Alternative

Construction—Construction noise impacts under this alternative would be similar to those under the Immobilization to DWPF Alternative (Section 4.1.7.4.2).

Operations—Operations noise impacts under this alternative would be similar to those under the Immobilization to DWPF Alternative (Section 4.1.7.4.2).

4.1.7.4.4 H-Canyon/HB-Line to DWPF Alternative

Construction—Construction noise impacts under this alternative would be similar to those under the Immobilization to DWPF Alternative (Section 4.1.7.4.2).

Operations—Operations noise impacts under this alternative would be similar to those under the Immobilization to DWPF Alternative (Section 4.1.7.4.2).

4.1.7.4.5 WIPP Alternative

Construction—Construction noise impacts under this alternative would be similar to those under the Immobilization to DWPF Alternative (Section 4.1.7.4.2).

Operations—Operations noise impacts under this alternative would be similar to those under the Immobilization to DWPF Alternative (Section 4.1.7.4.2).

4.1.7.5 Ecological Resources

This section addresses potential impacts on ecological resources, including terrestrial and aquatic resources, wetlands, and threatened and endangered species. Impacts on ecological resources are generally related to land disturbance activities that could occur during construction; little or no impacts would occur during operations. Ecological resources would not be further affected because additional land would not be disturbed during facility operations, and any artificial lighting and noise-producing activities would occur in areas that are already in industrial use. Therefore, this section only describes the impacts from construction of PDCF at F-Area, PDC at K-Area, and the K-Area immobilization capability at SRS, and impacts from modifications to PF-4 at LANL under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option. As summarized in Table 4–32, only construction or modification of these facilities would involve land-disturbing activities.

At SRS, construction of PDCF at F-Area, PDC at K-Area, and the K-Area immobilization capability have the potential to affect ecological resources by disturbance of the land surface. As described in Section 4.1.7.1.1, these facilities would disturb approximately 50 acres (20 hectares), 30 acres (12 hectares), and 2 acres (0.8 hectares), respectively. Land disturbance would not occur at the other pit disassembly and conversion and plutonium disposition facilities addressed in this *SPD Supplemental EIS.* All construction would be conducted consistent with the *Natural Resources Management Plan for the Savannah River Site* (DOE 2005b).

At LANL, modification of PF-4 at LANL under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option would disturb up to 2 acres (0.8 hectares) of land. During facility modification, the project would go through the LANL Permit Requirements Identification process, and compliance requirements would be identified and implemented to ensure that no natural resources would be impacted. Threatened and endangered species would be protected in accordance with the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2011a).

As described in Appendix H, no new construction is expected at the principal plutonium support facilities at SRS or LANL, and no impacts on ecological resources are expected during their operation. Therefore, impacts on ecological resources from construction and operation of the principal plutonium support facilities at SRS and LANL are not discussed further in this section.

4.1.7.5.1 No Action Alternative

Construction—As described in Section 4.1.7.1.1.1, PDCF would be constructed, disturbing about 50 acres (20 hectares) of land at F-Area. This area has already been cleared. Thus, construction of PDCF would not cause additional impacts on terrestrial resources. No aquatic resources or wetlands exist within the disturbed area required for the construction and operation of PDCF (WSRC 2008a). An SWPPP would be implemented during construction to minimize the amount of soil erosion and sedimentation that could be transported from the construction area. Control measures would include sediment fences and minimizing the amount of time that bare soil would be exposed. Therefore, any impacts on aquatic resources (including streams, lakes, or ponds) or wetlands would be minimized. During construction, BMPs such as silt fences, straw bales, geotextile fabrics, and revegetation would be used to control erosion, thus further limiting and mitigating any potential impacts on ecological resources. Construction of PDCF would take place on already disturbed land where no threatened or endangered species are known to forage, breed, nest, or occur. Because no threatened or endangered species occur within or nearby the area surrounding the proposed construction site, they would not be affected by noise from construction activities. Therefore, no impacts on threatened or endangered species are expected (WSRC 2008a; NRC 2005a:4-105). There would be no new construction at H-, K-, or S-Areas that would affect ecological resources.

Operations—Continued storage of surplus plutonium at K-Area and operation of surplus plutonium facilities would involve no ground disturbance and therefore, would have no impacts on ecological resources at SRS and LANL.

4.1.7.5.2 Immobilization to DWPF Alternative

Construction—As described in Section 4.1.7.1.1.2, construction would disturb a total of 2 to 52 acres (0.8 to 21 hectares) at SRS and up to 2 acres (0.8 hectares) at LANL. All of the land needed for construction at SRS has already been disturbed, and the preference at LANL would be to avoid previously undisturbed land. In addition, the use of SWPPPs and construction site BMPs as described for the No Action Alternative (Section 4.1.7.5.1), and implementation of other procedures and plans such as those discussed in the opening paragraphs of this section, would likely result in minimal impacts on SRS and LANL ecological resources.

Operations—Operation of facilities under this alternative would involve no ground-disturbing activities and, therefore, would result in minimal impacts on ecological resources at SRS and LANL.

4.1.7.5.3 MOX Fuel Alternative

Construction—As described in Section 4.1.7.1.1.3, construction would disturb up to 50 acres (20 hectares) at SRS and up to 2 acres (0.8 hectares) at LANL. The majority of land needed for construction to support SRS and LANL has already been disturbed. Construction of PDC at K-Area at SRS would require the clearing of 5 acres (2 hectares) of wooded land. In addition, the use of SWPPPs and construction site BMPs as described for the No Action Alternative (Section 4.1.7.5.1), and implementation of other procedures and plans, such as those discussed in the opening paragraphs of this section, would likely result in minimal impacts on SRS and LANL ecological resources.

Operations—Operation of facilities under this alternative would involve no ground-disturbing activities and, therefore, would result in minimal impacts on ecological resources at SRS and LANL.

4.1.7.5.4 H-Canyon/HB-Line to DWPF Alternative

The areas of land disturbed under this alternative would be the same as those under the MOX Fuel Alternative (Section 4.1.7.5.3). Therefore, impacts on ecological resources at SRS and LANL would be the same.

4.1.7.5.5 WIPP Alternative

The areas of land disturbed under this alternative would be the same as those under the MOX Fuel Alternative (Section 4.1.7.5.3). Therefore, impacts on ecological resources at SRS and LANL would be the same.

4.1.7.6 Cultural Resources

The analysis of impacts on cultural resources, including prehistoric, historic, American Indian, and paleontological, addresses potential impacts at SRS and LANL primarily from land disturbance activities associated with construction. The potential for the alternatives to impact cultural resources was assessed by comparing the locations of known cultural resources to the areas of potential effect from the alternatives.

New construction is associated with PDCF at F-Area, PDC at K-Area, and the immobilization capability in K-Area at SRS, and pit disassembly and conversion activities in PF-4 in TA-55 at LANL. As described in Appendix H, no new construction is expected at the principal SRS and LANL plutonium support facilities. Therefore, impacts on cultural resources from plutonium support activities at SRS and LANL are not discussed in this section.

4.1.7.6.1 No Action Alternative

Construction—PDCF would be constructed on 50 acres (20 hectares) within F-Area at SRS. Before construction of MFFF began, this entire area was surveyed for cultural resources and 15 prehistoric sites were identified as described in Appendix F, Section F.7.6.1. Data recovery of these sites was completed, as well as appropriate monitoring, which ensures that DOE, through the Savannah River Archaeological Research Program (SRARP), exceeded the recommendations in the data recovery plans (NRC 2005a:App. B) and met the terms of the Memorandum of Agreement (SRARP 1989:App. C) regarding mitigation of impacts on archaeological sites within the surplus plutonium disposition facilities project area (King 2010).

In addition, 75 acres (30 hectares) in F-Area were surveyed during 2008 and 2009 for the purpose of constructing a laydown yard for the proposed PDCF. This fieldwork located four of five previously recorded sites and identified a new site, as well as five artifacts. Because the artifacts have no research potential there would be no adverse impact; however, two sites are potentially eligible for nomination to the National Register of Historic Places (NRHP) so it is recommended that they be avoided. SRARP personnel are expecting an amended site use permit to facilitate this recommendation (SRARP 2009:10-12).

There would be no new construction in H-, K-, or S-Areas at SRS, or at PF-4 in TA-55 at LANL. Therefore, no impacts on cultural resources are expected at SRS or LANL.

Operations—Continued storage of surplus plutonium in K-Area, and operation of surplus plutonium disposition facilities, would involve no land disturbance; therefore, no impacts on cultural resources are expected at SRS or LANL.

4.1.7.6.2 Immobilization to DWPF Alternative

Construction—Under this alternative, a number of new structures would be constructed within the industrial portion of K-Area to support a new immobilization capability. During construction, these facilities could occupy approximately 2 acres (0.8 hectares) of land associated with the immobilization capability. Because construction would take place within the built-up portion of K-Area and previous archeological reviews did not reveal any identified sites where land disturbance would occur, impacts on cultural resources are unlikely. There are several NRHP-eligible structures in K-Area, so proposed changes to the historic fabric of these buildings and structure, or to any intact historically significant equipment, would be studied, discussed with the South Carolina State Historic Preservation Office (SHPO), and avoided, mitigated, or minimized (DOE 2005a:16). There would be no impacts on cultural resources in S-Area at SRS because minor modifications would take place within an existing facility (DWPF) that is not an NRHP-eligible property (SRR 2009).

At SRS, PDCF construction under the PDCF Option would occur on 50 acres (20 hectares) within F-Area with impacts on cultural resources as described for the No Action Alternative (Section 4.1.7.6.1). Modifications to K-Area and H-Area would occur under the PF-4, H-Canyon/HB-Line, and MFFF Option. Modifications to K-Area would involve replacement of non-historic equipment, and thus would have negligible impacts on cultural resources, while the modifications to H-Area would be more extensive. The H-Canyon building, including HB-Line, and any other attached auxiliaries have been identified as NRHP-eligible individually, and collectively, within the context of the Cold War Historic District. The H-Canyon building and its auxiliary facilities are considered highly significant given that these structures were primary to SRS's mission and housed one of the site's nuclear production processes (DOE 2005a:39, 58, 61, 66). Photographic mitigation and oral histories have been initiated, and when completed, will be distributed to the South Carolina SHPO to determine what, if any, further action is required to preserve the historical integrity of these facilities (DOE 2008c:4). The proposed facility modifications would be accessed in accordance with the *Cold War Historic Preservation Program* (Sauerborn 2011). Modifications to MFFF under the PF-4 and MFFF Option would be internal to a new facility, with no impacts on cultural resources.

At LANL, modification of PF-4 under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option would disturb up to 2 acres (0.8 hectares) of land in TA-55 for a temporary trailer and construction parking. Although a site has not been identified for these facilities, preference would be given to previously disturbed land. The project would go through the LANL Permit Requirements

Identification process, and compliance requirements would be identified and implemented, taking into account the potential for impacts on cultural resources; in particular, there are two archeological sites within TA-55 that have been identified as eligible or potentially eligible for listing on the NRHP (DOE 2011g:3-44). Modifications to PF-4 would also conform to requirements presented in *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (LANL 2006c).

Operations—Operation of facilities under this alternative would involve no land disturbance; therefore, no impacts on cultural resources are expected at SRS or LANL.

4.1.7.6.3 MOX Fuel Alternative

Construction—At SRS, PDCF construction under the PDCF Option would occur on 50 acres (20 hectares) within F-Area with impacts on cultural resources as described for the No Action Alternative (Section 4.1.7.6.1). Construction of PDC under the PDC Option would take place within K-Area, disturbing about 30 acres (12 hectares). The majority of this land is disturbed with the exception of approximately 5 acres (2 hectares) that are currently wooded. Because previous archeological reviews did not reveal any identified sites where land disturbance would occur, impacts on cultural resources are unlikely. Although six archeological sites have been identified in the vicinity of the project boundary, none would be disturbed (DOE 2005d:13-14; SRARP 2006:10; Blunt 2010). There are several NRHP-eligible structures in K-Area, however, so proposed changes to the historic fabric of buildings and structures, or to any intact historically significant equipment, would be studied, discussed with the South Carolina SHPO, and avoided, mitigated, or minimized (DOE 2005a:16).

An additional activity planned under the PDC Option is construction of a 2-mile (3.2-kilometer) sanitary tie-in connecting K-Area to a lift station in C-Area. Although the exact route is undetermined at this time, it would likely use existing easements; thus, it is not expected to impact cultural resources. This would be verified prior to construction through the SRS site use process and, if necessary, cultural resource surveys would be conducted (Reddick 2010; SRARP 1989:App. C).

Impacts on cultural resources as a result of modifications to MFFF under the PF-4 and MFFF Option and H-Canyon/HB-Line and K-Area under the PF-4, H-Canyon/HB-Line, and MFFF Option would be the same as those under the Immobilization to DWPF Alternative (Section 4.1.7.6.2).

At LANL, impacts on cultural resources as a result of modifications to PF-4 under the PF-4, H-Canyon/HB-Line, and MFFF Option would be the same as those under the Immobilization to DWPF Alternative (Section 4.1.7.6.2).

Operations—Operation of facilities under this alternative would involve no land disturbance; therefore, no impacts on cultural resources are expected at SRS or LANL.

4.1.7.6.4 H-Canyon/HB-Line to DWPF Alternative

Facility construction and modification activities would be the same as those under the MOX Fuel Alternative in Section 4.1.7.6.3, except for the possible installation of a buried transfer line at the H-Area tank farm. This activity would occur in a previously disturbed area with no impacts expected on cultural resources. Impacts on cultural resources during construction and operations would thus be the same.

4.1.7.6.5 WIPP Alternative

Facility construction and modification activities would be the same as those under the MOX Fuel Alternative in Section 4.1.7.6.3. Impacts on cultural resources during construction and operations would thus be the same.

4.1.7.7 Infrastructure

Impacts on infrastructure requirements at SRS and LANL could occur principally as a result of construction of PDCF at F-Area, PDC at K-Area, and the K-Area immobilization capability at SRS, and modification of PF-4 at LANL. Ongoing construction of the MFFF and WSB is not considered in this *SPD Supplemental EIS* because impacts from this construction have been previously assessed. There would be no new construction at the principal SRS and LANL plutonium support facilities.

Table 4–34 summarizes the additional peak annual infrastructure requirements at SRS and LANL related to construction for the alternatives and pit disassembly and conversion options evaluated in this *SPD Supplemental EIS*.

Table 4–34 Comparison of Peak Annual Infrastructure Requirements During Construction [a, b, c]

Resource	*Pit Disassembly and Conversion Option*	*Alternative*				
		No Action	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
Electricity (megawatt-hours)	PDCF	15,000 (SRS)	24,000 (SRS)	15,000 (SRS)	15,000 (SRS)	15,000 (SRS)
	PDC	N/A	N/A	9,400 (SRS)	9,400 (SRS)	9,400 (SRS)
	PF-4 and MFFF [d]	N/A	9,000 (SRS) 80 (LANL)	minimal (SRS) 80 (LANL)	minimal (SRS) 80 (LANL)	minimal (SRS) 80 (LANL)
	PF-4, HC/HBL, and MFFF [e]	N/A	9,000 (SRS) 80 (LANL)	minimal (SRS) 80 (LANL)	minimal (SRS) 80 (LANL)	minimal (SRS) 80 (LANL)
Water (gallons)	PDCF	2,600,000 (SRS)	2,600,000 (SRS)	2,600,000 (SRS)	2,600,000 (SRS)	2,600,000 (SRS)
	PDC	N/A	N/A (SRS)	1,100,000 (SRS)	1,100,000 (SRS)	1,100,000 (SRS)
	PF-4 and MFFF [d]	N/A	2,000 (SRS) 340,000 (LANL)	minimal (SRS) 340,000 (LANL)	minimal (SRS) 340,000 (LANL)	minimal (SRS) 340,000 (LANL)
	PF-4, HC/HBL, and MFFF [e]	N/A	2,000 (SRS) 340,000 (LANL)	minimal (SRS) 340,000 (LANL)	minimal (SRS) 340,000 (LANL)	minimal (SRS) 340,000 (LANL)
Fuel oil (gallons)	PDCF	390,000 (SRS)	400,000 (SRS)	390,000 (SRS)	390,000 (SRS)	390,000 (SRS)
	PDC	N/A	N/A	300,000 (SRS)	300,000 (SRS)	300,000 (SRS)
	PF-4 and MFFF [d]	N/A	5,000 (SRS) 2,800 (LANL)	minimal (SRS) 2,800 (LANL)	minimal (SRS) 2,800 (LANL)	minimal (SRS) 2,800 (LANL)
	PF-4, HC/HBL, and MFFF [e]	N/A	5,000 (SRS) 2,800 (LANL)	minimal (SRS) 2,800 (LANL)	minimal (SRS) 2,800 (LANL)	minimal (SRS) 2,800 (LANL)

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; LANL = Los Alamos National Laboratory; MOX = mixed oxide; MFFF = Mixed Oxide Fuel Fabrication Facility; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] As described in Appendix F, modification of H-Canyon/HB-Line and the addition of metal oxidation furnaces to MFFF at SRS would result in the requirement for little or no electricity, water, or fuel oil, with minimal impacts on infrastructure at these sites. There would be little to no additional resource use at LANL for minor upgrades to PF-4 under the No Action Alternative and the PDCF and PDC Options under the action alternatives.

[b] As described in Appendix G, construction of a K-Area immobilization capability would result in higher peak annual construction requirements related to this capability at SRS.

[c] As described in Appendix H, no new construction would be needed at any of the principal plutonium support facilities at SRS or LANL, with no impacts on infrastructure.

[d] Under this option, pits would be disassembled at PF-4 at LANL. Pits disassembled at LANL would be converted to plutonium oxide at LANL or using H-Canyon/HB-Line or metal oxidation furnaces installed in MFFF.

[e] Under this option, pits could be disassembled at PF-4 at LANL or at K-Area at SRS. Pits disassembled at PF-4 would be converted to plutonium oxide at LANL or SRS. Pits disassembled at K-Area at SRS would be converted to plutonium oxide at SRS at H-Canyon/HB-Line.

Note: Values are rounded to two significant figures. To convert gallons to liters, multiply by 3.7854.

Source: Appendix F, Section F.7.7; Appendix G, Section G.7.7.

Impacts also could occur because of changes in operational requirements at SRS and LANL. **Table 4–35** summarizes the additional peak annual infrastructure requirements at SRS and LANL related to operations.

Table 4–35 Comparison of Peak Annual Infrastructure Requirements During Operations

		Alternative				
Resource	*Pit Disassembly and Conversion Option*	*No Action*	*Immobilization to DWPF*	*MOX Fuel*	*HC/HBL to DWPF*	*WIPP*
Electricity (megawatt-hours)	PDCF	270,000 (SRS) 960 (LANL)	310,000 (SRS) 960 (LANL)	270,000 (SRS) 960 (LANL)	270,000 (SRS) 960 (LANL)	270,000 (SRS) 960 (LANL)
	PDC	N/A	N/A	220,000 (SRS) 960 (LANL)	220,000 (SRS) 960 (LANL)	220,000 (SRS) 960 (LANL)
	PF-4 and MFFF	N/A	220,000 (SRS) 1,900 (LANL)	170,000 (SRS) 1,900 (LANL)	170,000 (SRS) 1,900 (LANL)	170,000 (SRS) 1,900 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	220,000 (SRS) 1,900 (LANL)	180,000 (SRS) 1,900 (LANL)	180,000 (SRS) 1,900 (LANL)	180,000 (SRS) 1,900 (LANL)
Water (gallons)	PDCF	41,000,000 (SRS) 480,000 (LANL)	58,000,000 (SRS) 480,000 (LANL)	41,000,000 (SRS) 480,000 (LANL)	41,000,000 (SRS) 480,000 (LANL)	41,000,000 (SRS) 480,000 (LANL)
	PDC	N/A	N/A	41,000,000 (SRS) 480,000 (LANL)	41,000,000 (SRS) 480,000 (LANL)	41,000,000 (SRS) 480,000 (LANL)
	PF-4 and MFFF	N/A	42,000,000 (SRS) 1,200,000 (LANL)	25,000,000 (SRS) 1,200,000 (LANL)	25,000,000 (SRS) 1,200,000 (LANL)	25,000,000 (SRS) 1,200,000 (LANL)
	PF-4, HC/HBL, and MFFF	N/A	42,000,000 (SRS) 1,200,000 (LANL)	25,000,000 (SRS) 1,200,000 (LANL)	25,000,000 (SRS) 1,200,000 (LANL)	25,000,000 (SRS) 1,200,000 (LANL)
Fuel oil (gallons) [a]	PDCF	320,000 (SRS)	340,000 (SRS)	320,000 (SRS)	320,000 (SRS)	320,000 (SRS)
	PDC	N/A	N/A	450,000 (SRS)	450,000 (SRS)	450,000 (SRS)
	PF-4 and MFFF	N/A	300,000 (SRS)	280,000 (SRS)	280,000 (SRS)	280,000 (SRS)
	PF-4, HC/HBL, and MFFF	N/A	300,000 (SRS)	280,000 (SRS)	280,000 (SRS)	280,000 (SRS)

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] Values are for SRS only. Under any option, no additional fuel oil would be required at LANL to support PF-4 operations because these requirements are connected with the testing of diesel generators in TA-55 and these requirements would not change as a result of additional pit disassembly and conversion activities.

Note: Values are rounded to two significant figures. To convert gallons to liters, multiply by 0.2642.

Source: Appendix F, Section F.7.7; Appendix G, Section G.7.7; Appendix H, Sections H.1.7.3 and H.2.

4.1.7.7.1 No Action Alternative

Construction—As described in Appendix F, construction of PDCF at F-Area at SRS would require the use of additional electricity, water, and fuel oil.

As shown in Table 4–34, an annual estimated 15,000 megawatt-hours of electricity, 2.6 million gallons (9.8 million liters) of water, and 390,000 gallons (1.5 million liters) of fuel oil would be required to support construction under this alternative. These requirements would represent less than 1 percent of SRS's available electrical capacity (4.1 million megawatt-hours) and available water capacity (2.63 billion gallons [9.96 billion liters]) (see Chapter 3, Section 3.1.9). Fuel oil usage is not limited by site capacity because fuel oil is delivered to the site as needed. However, these construction requirements would represent approximately 95 percent of SRS's current annual fuel usage (about 410,000 gallons [1.6 million liters] per year).

Operations—Continued storage of surplus plutonium at K-Area, and operation of PDCF at F-Area, MFFF at F-Area, and support facilities at SRS would require an annual estimated 270,000 megawatt-hours of electricity, 41 million gallons (160 million liters) of water, and 320,000 gallons (1.2 million liters) of fuel oil, annually, as shown in Table 4–35. These requirements represent about 7 percent of SRS's available electrical capacity and 2 percent of the site's available water capacity. Fuel oil usage would represent approximately 78 percent of SRS's current annual fuel usage.

Pit disassembly and conversion at PF-4 would annually require about 960 megawatt-hours of electricity and 480,000 gallons (1,800,000 liters) of water. These requirements would each represent less than 1 percent of LANL's current annual available capacities of 352,000 megawatt-hours and 114 million gallons (432 million liters) (Chapter 3, Section 3.2.9). This is a very conservative comparison because the electrical capacity of the entire service area is much larger (1,226,000 megawatt-hours per year), as are DOE's leased water rights (542 million gallons [2.05 billion liters]). No additional fuel oil would be required at LANL to support PF-4 operations since these requirements are connected with the testing of emergency diesel generators in TA-55 and these requirements would not change as a result of pit disassembly and conversion activities. There would be no change in resource use at the principal LANL plutonium support facilities.

4.1.7.7.2 Immobilization to DWPF Alternative

Construction—Construction of PDCF at F-Area and the K-Area immobilization capability at SRS would require the use of additional electricity, water, and fuel oil. In addition to the option of building a new PDCF, options are being considered for pit disassembly and conversion whereby existing facilities at LANL (PF-4) and SRS (the K-Area Complex, H-Canyon/HB-Line, and the addition of metal oxidation furnaces to MFFF) would be modified to support pit disassembly and conversion activities. These options are expected to result in lower construction requirements compared to those required to support construction of PDCF (see Appendix F).

As shown in Table 4–34, an estimated 9,000 to 24,000 megawatt-hours of electricity, 2,000 to 2.6 million gallons (7,600 to 9.8 million liters) of water, and 5,000 to 400,000 gallons (19,000 to 1.5 million liters) of fuel oil would be required annually to support construction under this alternative at SRS. Under any of the pit disassembly and conversion options, these requirements represent less than 1 percent of SRS's available electrical and water capacity. Fuel oil construction requirements would represent approximately 1 percent (for modifying existing facilities) to 98 percent (for building new facilities) of SRS's current annual fuel usage.

As shown in Table 4–34, minimal electricity, 340,000 gallons (1.3 million liters) of water, and 2,800 gallons (11,000 liters) of fuel oil would be required annually to support modifications at LANL under two of the pit disassembly and conversion options. These optional requirements would represent less than 1 percent of LANL's available electrical and water capacity. Fuel oil construction requirements would be minimal.

Operations—Immobilization of surplus plutonium, and operation of pit disassembly and conversion and MFFF activities, and support facilities at SRS would annually require 220,000 to 310,000 megawatt-hours of electricity, 42 million to 58 million gallons (160 million to 220 million liters) of water, and 300,000 to 340,000 gallons (1.1 million to 1.3 million liters) of fuel oil, annually, as shown in Table 4–35. These requirements represent 5 to 8 percent of SRS's available electrical capacity and about 2 percent of the site's available water capacity. Fuel oil usage would represent approximately 73 to 83 percent of SRS's current annual fuel usage.

Operation of pit disassembly and conversion activities at PF-4 at LANL would annually require 960 to 1,900 megawatt-hours of electricity, and 480,000 to 1,200,000 gallons (1.8 million to 4.5 million liters) of water, as shown in Table 4–35. No additional fuel oil would be required under any option. These requirements would represent 0.3 to 0.5 percent of LANL's available electrical capacity and 0.4 to 1 percent of LANL's available water capacity (conservative comparisons as discussed for the No Action Alternative [Section 4.1.7.7.1]).

4.1.7.7.3 MOX Fuel Alternative

Construction—Construction of PDCF at F-Area at SRS would require the use of additional electricity, water, and fuel oil similar to that under the No Action Alternative (Section 4.1.7.7.1). In addition to the option of building a new PDCF, options are considered for pit disassembly and conversion whereby a new PDC would be constructed in K-Area or existing facilities at LANL and SRS would be modified to support pit disassembly and conversion activities. Similar to the Immobilization to DWPF Alternative, these options are expected to result in lower construction requirements compared to those required to support construction of PDCF at F-Area (see Appendix F).

As shown in Table 4–34, minimal to 15,000 megawatt-hours of electricity, minimal to 2.6 million gallons (9.8 million liters) of water, and minimal to 390,000 gallons (1.5 million liters) of fuel oil would be required to support construction under this alternative at SRS. Modifications to the K-Area Complex, H-Canyon/HB-Line, and MFFF to support pit disassembly and conversion activities are expected to result in minimal additional infrastructure requirements and to fall within SRS's current infrastructure requirements. Under any of the options being analyzed, these requirements represent less than 1 percent of SRS's available electrical and water capacity. Construction fuel oil requirements would represent less than 1 percent (for modifying existing facilities) to 95 percent (for building PDCF) of SRS's current annual fuel usage.

As shown in Table 4–34, the construction-related infrastructure requirements at LANL related to optional modifications at PF-4 to support proposed pit disassembly and conversion activities would be the same as those under the Immobilization to DWPF Alternative.

Operations— Operation of pit disassembly and conversion and MFFF activities, and support facilities at SRS would require 170,000 to 270,000 megawatt-hours of electricity, 25 million to 41 million gallons (95 million to 160 million liters) of water, and 280,000 to 450,000 gallons (1.1 million to 1.7 million liters) of fuel oil, annually, as shown in Table 4–35. These requirements represent 4 to 7 percent of SRS's available electrical capacity and 1 to 2 percent of the site's available water capacity. Fuel oil usage would represent approximately 68 to 110 percent of SRS's current annual fuel usage.

Pit disassembly and conversion activities in PF-4 at LANL under the MOX Fuel Alternative would require the same levels of infrastructure support as those under the Immobilization to DWPF Alternative.

4.1.7.7.4 H-Canyon/HB-Line to DWPF Alternative

Construction—Construction-related infrastructure requirements at SRS or LANL in support of the H-Canyon/HB-Line to DWPF Alternative would be the same as those under the MOX Fuel Alternative (see Table 4–34).

Operations—Operations-related infrastructure requirements at SRS or LANL in support of the H-Canyon/HB-Line to DWPF Alternative would be the same as those under the MOX Fuel Alternative (see Table 4–35).

4.1.7.7.5 WIPP Alternative

Construction—Construction-related infrastructure requirements at SRS or LANL in support of the WIPP Alternative would be the same as those under the MOX Fuel Alternative (see Table 4–34).

Operations—Operations-related infrastructure requirements at SRS or LANL in support of the WIPP Alternative would be the same as those under the MOX Fuel Alternative (see Table 4–35).

4.2 Incremental Impacts of Processing Additional Surplus Plutonium

In addition to the amounts of plutonium analyzed for disposition in this *SPD Supplemental EIS* and other NEPA documents, DOE may, in the future, identify additional quantities of surplus plutonium that could be processed for disposition through the facilities and capabilities analyzed herein.[8] This section describes the potential impacts of processing such quantities of surplus plutonium. Any need for further NEPA analysis related to the potential impacts of handling, transporting, or processing specific quantities of such additional plutonium would be addressed as part of, and at the time of, the planning process for its disposition.

For most resource areas, this chapter presents the maximum annual impacts from construction and operation of the plutonium facilities. The analyses in this *SPD Supplemental EIS* are based on a conservative set of assumptions and estimates under which the plutonium facilities described for each of the alternatives and options would each operate for a given number of years to process a given quantity of surplus plutonium. The maximum lifespan of operations for the plutonium disposition facilities, as considered in this *SPD Supplemental EIS*, is listed for each alternative in Appendix B, Table B–2. The actual operating period for each facility would depend on the particular mix of facilities used for plutonium processing, and their throughputs. If a future decision is made, pursuant to an appropriate disposition planning process, to address additional surplus plutonium, then some plutonium disposition facilities could potentially be required to operate for longer periods of time than those analyzed in this *SPD Supplemental EIS*. Processing additional surplus plutonium would not change the maximum annual impacts of operations, but would extend the impacts described in this *SPD Supplemental EIS* for affected facilities further out in time. The contributions attributable to those facilities to total cumulative life-cycle impacts, such as those for total worker and population dose and LCFs, and total waste generation, would increase in proportion to the extended processing time. These impacts can be estimated from the analyses provided for facility operations by adding additional years of operation.

4.3 Incremental Impacts of Processing Plutonium at Reduced Rates or of Constructing and Operating Smaller Surplus Plutonium Disposition Facilities

As noted in Section 4.2, the plutonium facilities addressed under each of the alternatives and options for this *SPD Supplemental EIS* are each assumed to operate for a given number of years to address a given quantity of surplus plutonium. The operating periods of the plutonium facilities, however, could be extended if: (1) surplus plutonium were processed at reduced rates at the facilities, or (2) smaller facilities with reduced throughput capabilities were constructed.

For the first case, the same facility construction impacts would occur as those described in the other sections of this chapter. For a given total quantity of processed plutonium, however, annual operational impacts would be comparable to or smaller than those described in Section 4.1. For example, if the plutonium throughput for MFFF were smaller than the annual quantities assumed for the alternatives addressed in this *SPD Supplemental EIS*, then the annual operational impacts would be comparable to or smaller than those described, although MFFF would operate longer to process the same total quantity of plutonium. Facilities such as WSB that support MFFF operations would also operate longer.

Impacts on some resource areas would occur only during plutonium processing. For these resource areas, the annual impacts could be reduced if the plutonium was processed at a reduced rate, but the total impacts for processing a given quantity of surplus plutonium would not change if the processing schedule was extended. This includes impacts from hazardous and radioactive waste management, human health

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[8] *For example, future sources of additional surplus plutonium could include additional future plutonium quantities recovered from foreign locations through NNSA's Global Threat Reduction Initiative or future additional quantities of plutonium from the defense stockpile declared to be excess to U.S. defense needs. DOE previously set aside for programmatic use 4 metric tons (4.4 tons) of surplus plutonium in the form of Zero Power Physics Reactor (ZPPR) fuel at its Idaho National Laboratory. DOE no longer has a programmatic use for this material. DOE is considering using a portion (about 0.4 metric tons [4.4 tons]) of the material for a different programmatic use. While the bulk of the ZPPR fuel currently stored at the Idaho National Laboratory has been declared excess, specific disposition proposals remain to be developed. The ZPPR material is not included in the scope of the present analyses for surplus plutonium.*

risk, facility accidents during plutonium processing, impacts from waste transportation, and environmental justice. For example, if the plutonium processing rate at MFFF were slowed and the processing period extended by 1 year, the total doses and LCFs for workers and the public from facility operation would remain unchanged, even though the annual doses and LCFs would decrease.

Impacts on some resource areas would occur but would be less strongly linked to plutonium processing throughput – that is, some level of impacts would occur whenever a facility is operational, although the impacts could be somewhat reduced if the rate of plutonium processing were reduced. These impacts include those on air quality for criteria pollutants, solid nonhazardous waste management, socioeconomics, facility accidents not associated with plutonium processing, transportation impacts from employee trips, and infrastructure. For example, some air quality impacts from criteria pollutant emissions associated with building heating would continue as long as a facility is operational. Likewise, impacts from nonhazardous solid waste management and impacts on infrastructure would occur to some extent as long as personnel continue to use utilities (e.g., electricity, fuel for heating, and potable water) and generate solid nonhazardous waste. Extending operations by 1 year would conservatively mean that these types of impacts would continue up to the levels described in this chapter for 1 year longer.

For the second case, in which smaller surplus plutonium facilities would be constructed having reduced plutonium throughputs, construction and annual operational impacts would both be generally reduced compared to those impacts described in Section 4.1. But because the plutonium processing throughput of the facilities would be reduced, their operating periods would be extended to process the same amount of surplus plutonium. This would apply to all plutonium facilities under consideration in this *SPD Supplemental EIS*. For example, a reduced pit disassembly and conversion capability could be implemented that would process surplus plutonium pits at a lower throughput than the full capability evaluated in this chapter.

Construction impacts would be reduced if smaller facilities were constructed. There would be less land disturbance and, therefore, less potential for impacts on air quality, land resources, geology and soils, water resources, noise, ecological resources, and cultural resources; less construction employment; less construction waste generation; fewer construction resources needed; and smaller impacts from transportation of waste and construction materials. The reduction in impacts would be generally proportional to the reduction in the amount of land disturbed, reduction in the amounts of construction materials and resources needed, and reduction in construction employment. Also, the time required for construction might be reduced, and the facilities could start operations at an earlier date.

Annual operations impacts would be reduced if smaller facilities were operated. Although the annual impacts would be reduced (e.g., less annual generation of waste or smaller radioactive air emissions), the total impacts of processing the same amount of surplus plutonium would likely be similar. For example, although the annual doses to workers would be reduced, assuming a lower plutonium throughput in a smaller facility, the total dose to the worker population for the entire campaign is likely to be similar to the total dose from processing the same quantity of plutonium at a higher throughput.

The impacts on some resource areas could depend on the revised facility design. For example, although it is expected that the design of a reduced pit disassembly and conversion capability would incorporate HEPA filtration of process exhaust gases, a revised design may or may not incorporate the use of a sand filter. The small annual emissions using both HEPA and sand filters could increase if only HEPA filters were used. In addition, a sand filter would be more robust in the event of some potential accident scenarios.

4.4 Avoided Environmental Impacts Associated with Using MOX Fuel from Surplus Plutonium in Commercial Nuclear Power Reactors Versus LEU Fuel

As discussed in Chapter 4, Section 4.28.3, of the *SPD EIS* (DOE 1999b), using MOX fuel in commercial nuclear power reactors would preclude that part of the nuclear fuel cycle for the LEU that would be displaced by plutonium as the fissile material needed to maintain a nuclear reaction. The nuclear fuel cycle includes mining, possibly milling,[9] converting, and enriching uranium.

Typical uranium enrichment for unirradiated light-water reactor fuel is between 4.0 and 4.5 percent uranium-235. To create 1 metric ton (1.1 tons) of enriched uranium at these enrichment levels, it is necessary to mine 9 to 10 metric tons (10 to 11 tons) of natural uranium, depending on the enrichment level sought. (The higher the enrichment level, the more natural uranium is required.) The use of up to 45.1 metric tons (49.7 tons) of plutonium in MOX fuel as analyzed for the MOX Fuel Alternative of this *SPD Supplemental EIS* would displace 1,000 to 1,125 metric tons (1,102 to 1,240 tons) of LEU fuel at the same enrichment levels. Therefore, use of MOX fuel as analyzed in this *SPD Supplemental EIS* could eliminate the need to mine and enrich 10,000 to 10,125 metric tons (11,023 to 11,161 tons) of natural uranium.

The mining and enrichment of uranium results in increased radiological emissions to workers and the public. Although increased radiological emissions would also be associated with the fabrication of MOX fuel, these emissions are expected to be lower than those associated with creating LEU fuel. About 0.25 LCFs are expected among the public living within 80 kilometers (50 miles) of the uranium mining, conversion, and enrichment facilities involved with the uranium fuel cycle over a 10-year operating period; 0.0085 LCFs could be associated with normal operation of the facilities needed to produce MOX fuel for a comparable period. A similar reduction is expected in adverse impacts on involved workers. The expected LCFs for involved uranium workers would range between 8.3 and 9.4 over a 10-year operating period, versus 1.5 for involved workers at the facilities needed to produce MOX fuel over the same period.[10]

As discussed in Chapter 4, Section 4.28.3, of the *SPD EIS* (DOE 1999b), energy would be needed to support the processing and enrichment of a quantity of LEU equivalent to the MOX fuel produced each year at MFFF. As indicated in Section 4.1.7.7.3, the facilities needed to produce MOX fuel under the MOX Fuel Alternative would annually require approximately 170,000 to 270,000 megawatt-hours of electricity. The output of MFFF in this *SPD Supplemental EIS* is estimated to be 73 to 83 metric tons per year (80 to 91 tons per year) of MOX fuel. To produce an equivalent amount of LEU using gaseous diffusion technology, it is estimated that the uranium fuel cycle would require approximately 893,000 megawatt-hours per year of electricity.[11] Considerably less electricity (as much as 50 times less electricity, or about 18,000 megawatt-hours per year) would be annually needed to produce an equivalent amount of LEU using centrifuge or other modern uranium enrichment technologies, which are currently replacing the remaining operating gaseous diffusion plants.

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[9] *Milling refers to the step where uranium ore is processed to concentrate the uranium in a powder form. Uranium mills are used during conventional mining operations. Nearly all of the uranium produced in the United States is now produced through in situ processes whereby uranium is dissolved underground and pumped to the surface in a slurry that is separated to concentrate the uranium. This process does not require the use of a mill.*

[10] *Estimates of LCFs and other environmental impacts presented in this section for uranium mining, conversion, and enrichment facilities are based on information contained in the* Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement *(DOE 1996a:4-142–4-146). The impacts presented in that EIS were based on an annual production rate of 150 metric tons (165 tons) of enriched uranium and an estimated production rate at a proposed MOX facility of 73 to 83 metric tons per year (80 to 91 tons per year) of MOX fuel, both types of fuel at an enrichment value of 4.0 to 4.5 percent. Accordingly, the impacts have been factored by a ratio of 73/150 to 83/150 to support a consistent comparison with expected MFFF throughputs.*

[11] *The figures in 10 CFR Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, Table S–3, are based on the production of about 30 metric tons per year (33 tons per year) of LEU fuel, assuming the use of gaseous diffusion for enrichment. MFFF is expected to produce 73 to 83 metric tons per year (80 to 91 tons per year) of MOX fuel.*

Ambient air quality is affected by emissions of chemical pollutants from the uranium fuel cycle. These pollutants are released during uranium processing and also from fossil fuel plants used to supply electricity for uranium enrichment. It is estimated that LEU processing and enrichment using gaseous diffusion technology would result in the release of an estimated 720 to 820 metric tons (790 to 900 tons) of carbon monoxide over 10 years (DOE 1999b) as opposed to operation of the facilities needed to produce MOX fuel at SRS, which are estimated to produce approximately 35 metric tons (38.6 tons) of carbon monoxide (NRC 2005a) over the same time period. Similarly, nitrogen dioxide emissions would decrease from between 29,000 and 33,000 metric tons (32,000 and 36,000 tons) over 10 years to approximately 430 metric tons (470 tons); sulfur dioxide emissions, from between 110,000 and 120,000 metric tons (120,000 and 130,000 tons) to approximately 16 metric tons (18 tons); and particulate matter, from between 28,000 and 32,000 metric tons (31,000 to 35,000 tons) to approximately 13 metric tons (14 tons) (DOE 1999b; NRC 2005a). But as noted above, electricity requirements assuming use of modern uranium enrichment technologies to produce LEU fuel would be much smaller than those assuming use of gaseous diffusion technology, with resulting reductions in emissions from fossil fuel plants assumed to generate this electricity.

4.5 Cumulative Impacts

Council on Environmental Quality regulations (40 CFR Parts 1500–1508) define cumulative impacts as effects on the environment that result from implementing any of the alternatives when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR 1508.7). Thus, the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource irrespective of the proponent (EPA 1999).

Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. Cumulative effects can also result from spatial (geographic) and/or temporal (time) crowding of environmental perturbations (i.e., concurrent human activities and the resulting impacts on the environment are additive if there is insufficient time for the environment to recover).

The impacts of continued storage of surplus plutonium pits in existing facilities at Pantex would be small, as described in the *Final Environmental Impact Statement for Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996b), its 2003 supplement analysis (DOE 2003a), and the *Complex Transformation SPEIS* (DOE 2008j). Because the cumulative impacts of continued storage of surplus plutonium pits at Pantex are analyzed and accounted for in existing NEPA documents, they are not discussed further in this section.

4.5.1 Methodology and Assumptions

In general, the following approach was used to estimate cumulative impacts for this S*PD Supplemental EIS*:

- The ROIs for impacts associated with the alternatives analyzed in this *SPD Supplemental EIS* were defined. These ROIs are described in Chapter 3, Table 3–1.
- The affected environment and baseline conditions were identified. Most of this information was taken from Chapter 3, Affected Environment, of this *SPD Supplemental EIS*.
- Past, present, and reasonably foreseeable actions and the effects of those actions were identified.
- Aggregate (additive) effects of past, present, and reasonably foreseeable actions were assessed.

Cumulative impacts were assessed by combining the effects of *SPD Supplemental EIS* alternative activities with the effects of other past, present, and reasonably foreseeable actions in the ROI. Many of these actions occur at different times and locations and may not be truly additive. For example, actions affecting air quality occur at different times and locations across the ROI; therefore, it is unlikely that the impacts would be completely additive. The effects were combined irrespective of the time and location of the impact, to envelop any uncertainties in the projected activities and their effects. This approach produces a conservative estimation of cumulative impacts for the activities considered.

4.5.2 Reasonably Foreseeable Actions

In addition to the alternatives evaluated in this *SPD Supplemental EIS*, actions that may contribute to cumulative impacts include onsite and offsite projects conducted by Federal, state, and local governments; the private sector; or individuals that are within the ROIs of the actions considered in this *SPD Supplemental EIS*. Information on present and future actions was obtained from a review of site-specific actions and NEPA documents to determine if current or proposed projects could affect the cumulative impacts analysis at the potentially affected sites. For those actions that are speculative, are not yet well defined, or are expected to have a negligible contribution to cumulative impacts, the actions are described but not included in the determination of cumulative effects. The potentially cumulative actions discussed here are the major projects that may contribute to cumulative impacts on or in the vicinity of the potentially affected sites.

4.5.2.1 U.S. Department of Energy Actions

4.5.2.1.1 Savannah River Site

Because the analysis presented earlier in this chapter includes an evaluation of the operational impacts for both MFFF and WSB, they are generally not addressed under cumulative impacts. Likewise, because construction of these facilities is under way, waste generated from construction activities is included in the baseline for existing SRS activities and is not addressed separately in this section.

Savannah River Site Salt Processing Alternatives Final Supplemental Environmental Impact Statement (*Salt Processing EIS*) (DOE/EIS-0082-S2) (DOE 2001). A process to separate the high-activity and low-activity waste fractions in HLW solutions is planned to replace the in-tank precipitation process evaluated in the *Defense Waste Processing Facility Supplemental Environmental Impact Statement* (DOE 1994). The *Salt Processing EIS* evaluates four alternatives: (1) small tank precipitation; (2) ion exchange; (3) solvent extraction; and (4) direct disposal in grout. The cumulative impacts analysis in this *SPD Supplemental EIS* includes the maximum impacts of the solvent extraction process, as selected in the DOE Record of Decision (ROD) for the *Salt Processing EIS* (66 FR 52752). On January 24, 2006, DOE issued a revised ROD (71 FR 3834) adopting an approach that implements interim salt processing until the solvent extraction process becomes operational.

Savannah River Site High-Level Waste Tank Closure Final Environmental Impact Statement (*HLW EIS*) (DOE/EIS-0303) (DOE 2002b). DOE proposes to close the HLW tanks at F- and H-Areas at SRS in accordance with applicable laws and regulations, DOE orders and regulations, and the Industrial Wastewater Closure Plan for the F- and H-Area High-Level Waste Tank Systems (approved by SCDHEC), which specifies the management of residuals as waste incidental to reprocessing. The proposed action would begin after bulk waste removal has been completed. The *HLW EIS* evaluates three alternatives regarding the HLW tanks at SRS: (1) the Stabilize Tanks Alternative (referred to as the "Clean and Stabilize Tanks Alternative" in the *Draft HLW EIS*), (2) the Clean and Remove Tanks Alternative, and (3) the No Action Alternative. Under the Stabilize Tanks Alternative, the *HLW EIS* considers three options for tank stabilization: Fill with Grout (Preferred Alternative), Fill with Sand, and Fill with Saltstone. Under each alternative (except No Action), DOE would close 49 HLW tanks and associated waste-handling equipment, including evaporators, pumps, diversion boxes, and transfer lines. In the ROD issued on August 19, 2002 (67 FR 53784), DOE selected the Preferred Alternative identified in the *HLW EIS*, Stabilize Tanks—Fill with Grout.

In a 2012 supplement analysis, DOE addressed the potential environmental impacts from using additional tank cleaning technologies than those specifically analyzed in the *HLW EIS*, and from performing a Waste Incidental to Reprocessing evaluation process using criteria specified in Section 3116(a) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (Public Law 108-375) rather than criteria specified in DOE Manual 435.1-1, *Radioactive Waste Management*. DOE determined that these proposed actions did not constitute substantial changes from those evaluated in the *HLW EIS*, and that no significant new information was identified that would affect the basis for its original decision as documented in the ROD (DOE 2012c:14). In April 2012, after completion of cleaning operations for Tanks 18 and 19 in F-Area, DOE began filling these tanks with grout with projected completion of closure activities for these tanks in late summer (DOE 2012d).

Environmental Assessment for Biomass Cogeneration and Heating Facilities at the Savannah River Site (DOE/EA-1605) (DOE 2008e). The proposed action analyzed in this environmental assessment is the construction and operation of new biomass cogeneration and heating facilities at SRS. The facilities would consist of: a new biomass cogeneration facility to replace the existing coal-fired D-Area powerhouse, and two new biomass heating plants at K- and L-Areas to replace the existing oil-fired K-Area steam plant. The proposed biomass cogeneration and heating facilities would supply energy to F-, H-, K-, L-, and S-Areas at SRS. The project would help SRS meet its energy requirements for an initial term of 21 years, with the potential for many years of continued operation after the initial term. These facilities are now operational and are included in the baseline air pollutant concentrations in Chapter 3, Section 3.1.4.

Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement (DOE/EIS-0026-S-2) (DOE 1997b). In 1980, the original *Final Environmental Impact Statement, Waste Isolation Pilot Plant* (DOE/EIS-0026) (DOE 1980) was issued. Supplemental environmental impact statements were issued in 1990 and in 1997. In addition, several supplement analyses have been issued. In a ROD issued in January 1998 (63 FR 3624), DOE decided to open WIPP for the disposal of contact-handled and remote-handled TRU waste. On June 30, 2004, DOE issued a revised ROD (69 FR 39456) to allow for shipments of polychlorinated biphenyl-contaminated TRU waste to WIPP from various DOE locations, including SRS.

Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (*GTCC EIS*) (DOE/EIS-0375-D) (DOE 2011a). In February 2011, DOE issued the *Draft GTCC EIS* to evaluate the potential environmental impacts associated with the proposed development, operation, and long-term management of a facility or facilities for disposal of greater-than-Class C (GTCC) LLW and DOE GTCC-like waste. GTCC LLW has radionuclide concentrations exceeding the limits for Class C LLW established by NRC in 10 CFR Part 61. The *Draft GTCC EIS* also considers DOE waste having similar characteristics. Currently, there is no location for disposal of GTCC LLW and DOE is responsible for such disposal under the Low-Level Radioactive Waste Policy Amendments Act of 1985 (Public Law 99-240). SRS is one of eight candidate DOE disposal sites being considered for GTCC LLW disposal in the *Draft GTCC EIS*, along with generic commercial disposal facility options in arid and humid environments. DOE is evaluating several disposal technologies in the *Draft GTCC EIS*, including geologic repositories, intermediate depth boreholes, and enhanced near-surface disposal facilities. Only enhanced near-surface disposal facilities are considered for SRS.

Final Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS) (DOE/EIS-0236-S4) (DOE 2008j). On October 24, 2008, NNSA announced the availability of the *Complex Transformation SPEIS*, which analyzes the environmental impacts from the continued transformation of the U.S. nuclear weapons complex over the next 10 to 20 years. NNSA's proposed action is to continue currently planned modernization activities: (1) selection of a site to consolidate plutonium research and development, surveillance, and pit manufacturing; (2) selection of a site to consolidate special nuclear material throughout the complex; (3) selection of a site to consolidate, relocate, or eliminate duplicative facilities and programs and improve operating efficiencies; (4) identification of one or more sites for conducting NNSA flight test operations; and (5) acceleration of nuclear weapons dismantlement activities. SRS was assessed as a potential location for a consolidated nuclear production center, which entails consolidation of special nuclear material storage and production of 125 pits, with a potential surge capacity of 200 pits annually. On December 19, 2008 (73 FR 77644), the ROD was published selecting the preferred alternative, which did not include placing new facilities at

SRS. Thus, there would be no cumulative impacts at SRS resulting from decisions made relative to the *Complex Transformation SPEIS*.

Draft Environmental Assessment for the Proposed Use of the Savannah River Site Lands for Military Training (DOE/EA-1606) (DOE 2011i). DOE prepared this environmental assessment to evaluate potential environmental impacts regarding the use of SRS by the U.S. Departments of Defense and Homeland Security (DOD and DHS, respectively) for military training purposes. Alternatives considered are No Action (i.e., SRS would not be used for military training) and the proposed action (i.e., use of a specific area of SRS for non-live-fire tactical maneuver training). The purpose of the proposed action is to enable DOD and DHS to conduct low intensity, non-live-fire tactical maneuver training activities on SRS to support current and future mission requirements.

Other. Memoranda of understanding between Hyperion Power Generation and GE-Hitachi Nuclear Energy America, LLC, and Savannah River Nuclear Solutions were signed in 2010. The companies agreed to explore opportunities to work on expedited development and deployment of small modular nuclear reactors at SRS. Although eight locations within SRS have been identified as venues for the development of these reactors (Pavey 2012), specific data are not available at this time on the size of the parcels. Nor is information available on the design or potential environmental impacts of such reactors; thus, they are not addressed further in this cumulative impacts section.

4.5.2.1.2 Los Alamos National Laboratory

Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (LANL SWEIS) (DOE/EIS-0380) (DOE 2008f). In the *LANL SWEIS*, NNSA assessed three alternatives for the continued operation of LANL: (1) No Action, (2) Reduced Operations, and (3) Expanded Operations. NNSA decided in the ROD (73 FR 55833) to continue to implement the No Action Alternative, that is, to continue historical mission support activities at currently approved operational levels, with the addition of some elements of the Expanded Operations Alternative. These elements include increases in operation of some existing facilities and new facility projects needed for ongoing programs and protection of workers and the environment. However, most missions would continue to be conducted at LANL at current levels. Additionally, the ROD determined that NNSA would continue to implement actions necessary to comply with the March 2005 Compliance Order on Consent, which requires investigation and remediation of environmental contamination at LANL. Also, NNSA would not change pit production at LANL at this time. One project analyzed in the *LANL SWEIS*, the Los Alamos Science and Engineering Complex, has been cancelled (LANL 2012a).

Final Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (*CMRR-NF SEIS*) (DOE/EIS-0350-S1) (DOE 2011g). In 2003, NNSA issued the *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2003d). In 2004, the ROD (69 *FR* 6967) was issued which called for the construction of a two-building, partially above-ground, Chemistry and Metallurgy Research Building Replacement (CMRR) Facility at TA-55. The first building, the Radiological Laboratory/Utility/Office Building (RLUOB), was completed; however, further seismic and safety studies indicated that the CMRR Nuclear Facility (CMRR-NF) required design changes. These changes, as well as additional ancillary support requirements, such as additional equipment storage areas, soil storage areas, additional transportation needs, and worker parking areas, were addressed in the *CMRR-NF SEIS*. The ROD for the *CMRR-NF SEIS* (76 FR 64344) selected the Modified CMRR-NF Alternative for constructing and operating the CMRR-NF portion of the CMRR Project, but delayed selection of the appropriate Excavation Option (Shallow or Deep) for implementing the construction of this building until after initiating final design activities. Note that the fiscal year 2012 Presidential budget request defers further CMRR-NF design and construction for at least 5 years. Although the project has been delayed, it has been included in the analysis of cumulative impacts.

Final Complex Transformation Supplemental Programmatic Environmental Impact Statement (DOE/EIS-0236-S4) (DOE 2008j). See Section 4.5.2.1.1 for a general discussion of the *Complex Transformation SPEIS*. With respect to LANL, the ROD (73 FR 77644) determined that manufacturing and research and development involving plutonium would remain at LANL and, in order to support these activities, NNSA would construct and operate the CMRR–NF. As noted above, however, the CMRR-NF has been deferred.

Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (GTCC EIS) (DOE/EIS-0375-D) (DOE 2011a). See Section 4.5.2.1.1 for a general discussion of the *GTCC EIS*. LANL is one of eight candidate DOE sites being considered for GTCC LLW disposal in the *Draft GTCC EIS*. Specifically, a site in TA-54 is under consideration. The primary function of TA-54 is the management of radioactive and hazardous chemical wastes.

Final Environmental Assessment for the Expansion of the Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 Sandia Canyon at Los Alamos National Laboratory, Los Alamos, New Mexico (SERF EA) (DOE/EA-1736) (DOE 2010e). With respect to the Sanitary Effluent Reclamation Facility (SERF), the environmental assessment assessed the goal of reclaiming, treating, and reusing cooling tower water. Alternatives addressed include No Action, Partial Reuse, and Total Reuse. Under the No Action Alternative, the existing SERF would be used to treat a limited amount of sanitary effluent for reuse without any structural enlargement or addition of extra equipment, storage tanks, or other pumps or piping structures. Under both the Partial Reuse and Total Reuse Alternatives, the goal would be to recycle up to 100 percent of SERF effluent and reduce potable water demand in TA-3 by 60 and 75 percent, respectively.

Additional DOE activities planned for, or occurring at, LANL include the following:

- *SOC Training Center* – DOE is constructing a new training campus for the SOC (the protective force at LANL). The project includes a Tactical Training Center, an indoor firing range, and an office building, all at TA-16. The Tactical Training Center is almost complete and construction of the indoor firing range has been initiated (LANL 2012a).
- *Sandia Road* – The new Sandia Road is being constructed to allow access to Sandia Canyon as part of the Individual Permit project and as part of the mitigation action commitments made in the *SERF EA* to evaluate impacts on the Sandia Canyon wetlands associated with the expansion. DOE is completing a biological assessment to evaluate the potential impacts on threatened and endangered species in the project area (LANL 2012a).
- *Clean Fill Yard at Sigma Mesa* – Reuse of clean fill at LANL was one of the mitigation action commitments addressed in the *2008 Site-Wide Environmental Impact Statement Mitigation Action Plan Annual Report for Fiscal Year 2010* (LANL 2011c). In 2011, DOE completed the database development portion of the project and in 2012, the Clean Fill Yard will open on Sigma Mesa and will provide a staging yard for clean fill generated by projects so that it can be stored and distributed to other projects as required. DOE is completing a biological assessment to determine if there are impacts on threatened and endangered species in the proposed project area (LANL 2012a).
- *TA-49 Fire Center* – DOE has permitted the National Park Service to construct a Fire Center in TA-49. This project includes construction of a new, single-story multipurpose interagency building that would contain about 6,500 square feet (600 square meters) of space. The project includes replacement of temporary office trailers and structures currently on the site, realignment of a short segment of the existing access road to the existing temporary buildings, paving and gravelling, and installation of utilities. The building is being designed to qualify for Leadership in Energy and Environmental Design (LEED) certification. Habitat disturbance would be both temporary and minimal at the Fire Center site, with less than 1 acre (0.4 hectare) of undeveloped land disturbed. Operation of this facility would have a negligible increase in utility usage for the site (LANL 2012a).

4.5.2.2 Other Actions

4.5.2.2.1 Savannah River Site

Nuclear facilities in the vicinity of SRS include Georgia Power's two-unit Vogtle Electric Generating Plant across the river from SRS; Chem-Nuclear Systems, LLC, a commercial LLW disposal facility just east of SRS, and a wholly owned subsidiary of Duratek, Inc.; and Starmet CMI, Inc. (formerly Carolina Metals), located southeast of SRS, which processes uranium-contaminated metals. The Vogtle Plant, Chem-Nuclear Services facility, and Starmet CMI facility are located approximately 11, 8, and 15 miles (18, 13, and 24 kilometers), respectively, from F- and H-Areas. NRC has issued the *Final Supplemental Environmental Impact Statement for Combined Licenses (COLs) for Vogtle Electric Generating Plant Units 3 and 4* (NRC 2011a) and has recently approved the combined construction and operating license for both units (NEI 2012). Due to the proximity of the plant to SRS, the cumulative impacts of expansion of the Vogtle Plant are addressed for each resource area, as appropriate. Annual monitoring reports filed with the State of South Carolina indicate that operation of the Chem-Nuclear Services facility and the Starmet CMI facility does not noticeably affect radiation levels in air or water in the vicinity of SRS. Therefore, they are not included in this assessment. Other nuclear facilities (e.g., Virgil C. Summer Nuclear Station, Unit 1, operated by South Carolina Electric and Gas) are too far (more than 50 miles [80 kilometers]) from SRS to have an appreciable cumulative effect (DOE 2002b:5-3).

Numerous existing and planned industrial facilities (e.g., textile mills, paper product mills, and manufacturing facilities) operate within the counties surrounding SRS, with permitted air emissions and discharges to surface waters. Because of the distances between SRS and these private industrial facilities, there is little opportunity for interaction of plant emissions, and no major cumulative impacts on air or water quality are expected (DOE 2002b:5-3).

An additional offsite facility having the potential to affect the nonradiological environment is South Carolina Electric and Gas Company's Urquhart Station. Urquhart Station is a three-unit, 250-megawatt, coal- and natural gas-fired steam electric plant in Beech Island, South Carolina, located about 18 miles (29 kilometers) north of SRS. Because of the distance between SRS and Urquhart Station, and the regional wind direction frequencies, there is little opportunity for any interaction of plant emissions, and no major cumulative impacts on air quality are expected (DOE 2002b:5-3, 5-4).

4.5.2.2.2 Los Alamos National Laboratory

Numerous actions having potential cumulative impacts were addressed in the *CMRR-NF SEIS* (DOE 2011g). Most of these actions at other sites located in the general LANL area were not expected to affect cumulative impacts because of their distance from LANL; their routine nature; their relatively small size; and the zoning, permitting, environmental review, and construction requirements they must meet. Those actions with potential cumulative impacts are addressed in this section.

Los Alamos County Department of Public Utilities is the lead agency for the reconstruction of the Los Alamos Canyon Dam, which would enable recreation at the Los Alamos Canyon Reservoir. The project began in March 2011. Although scheduled to be completed on November 15, 2011, the project was suspended in the fall of 2011 due to flooding. The project is now scheduled to be completed mid-summer 2012 (LADPU 2011a, 2011b).

The Buckman Direct Diversion Project diverts water from the Rio Grande for use by the City of Santa Fe and Santa Fe County. The diversion project withdraws water from the Rio Grande approximately 3 miles (5 kilometers) downstream from where New Mexico State Road 502 crosses the river. The pipelines for this project largely follow existing roads and utility corridors. Potential impacts on fish and aquatic habitats below the proposed project due to effects on water flow are minimal (BDDP 2010a; BLM and USFS 2006). An independent peer review was conducted on behalf of the Buckman Direct Diversion Board to obtain an independent analysis and synthesis of existing information to support a description of potential tap water health risks. This review found no risk to human health from drinking water provided by the Buckman Direct Diversion Project (BDDP 2010b). A Memorandum of Understanding regarding water quality monitoring between the Buckman Direct Diversion Board and DOE was published on May 12, 2010, establishing the roles and responsibilities of each agency. The memorandum involves DOE's funding of sampling programs and analysis to ensure no contamination enters the water supply, as well as coordination and sharing of data obtained from sampling between both agencies (BDDP 2010a). In January 2011, the New Mexico Environment Department approved a fourth source of water to be distributed from the Buckman Direct Diversion Project to consumers in the City of Santa Fe and Santa Fe County. In the spring of 2011, the Buckman Direct Diversion Project provided approximately 15 million gallons (57 million liters) per day of drinking water (BDDP 2011).

4.5.3 Cumulative Impacts

A cumulative impact analysis is only conducted for those resource areas having the greatest potential for cumulative impacts at SRS and LANL. Based on an analysis of the impacts presented in this chapter, these resource areas were considered to be land use, air quality, human health, socioeconomics, infrastructure, waste management, transportation, and environmental justice.

4.5.3.1 Land Use

4.5.3.1.1 Savannah River Site

Cumulative impacts on land use at SRS are presented in **Table 4–36**. Cumulative actions could occupy 10,567 to 10,617 acres (4,276 to 4,297 hectares) of land and would be generally compatible with existing land use plans and allowable uses. Within the boundaries of SRS, cumulative land use would involve 5.3 to 5.4 percent of the 198,344 acres (80,268 hectares) encompassing the site. Activities evaluated under the *SPD Supplemental EIS* alternatives would disturb a maximum of 52 acres (21 hectares) of land, or approximately 0.03 percent of available SRS land. Existing activities currently occupy approximately 9,900 acres (4,000 hectares) of SRS land. As noted in Section 4.5.2.2.1, a construction and operating license has been issued for Vogtle Units 3 and 4. Land impacted on a long-term basis from this project would total 379 acres (153 hectares) (NRC 2011a:4-2). Use of this acreage would not have a cumulative impact on land use at SRS and only a minimal impact within the larger ROI.

Table 4–36 Cumulative Land Use Impacts at the Savannah River Site

Activity		*Land Use Commitment (acres)*
Past, Present, and Reasonably Foreseeable Future Actions		
Existing site activities [a]		9,900
High-Level Radioactive Waste Salt Processing Facility (DOE 2001:4-3)		203
Tank closure (DOE 2002b:4-13)		14
Biomass cogeneration and heating (DOE 2008e:4, 8)		36
MFFF [b]		87
WSB [b]		15
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a:5-1)		60
Military training (DOE 2011i:8)		250
Subtotal -- Baseline Plus Other DOE Actions		**10,565**
SPD Supplemental EIS Alternatives [c]	No Action	50
	Immobilization to DWPF	2 to 52
	MOX Fuel	30
	H-Canyon/HB-Line to DWPF	30
	WIPP	30
Total [d]		**10,567–10,617**
Total Site Capacity [a]		**198,344**

DWPF = Defense Waste Processing Facility; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] From Chapter 3, Section 3.1.1.1, assuming that 5 percent of the Savannah River Site is developed landscape.

[b] From Appendix F, Section F.7.1.1.

[c] Impact indicator values from this chapter.

[d] Total is a range that includes the minimum and maximum values from the *SPD Supplemental EIS* alternatives. Total may not equal the sum of the contributions due to rounding.

Note: To convert acres to hectares, multiply by 0.40469.

4.5.3.1.2 Los Alamos National Laboratory

Modification of PF-4 would not contribute to cumulative impacts since less than 2 acres (0.8 hectares) of land would be temporarily disturbed.

4.5.3.2 Air Quality

4.5.3.2.1 Savannah River Site

Effects on air quality from construction, excavation, and remediation activities at SRS could result in temporary increases in air pollutant concentrations at the site boundary and along roads to which the public has access. These impacts would be similar to the impacts that would occur during construction of a similar-sized housing development or a commercial project. Emissions of fugitive dust from these activities would be controlled using water sprays and other engineering and management practices, as appropriate. The maximum ground-level concentrations offsite and along roads to which the public has regular access would be below ambient air quality standards. Because earthmoving activities related to the actions considered in this cumulative impacts analysis would occur at different times and locations, air quality impacts are not likely to be cumulative.

Table 4–37 compares the cumulative concentrations of nonradioactive air pollutants from operation of facilities at SRS to Federal and state regulatory standards. Maximum nonradioactive air pollutant concentrations at the site boundary from operation of SRS facilities would meet regulatory standards. In general, the contributions from *SPD Supplemental EIS* alternatives would be less than significance levels (defined in Section 4.1.1), except for the 1-hour nitrogen dioxide contribution under each alternative and the 24-hour $PM_{2.5}$ and 24-hour sulfur dioxide contributions under the Immobilization to DWPF Alternative and the PDC Option under the other action alternatives. It is unlikely that actual concentrations would be as high as those projected for existing activities at SRS because the values for the existing activities are based on the maximum permitted allowable emissions and not on actual emissions.

DOE expects that the recent replacement of the boilers in D- and K-Areas with new biomass cogeneration and heating facilities would decrease overall annual air pollutant emissions rates for particulate matter by about 360 metric tons (400 tons), nitrogen oxides by 2,300 metric tons (2,500 tons), and sulfur dioxide by 4,500 metric tons (5,000 tons). Annual emissions of carbon monoxide would increase by about 180 metric tons (200 tons) and volatile organic compounds would increase by about 25 metric tons (28 tons) (DOE 2008e:30-31). Overall, this would significantly reduce some air pollutant concentrations from SRS facilities and improve ambient air quality. Emissions of carbon dioxide and greenhouse gas emissions are expected to be reduced by about 90,000 metric tons (100,000 tons) per year by replacing these units with the biomass facilities (DOE 2012b).

Construction of the proposed Vogtle Units 3 and 4 would result in small temporary impacts on air quality near the Vogtle Plant. Operation of standby diesel generators and auxiliary power systems at Vogtle Units 3 and 4 would have small air quality impacts (NRC 2008).

4.5.3.2.2 Los Alamos National Laboratory

Because of the small amount of land (2 acres [0.8 hectares]) that could be disturbed during modifications at PF-4, air quality impacts are not expected. As noted in Section 4.1.1, there would be no increase in emissions of criteria or nonradioactive toxic air pollutants from operation of PF-4; therefore, the contribution to cumulative impacts would be negligible.

Table 4–37 Cumulative Air Quality Impacts of Criteria Pollutants at the Savannah River Site

Activity		Maximum Average Concentration (micrograms per cubic meter)				
		Carbon Monoxide	Nitrogen Dioxide	Particulate Matter		Sulfur Oxides
				PM_{10}	$PM_{2.5}$	
Past, Present, and Reasonably Foreseeable Future Actions						
Ambient [a]		2,863	6.6	61	29	39.3
Existing site activities [a]		290	42	51	N/R	720
High-Level Radioactive Waste Salt Processing Facility (DOE 2001:4-14)		1.9	0.03	0.07	N/R	0.3
Tank closure (DOE 2002b:4-7)		0.3	0.03	0.08	N/R	0.2
Biomass cogeneration and heating (DOE 2008e:31)		N/R [d]	N/R [d]	N/R [d]	N/R [d]	N/R [d]
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a: 10-52 -10-55)		N/R [e]	N/R [e]	N/R [e]	N/R [e]	N/R [e]
Subtotal Baseline Plus Other Actions		3,200	49	110	N/R [f]	760
SPD Supplemental EIS alternatives (operational contributions) [b]	No Action	37	0.091	1.3	1.1	22
	Immobilization to DWPF	41–55	0.074–0.12	1.8–2.3	1.8–2.1	81 [g]
	MOX Fuel	23–37	0.05–0.092	0.78–1.4	0.78–1.3	22 [g]
	H-Canyon/HB-Line to DWPF	23–37	0.05–0.092	0.78–1.4	0.78–1.3	22
	WIPP	23–37	0.05–0.092	0.78–1.4	0.78–1.3	22
Total [c]		**3,300**	**49**	**110**	**N/R [f]**	**840**
Most Stringent Standard or Guideline		10,000 (8 hours)	100 (annual)	150 (24 hours)	35 (24 hours)	1,300 (3 hours)

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; N/R = not reported; PM_n = particulate matter less than or equal to *n* micrometers in aerodynamic diameter; WIPP = Waste Isolation Pilot Plant.

[a] From Chapter 3, Section 3.1.4.2.

[b] Impact indicator values from this chapter.

[c] The total equals the subtotal baseline plus other actions, and the maximum among the ranges for each alternative. The total may not equal the sum of the contributions due to rounding.

[d] Replacement of coal- and oil-fired units with biomass facilities is reflected in existing site activities.

[e] Emissions from possible construction and operation of a GTCC LLW disposal facility at SRS are reported as small or negligible. Contributions to ambient air pollutant concentrations were not reported.

[f] The $PM_{2.5}$ subtotal and total are not reported because no value for existing site activities was reported. Compliance with the PM_{10} standard was used as a surrogate to assess compliance with the $PM_{2.5}$ standards.

[g] Values would be somewhat higher because the contributions from at least one facility were not reported and are not included in the totals.

Note: This table presents concentrations for selected averaging times and pollutants for comparison of alternatives. The pollutants presented are the criteria pollutants presented in Section 4.1.1 for the *SPD Supplemental EIS* alternatives.

During the time period that surplus plutonium disposition activities would occur at LANL, other activities could occur which could result in increased concentrations of air pollutants to which the public could be exposed. These activities could include construction and operation of various facilities including the Modified CMRR-NF (DOE 2011g: 4-5 – 4-6, 4-115) and remediation of material disposal areas as discussed in the 2008 *LANL SWEIS* (DOE 2008f: 5-56). Some of these activities were projected to result in potential exceedances of ambient air quality standards, as analyzed, and additional mitigation measures could be required to continue to comply with the standards.

4.5.3.3 Human Health

4.5.3.3.1 Savannah River Site

Cumulative radiological health effects on the public in the vicinity of SRS are presented in terms of radiological doses, the associated excess LCFs in the offsite population, and the increased LCF risk to the hypothetical MEI. Radiological health effects on involved SRS workers are presented in terms of radiological doses and associated excess LCFs in the workforce.

Table 4–38 summarizes the annual cumulative radiological health effects from routine SRS operations, proposed DOE actions, and non-Federal nuclear facility operations (Vogtle Electric Generating Plant).

As shown in Table 4–38, the maximum cumulative offsite population dose is estimated to be 25 person-rem per year for the regional population. This population dose is not expected to result in any LCFs. Activities proposed under the *SPD Supplemental EIS* alternatives could result in annual doses of 0.54 to 0.97 person-rem with no associated LCFs. For perspective, the annual doses to the same local population from naturally occurring radioactive sources (311 millirem per person – see Chapter 3, Section 3.1.6.1) would be about 270,000 person-rem, from which approximately 160 LCFs would be inferred. The assumed population, about 860,000 persons in the year 2020, is the average of the populations within 50 miles (80 kilometers) of F-Area, K-Area, and H-/S-Area.

Table 4–38 indicates that the maximum dose to the MEI at SRS is estimated to be up to 0.44 millirem per year, below applicable DOE regulatory limits (10 millirem per year from the air pathway, 4 millirem per year from the liquid pathway, and 100 millirem per year for all pathways).[12] This is a very conservative estimate of potential dose to an MEI because the SRS activities contributing to this dose are not likely to occur at the same time and location.

Table 4–38 Annual Cumulative Population Health Effects of Exposure to Radioactive Contaminants at the Savannah River Site

Activity		*Population within 50 Miles (80 kilometers)*		*MEI*	
		Dose (person-rem per year)	***Annual LCFs*** [a]	***Dose (millirem per year)***	***Annual LCF Risk*** [a]
Past, Present, and Reasonably Foreseeable Future Actions					
Existing site activities for 2010 (Baseline) [b]		3.6	0.002	0.12	7×10^{-8}
High-Level Radioactive Waste Salt Processing Facility (DOE 2001:4-21)		18	0.01	0.31	2×10^{-7}
Tank closure (DOE 2002b:4-17)		1.4×10^{-3}	8×10^{-7}	2.5×10^{-5}	2×10^{-11}
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a:10-79) [c]		-	-	-	-
Subtotal - Baseline Plus Other DOE Actions		**22**	**0.01**	**0.43**	$\mathbf{3 \times 10^{-7}}$
SPD Supplemental EIS alternatives [d, e]	No Action	0.54	0.0003	0.0066	4×10^{-9}
	Immobilization to DWPF	0.71	0.0004	0.0076	5×10^{-9}
	MOX Fuel	0.97	0.0006	0.010	6×10^{-9}
	H-Canyon/HB-Line to DWPF	0.72	0.0004	0.0077	5×10^{-9}
	WIPP	0.97	0.0006	0.010	6×10^{-9}
Total for Savannah River Site		**23**	**0.01**	**0.44** [f]	$\mathbf{3 \times 10^{-7}}$
Vogtle Plant (NRC 2008:5-70, 2011a:5-14)		1.8	0.001	2.4	1×10^{-6}
Total for Region		**25**	**0.01**	**-** [f]	**-** [f]

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MEI = maximally exposed individual; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] LCFs are calculated using a conversion of 0.0006 LCFs per rem or person-rem (DOE 2003b).

[b] Impact indicators are from Chapter 3, Section 3.1.6.1, of this *SPD Supplemental EIS*.

[c] It is not expected that the general public would receive any measurable radiation doses during waste disposal operations given the solid nature of greater-than-Class C LLW and the distance of potential waste handling activities from potentially affected individuals.

[d] The exposed population used to estimate population dose varies with the release location at SRS. Appendix C, Population Data, of this *SPD Supplemental EIS* presents estimates of year 2020 populations within 50 miles of F-Area, K-Area, and H-/S-Area. The rounded populations are 869,000, 809,000, and 886,000, respectively.

[e] Impact indicators are from Section 4.1.2.1. Only the highest doses and LFCs for each alternative are presented.

[f] The same individual would not be the MEI for all activities at SRS and the Vogtle Plant; therefore, MEI impacts for SRS and the Vogtle Plant have not been summed.

Note: Due to rounding, the column totals may be slightly different than those obtained by summing the individual values.

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[12] *As derived from DOE Order 458.1,* Radiation Protection of the Public and the Environment.

Table 4–39 summarizes annual cumulative worker doses and annual LCFs from routine DOE operations and proposed DOE actions at SRS. As shown, the maximum cumulative annual SRS worker dose could total 540 to 860 person-rem, which could result in up to 1 annual LCF. In 2010, workers at SRS received 180 person-rem of radiation dose from normal operations (see Chapter 3, Section 3.1.6.1). Activities proposed under the *SPD Supplemental EIS* alternatives could produce annual workforce doses of 300 to 620 person-rem, expected to result in no annual LCFs. Doses to individual workers would be kept below the regulatory limit of 5,000 millirem per year (10 CFR 835.202). Further, ALARA principles would be implemented to maintain individual worker doses below the DOE Administrative Control Level of 2,000 millirem (DOE 2009a) and as low as reasonably achievable.

Table 4–39 Annual Cumulative Health Effects on Savannah River Site Workers

Activity		*Involved Workers*	
		Dose (person-rem per year)	***Annual LCFs*** [a]
Past, Present, and Reasonably Foreseeable Future Actions			
Existing site activities for 2010 (Baseline) [b, c]		180 [c]	0.1
High-Level Radioactive Waste Salt Processing Facility (DOE 2001:4-21)		6.5	0.004
Tank Closure (DOE 2002b:S-14, 2-8, 4-17)		53	0.03
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a:10-79) [d]		5.2	0.003
Baseline Plus Other DOE Actions		**240**	**0.1**
SPD Supplemental EIS alternatives [e, f]	No Action	300	0.2
	Immobilization to DWPF [f]	620	0.4
	MOX Fuel	320	0.2
	H-Canyon/HB-Line to DWPF	310	0.2
	WIPP	360	0.2
Total [g]		**540 – 860**	**0.3 – 0.5**

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] LCFs calculated using a conversion of 0.0006 LCFs per rem or person-rem (DOE 2003b).

[b] Impact indicators are from Chapter 3, Section 3.1.6.1, of this *SPD Supplemental EIS.*

[c] Includes 2,587 workers having a measurable dose – see Chapter 3, Section 3.1.6.1, of this *SPD Supplemental EIS*.

[d] The indicated doses and LCF risks are associated with the vault method of waste disposal at SRS. Doses and risks associated with the trench method of waste disposal at SRS would be smaller.

[e] Impact indicators are from Section 4.1.2.1.

[f] Only the highest doses and LCFs for each alternative are presented.

[g] The range reflects the differences of doses and LCFs for the alternatives addressed in this *SPD Supplemental EIS*.

Note: Due to rounding, the column totals may be slightly different than those obtained by summing the individual values.

4.5.3.3.2 Los Alamos National Laboratory

Cumulative radiological health effects on the public in the vicinity of LANL are presented in terms of radiological doses, associated excess LCFs in the offsite population, and increased LCF risk to a hypothetical MEI. Radiological health effects on involved workers are presented in terms of radiological doses and associated excess LCFs in the workforces.

Table 4–40 presents the estimated cumulative impacts on the public from: (1) the doses from radiological emissions and radiation exposure under the 2008 *LANL SWEIS* Expanded Operations Alternative (DOE 2008f); (2) the doses associated with operation of the CMRR-NF and RLUOB under the Modified CMRR-NF Alternative of the 2011 *CMRR-NF SEIS* (DOE 2011g); (3) the doses associated with the possible disposal of GTCC LLW at LANL (DOE 2011a); and (4) the doses associated with pit disassembly and conversion activities at LANL, as addressed in this *SPD Supplemental EIS*. The estimated doses under the *LANL SWEIS* Expanded Operations Alternative, which reflects the highest level of operations that is expected to occur at LANL, represent a conservative estimate of the doses that could result from ongoing LANL activities because they include doses associated with the continued operation of the Los Alamos Neutron Science Center (LANSCE) and ongoing remediation of material disposal areas (MDAs) at LANL. Operation of LANSCE is the predominant contributor to offsite dose to the population surrounding LANL. Remediation of MDAs at LANL is the predominant contributor to worker dose.

Table 4–40 Annual Cumulative Population Health Effects of Exposure to Radioactive Contaminants at Los Alamos National Laboratory

Activity	*Population within 50 Miles (80 kilometers)*		*MEI*	
	Dose (person-rem per year)	*Annual LCFs* [a]	*Dose (millirem per year)*	*Annual LCF Risk* [a]
LANL SWEIS Expanded Operations Alternative (DOE 2008f:5-221)	36	0.02	8.2	5×10^{-6}
Modified CMRR-NF Alternative (DOE 2011g:4-57) [b]	1.8	0.001	0.31	2×10^{-7}
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a:5-52, 8-72) [c]	–	–	–	–
PF-4 operations in TA-55 [d]	0.025 / 0.21	2×10^{-5} / 1×10^{-4}	0.0097 / 0.081	6×10^{-9} / 5×10^{-8}
Total	**38**	**0.02**	**8.6**	**5×10^{-6}**

CMRR-NF = Chemistry and Metallurgy Research Replacement Building Nuclear Facility; LCF = latent cancer fatality; MEI = maximally exposed individual; PF-4 = Plutonium Facility; TA-55 = Technical Area 55.

[a] LCFs are calculated using a conversion of 0.0006 LCFs per rem or person-rem (DOE 2003b).

[b] Construction of CMRR-NF has been deferred for at least 5 years.

[c] Doses and risks are not presented in the reference cited (DOE 2011a). However, it is stated that doses to members of the public would be very low, generally indistinguishable from normal background radiation.

[d] Impact indicators are taken from Section 4.1.2.1 of this *SPD Supplemental EIS*. The first value in each column is the case where pit disassembly and conversion of 2 metric tons of plutonium occurs at LANL; the second value is the case where pit disassembly and conversion of 35 metric tons of plutonium occurs at LANL.

Note: Due to rounding, the column totals may be slightly different than those obtained by summing the individual values. To convert metric tons to tons, multiply by 1.1023.

The Modified CMRR-NF Alternative impacts are expected to be about equal to those that would have been realized from operation of the 2004 CMRR-NF and greater than those associated with continued operation of the Chemistry and Metallurgy Research (CMR) Building due to reduced operations at that building. In addition, the *LANL SWEIS* totals include operation of the CMRR Facility, and this analysis does not make any adjustment for a reduction in dose that would be realized when the existing CMR Building is completely shut down. Beyond activities at LANL, no other activities in the area surrounding LANL are expected to result in radiological impacts on the public beside those associated with natural background radiation and other background radiation, as discussed in Chapter 3, Section 3.11.1, of the *CMRR-NF SEIS* (DOE 2011g). The projected dose from LANL operations is a small fraction of the dose persons living near LANL receive annually from natural background radiation.

The dose to the offsite MEI of 8.6 millirem per year is expected to remain within the 10-millirem-per-year limit required by 40 CFR Part 61, Subpart H, “National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities.” No LCFs are expected for the MEI or the general population. The estimated doses shown in Table 4-40 are also very small fractions of the normal background dose received by the population in and around LANL (Chapter 3, Section 3.2.6.1). The dose to an individual from natural background radiation is about 480 millirem per year (Chapter 3, Section 3.2.6.1) compared to the total annual MEI doses from LANL operations of about 8.6 millirem per year.

Table 4–41 presents the worker doses associated with normal LANL operations. If the *LANL SWEIS* Expanded Operations Alternative MDA Removal Option were implemented, collective worker doses from that option would average 540 person-rem per year. The addition of impacts from the operation of the Modified CMRR-NF and RLUOB would not change this estimate because the workforce dose of approximately 61 person-rem per year was included in the estimate in the 2008 *LANL SWEIS* (DOE 2008f). The 540 person-rem projected dose under the Expanded Operations Alternative in the *LANL SWEIS* corresponds to 1 LCF in the worker population for every 3 years of operation. Workforce doses would decrease by about 140 person-rem per year after remediation of the material disposal areas is complete (DOE 2008f). Inclusion of GTCC LLW disposal activities at LANL (DOE 2011a) would add 5.2 person-rem per year for the vault method of waste disposal, but would not increase the annual risk to workers appreciably. Worker doses associated with operation of PF-4 were estimated by LANL (LANL 2012a).

ALARA principles would be implemented to insure that the doses to individual workers are maintained below the DOE Administrative Control Level of 2,000 millirem (DOE 2009a) and as low as reasonably achievable.

Table 4–41 Annual Cumulative Health Effects on Los Alamos National Laboratory Workers

	Involved Workers	
Activity	*Dose (person-rem per year)*	*Annual LCFs* [a]
LANL SWEIS Expanded Operations Alternative (DOE 2008f:5-221)	540	0.3
Modified CMRR-NF Alternative	Included above	Included above
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a:5-54,55)	5.2 [b]	0.003 [b]
PF-4 operations in TA-55 [c]	29 / 190	0.02 / 0.1
Total [d]	**570 / 740**	**0.3 / 0.4**

CMRR-NF = Chemistry and Metallurgy Research Building Replacement Nuclear Facility; LCF = latent cancer fatality; PF-4 = Plutonium Facility; TA-55 = Technical Area 55.

[a] LCFs are calculated using a conversion of 0.0006 LCFs per rem or person-rem (DOE 2003b).

[b] The indicated dose and LCF risk are associated with the vault method of waste disposal at LANL. Dose and risks associated with the trench and borehole methods of waste disposal would be smaller.

[c] Impact indicators are taken from Section 4.1.2.1 of this *SPD Supplemental EIS*.

[d] The first value in each column is the case where pit disassembly and conversion of 2 metric tons of plutonium occurs at LANL; the second value is the case where pit disassembly and conversion of 35 metric tons of plutonium occurs at LANL.

Note: Due to rounding, the column totals may be slightly different than those obtained by summing the individual values. To convert from metric tons to tons, multiply by 1.1023.

4.5.3.4 Socioeconomics

4.5.3.4.1 Savannah River Site

As shown in **Table 4–42**, cumulative employment at SRS from past, present, and reasonably foreseeable future actions could reach a peak of 9,000 to 9,900 persons. These values are conservative estimates of short-term future employment at SRS. Some of the employment would occur at different times and may not be additive. Future employment due to surplus plutonium disposition activities could reduce the adverse socioeconomic effects of a recent SRS workforce reduction of approximately 1,240 workers (Pavey 2011). Activities proposed under the *SPD Supplemental EIS* alternatives could produce direct employment of about 1,200 (under the H-Canyon/HB-Line to DWPF Alternative and the PF-4 and MFFF Option) to about 2,100 (under the Immobilization to DWPF Alternative and the PDCF Option). By comparison, approximately 215,000 people were employed in the SRS ROI in 2011. In the ROI, in addition to the direct jobs, an estimated 2,500 indirect jobs[13] could be created. Anticipated fluctuations in ROI employment from activities at SRS are unlikely to greatly stress housing and community services in the ROI.

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[13] *Indirect jobs were estimated using the 2.19 employment multiplier provided in Chapter 3, Section 3.1.8.*

Table 4–42 Cumulative Employment Changes at the Savannah River Site

Activity		*Peak Operations Employment (persons)*
Past, Present, and Reasonably Foreseeable Future Actions		
Existing site activities for 2010 [a]		8,730
High-Level Radioactive Waste Salt Processing Facility (DOE 2001:4-29)		220
Tank closure (DOE 2002b:4-14)		85
Biomass cogeneration and heating (DOE 2008e:41)		-40 [d]
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a)		51
Workforce restructuring (Pavey 2011)		-1,240
Subtotal - Baseline Plus Other Actions		**7,800**
SPD Supplemental EIS alternatives [b]	No Action	1,677
	Immobilization to DWPF	1,596 – 2,111
	MOX Fuel	1,357 – 1,716
	H-Canyon/HB-Line to DWPF	1,242 – 1,676
	WIPP	1,257 – 1,716
Total [c]		**9,000 – 9,900**
Total ROI Employment in 2011 [a]		**215,000**

DWPF = Defense Waste Processing Facility; MOX = mixed oxide fuel; ROI = region of influence; WIPP = Waste Isolation Pilot Plant.

[a] From Chapter 3, Section 3.1.8, of this *SPD Supplemental EIS*.

[b] Impact indicator values include employment from concurrent operations from this chapter. Impacts are presented for the pit disassembly and conversion options resulting in the highest peak direct employment.

[c] Total is a range that includes the minimum and maximum values from the *SPD Supplemental EIS* alternatives. Totals may not equal the sum of the contributions due to rounding.

[d] The new facility would only require 20 employees, a reduction from the 60 workers currently employed at the D-Area powerhouse.

In addition to the activities at SRS, construction of Units 3 and 4 at the Vogtle Plant is estimated to result in peak construction employment of up to 4,300 workers. An in-migration of 2,500 construction workers is estimated to support construction activities. Although the Vogtle Plant is located outside the SRS ROI for socioeconomic impacts in nearby Burke County, the impacts associated with activity at the Vogtle Plant would affect conditions in Richmond and Columbia Counties in Georgia, which are included in the SRS ROI. Both adverse and beneficial socioeconomic impacts are anticipated from construction at the Vogtle Plant. The impacts in both scenarios are estimated to be small to moderate (NRC 2011a:2-8, 4-16, 4-18, 4-20).

4.5.3.4.2 Los Alamos National Laboratory

As discussed in Section 4.1.3, expanded pit disassembly and conversion operations performed at PF-4 would require an increase of up to approximately 253 LANL employees. This additional employment would cause no change in the socioeconomic conditions of the LANL ROI. The number of LANL employees supporting expanded pit disassembly and conversion operations at PF-4 would represent a small fraction of the LANL workforce (approximately 13,500 in 2010) and an even smaller fraction of the regional workforce (approximately 163,000 in 2011). Future employment due to surplus plutonium disposition activities at LANL could reduce the adverse socioeconomic effects of an expected workforce reduction (LANL 2012d). Similarly, workers required to support operations at PF-4 would be drawn from the existing LANL workforce. In the ROI, in addition to the direct jobs, an estimated 256 indirect jobs could be created. Any fluctuations in ROI employment are unlikely to greatly stress housing and community services in the ROI.

4.5.3.5 Infrastructure

4.5.3.5.1 Savannah River Site

Table 4–43 presents the estimated annual cumulative infrastructure requirements at SRS for electricity and water. Including activities evaluated in this *SPD Supplemental EIS*, projected site activities would annually require approximately 460,000 to 600,000 megawatt-hours of electricity and 380 million to 410 million gallons (1.4 billion to 1.6 billion liters) of water. Table 4–43 indicates that SRS would remain well within its capacity to deliver electricity and water.

While Vogtle Units 3 and 4 would have a positive impact on electrical capacity within the SRS ROI, they would result in an increase in groundwater use. It has been concluded, however, that groundwater resources are sufficient to sustain the increase and that cumulative groundwater use for all four units would be small (NRC 2008:7-10, NRC 2011a:7-4).

Table 4–43 Annual Cumulative Infrastructure Impacts at the Savannah River Site

Activity		*Electricity Consumption (megawatt-hours per year)*	*Groundwater Usage (gallons per year)*
Past, Present, and Reasonably Foreseeable Future Actions			
Existing site activities [a]		310,000	320,000,000
High-Level Radioactive Waste Salt Processing Facility (DOE 2001:4-7, 4-38)		24,000	27,000,000
Tank closure (DOE 2002b:1-12, 4-27)		0	1,631,000
Biomass cogeneration and heating (DOE 2008e:4, 37)		-52,560	Not reported
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a)		5,050	1,400,000
Subtotal - Baseline Plus Other Actions		**286,490**	**350,031,000**
SPD Supplemental EIS alternatives [b]	No Action	270,000	41,000,000
	Immobilization to DWPF	220,000 – 310,000	42,000,000 – 58,000,000
	MOX Fuel	170,000 – 270,000	25,000,000 – 41,000,000
	H-Canyon/HB-Line to DWPF	170,000 – 270,000	25,000,000 – 41,000,000
	WIPP	170,000 – 270,000	25,000,000 – 41,000,000
Total [c]		**460,000 – 600,000**	**380,000,000 – 410,000,000**
Total Site Capacity [a]		**4,400,000**	**2,950,000,000**

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] From Chapter 3, Section 3.1.9, of this *SPD Supplemental EIS*.

[b] Operations infrastructure requirements show the range for each alternative from Section 4.1.7.7.

Note: Total is a range that includes the minimum and maximum values from the *SPD Supplemental EIS* alternatives. Totals may not equal the sum of the contributions due to rounding. To convert gallons to liters, multiply by 3.7854.

4.5.3.5.2 Los Alamos National Laboratory

Table 4–44 presents the estimated annual cumulative infrastructure requirements at LANL for electricity and water. Including activities proposed in this *SPD Supplemental EIS*, projected site and Los Alamos County activities would annually require approximately 880,000 megawatt-hours of electricity and 1.67 billion gallons (6.32 billion liters) of water. Table 4–44 indicates that LANL would remain within its capacity to deliver electricity and water.

Table 4–44 Annual Cumulative Infrastructure Impacts at Los Alamos National Laboratory

Activity		*Electricity Consumption (megawatt-hours per year)*	*Water Usage (gallons per year)*
Past, Present, and Reasonably Foreseeable Future Actions			
Existing site activities (DOE 2011g:4-113)		563,000	412,000,000
Operation of CMRR-NF and RLUOB (DOE 2011g:4-35) [a]		161,000	16,000,000
Subtotal – Existing Activities Plus CMRR-NF and RLUOB		**724,000**	**428,000,000**
Current Los Alamos County requirements (DOE 2011g:4-113)		150,000	1,241,000,000
Disposal of greater-than-Class C low-level radioactive waste (DOE 2011a)		5,050	900,000
Subtotal - Baseline Plus Other Actions		**879,050**	**1,670,000,000**
SPD Supplemental EIS alternatives [b]	No Action	960	480,000
	Immobilization to DWPF	960 – 1,900	480,000 – 1,200,000
	MOX Fuel	960 – 1,900	480,000 – 1,200,000
	H-Canyon/HB-Line to DWPF	960 – 1,900	480,000 – 1,200,000
	WIPP	960 – 1,900	480,000 – 1,200,000
Total		**880,000**	**1,670,000,000**
Total Site Capacity [c]		**1,226,000**	**1,807,000,000**

CMRR- NF = Chemistry and Metallurgy Research Replacement Building Nuclear Facility; DWPF = Defense Waste Processing Facility; MOX = mixed oxide; RLUOB = Radiological Laboratory/Utility/Office Building; WIPP = Waste Isolation Pilot Plant.

[a] Construction of CMRR-NF has been delayed by at least 5 years.

[b] Operations infrastructure requirements show the range for each alternative from Section 4.1.7.7.

[c] Total site electrical capacity is for the entire service area, including LANL and other Los Alamos County users. Total site water capacity includes LANL's current site requirement, the current Los Alamos County requirement, and the available system capacity (DOE 2011g).

Note: To convert gallons to liters, multiply by 3.7854.

4.5.3.6 Waste Management

4.5.3.6.1 Savannah River Site

Table 4–45 lists cumulative volumes of LLW, MLLW, hazardous waste, and solid nonhazardous sanitary wastes that would be generated at SRS from all activities including the waste that would be generated under the *SPD Supplemental EIS* alternatives. Cumulative waste volumes from existing site activities are projected over 30 years, a period of time that exceeds the projected periods of construction or operation of all plutonium facilities under the action alternatives addressed in this *SPD Supplemental EIS*. Cumulative TRU waste projections for SRS are discussed in Section 4.5.3.6.3. The cumulative waste volumes also include wastes from possible disposal of GTCC waste at SRS pursuant to the *Draft GTCC EIS* (DOE 2011a:1-9, 5-89). Also, SRS is being considered for use as a military training site; however, negligible waste generation is expected from this action (DOE 2011i:44).

Under some alternatives, there could be minor additions to the total number of HLW canisters resulting from DWPF vitrification of HLW. Under the Immobilization to DWPF Alternative, approximately 95 additional canisters containing vitrified HLW could be produced at DWPF. Under the MOX Fuel Alternative, up to approximately 2 additional canisters containing HLW could be generated from processing 4 metric tons (4.4 tons) of non-pit plutonium for MOX fuel fabrication. Under the H-Canyon/HB-Line to DWPF Alternative, some surplus plutonium materials would be dissolved at H-Canyon/HB-Line, mixed with HLW, and vitrified at DWPF. Because the dissolved plutonium would displace some of the HLW feed to DWPF, implementation of this alternative could result in the generation of up to 48 additional canisters containing vitrified HLW. Finally, under all action alternatives up to approximately 5 additional canisters containing vitrified HLW could be generated if H-Canyon/HB-Line is optionally used for pit conversion to plutonium oxide. DOE would store canisters of vitrified HLW at SRS in S-Area GWSBs pending their offsite disposition.

Table 4–45 Total Cumulative Waste Generation at the Savannah River Site (cubic meters)

Activity (duration or reference)		*Solid LLW*	*Solid MLLW*	*Solid Hazardous Waste*	*Solid Nonhazardous Waste*
Past, Present, and Reasonably Foreseeable Future Actions					
Existing site activities (30 years) [a]		390,000	2,580	2,520	2,490,000
ER/D&D; 35-Year Forecast (DOE 2002b:5-11)		61,600	3,100 [b]	3,100 [b]	N/R
HLW Salt Processing Facility [c] (DOE 2001:4-36)		920	13	43	7,670 [e]
Tank closure (DOE 2002b:4-25) [e]		1,284	257	43	428
Biomass cogeneration and heating (DOE 2008e:36) (30 years)		0	0	0	438,000 [f]
GTCC LLW facilities (DOE 2011a:5-89) [g]		12	0	128	230,000
GTCC LLW disposal at SRS (DOE 2011a:1-9)		12,000	170	0	0
Subtotal - Baseline Plus Other Actions		**466,000**	**6,100**	**5,800**	**3,200,000**
SPD Supplemental EIS alternatives	No Action	16,000	0	66	31,000
	Immobilization to DWPF	15,000 – 36,000	900 – 930	910 – 960	18,000 – 2,800,000
	MOX Fuel	20,000 – 42,000	14 – 220	7 – 7,000	1,200,000 – 2,800,000
	H-Canyon/ HB-Line to DWPF	27,000 – 49,000	31 – 240	7 – 7,000	2,600,000 – 2,800,000
	WIPP	11,000 – 33,000	0 – 210	6 – 7,000	15,000 – 2,800,000
Total		**480,000 – 520,000**	**6,100 – 7,000**	**5,800 – 13,000**	**3,200,000 – 6,000,000**

D&D = decontamination and decommissioning; DWPF = Defense Waste Processing Facility; ER = environmental restoration; GTCC = greater-than-Class C; HLW = high-level radioactive waste; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; MOX = mixed oxide; N/R = not reported; WIPP = Waste Isolation Pilot Plant.

[a] Except for HLW, volumes were obtained from Chapter 3, Section 3.1.10.1, of this *SPD Supplemental EIS*, assuming the 5-year average annual generation rate would continue for 30 years. HLW is currently stored in waste storage tanks as discussed in Chapter 3, Section 3.1.10.2.

[b] A projected 6,200 cubic meters of waste is estimated for combined MLLW and hazardous waste (DOE 2002b:5-11); half was assumed for each type of waste.

[c] Under the preferred solvent extraction cesium separations process, salt waste processing could also generate about 45,400 cubic meters of liquid radioactive waste that would be evaporated (DOE 2001:4-36).

[d] Assuming 910 metric tons of sanitary solid and industrial waste to be disposed of at the Three Rivers Regional Landfill, and a non-compacted waste density of 0.1186 metric tons per cubic meter (200 pounds per cubic yard).

[e] Under the preferred Fill-with-Grout option, tank closure activities could also generate about 48,600 cubic meters of liquid radioactive waste that would be evaporated (DOE 2002b:4-25).

[f] Assuming 30 years of wood ash generation at a rate of about 7,300 metric tons per year (DOE 2008e:35), and a wood fly ash density of 490 kilograms per cubic meter (31 pounds per cubic foot) (Naik 2002:47).

[g] Highest potential construction and operations generation volume from either the trench, borehole, or vault alternative as shown in Table 5.3.11-1 of the *Draft GTCC EIS* (DOE 2011a).

Note: Total may not equal the sum of the contributions due to rounding. To convert cubic meters to cubic feet, multiply by 35.314; metric tons to tons, multiply by 1.1023.

Increases in the generation of LLW, MLLW, hazardous waste, and solid nonhazardous waste are also projected. LLW would be sent to E-Area for disposal in slit trenches or engineered trenches, stored in low-activity waste vaults, or transported off site to commercial disposal facilities or the Nevada National Security Site. MLLW would be temporarily stored at permitted SRS storage facilities and transported to offsite treatment, storage, and disposal facilities.

Consistent with the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* ROD (63 FR 41810), hazardous waste would continue to be disposed off site. Solid nonhazardous waste would continue to be disposed of at the Three Rivers Regional Landfill, consistent with current practices. Efforts would be made to recycle as much of the solid nonhazardous waste as reasonably possible to reduce the need for its disposal.

Although operation of the proposed biomass cogeneration and heating plants at D-, K-, and L-Areas would generate wood ash that would be disposed of at landfills such as the Three Rivers Regional Landfill, DOE expects an overall decrease in the quantities of solid nonhazardous wastes requiring disposal. This is because the biomass fuels to be burned in the new plants would reduce the amount of fly and bottom ash (compared to coal ash) entering SRS landfills by more than 95 percent. Furthermore, the biomass fuels to be burned would otherwise require disposal space in landfills (DOE 2008e:36).

Construction of Vogtle Units 3 and 4 would result in negligible quantities of solid hazardous and nonhazardous waste, while its operation would principally generate solid LLW and used fuel. Generation of solid LLW is not expected to exceed 162 cubic meters (212 cubic yards) per year. Used fuel would be stored on site until a Federal repository becomes available to accept HLW and used fuel. DOE personnel at the Nevada National Security Site have concluded that operation of Vogtle Units 3 and 4 would result in small environmental impacts from radioactive waste disposal (NRC 2008:3-15; 6-12 – 6-14). Further, because radioactive waste generated at SRS and Vogtle Units 3 and 4 would use different waste management facilities, there would be no cumulative impact.

4.5.3.6.2 Los Alamos National Laboratory

Table 4–46 lists cumulative volumes of LLW, MLLW, hazardous waste, and solid nonhazardous sanitary wastes that would be generated at LANL from all activities, including the waste that would be generated under the *SPD Supplemental EIS* alternatives. Cumulative waste volumes from existing site activities are projected over 30 years, a period of time that exceeds the projected periods of construction or operation of all plutonium facilities under the action alternatives in this *SPD Supplemental EIS*. Cumulative TRU waste projections for LANL are discussed in Section 4.5.3.6.3. Volumes of other wastes from existing site activities are derived from the *CMMR-NF SEIS* (DOE 2011g:4-119), which updates project waste generation volumes presented in the 2008 *LANL SWEIS* (DOE 2008f). Since publication of the *CMRR-NF SEIS*, the Los Alamos Science and Engineering Complex project, referred to in the *LANL SWEIS* as the "Science Complex," was cancelled; however, projected waste generation from this project is negligible. The cumulative waste volumes also include wastes from possible disposal of GTCC waste at LANL pursuant to the *Draft GTCC EIS* (DOE 2011a:1-9, 5-89). Also considered in the cumulative analysis is the maximum potential waste generation under the Removal with Off-Site Disposal Alternative as presented in the *SERF EA* (DOE 2010e:78).

Table 4–46 Total Cumulative Waste Generation at Los Alamos National Laboratory (cubic meters)

Activity (duration or reference)		*Solid LLW*	*Solid MLLW*	*Solid Hazardous Waste*	*Solid Nonhazardous Waste*
Past, Present, and Reasonably Foreseeable Future Actions					
Existing site activities (30 years) [a]		25,000 – 105,000	320 – 14,000	1,650 – 3,000	135,000 – 160,000
GTCC waste facilities (DOE 2011a:5-89) [b]		12	0	128	230,000
GTCC waste disposal at LANL (DOE 2011a:1-9)		12,000	170	0	0
Expansion of SERF and environmental restoration of Reach S-2 of Sandia Canyon (DOE 2010e) [c]		0	0	38,300	38,300
Subtotal - Baseline Plus Other Actions		**37,000 – 117,000**	**490 – 14,000**	**40,000 – 41,000**	**400,000 – 430,000**
SPD Supplemental EIS alternatives	No Action	200	2	0	0
	Immobilization to DWPF	200 – 4,000	2 – 87	0 – 4	0
	MOX Fuel	200 – 4,000	2 – 87	0 – 4	0
	H-Canyon/HB-Line to DWPF	200 – 4,000	2 – 87	0 – 4	0
	WIPP	200 – 4,000	2 – 87	0 – 4	0
Total		**37,000 – 121,000**	**490 – 14,000**	**40,000 – 41,000**	**400,000 – 430,000**

DWPF = Defense Waste Processing Facility; GTCC = greater-than-Class C; LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; MOX = mixed oxide; SERF = Sanitary Effluent Reclamation Facility; WIPP = Waste Isolation Pilot Plant.

[a] Volumes were obtained from Chapter 4, Table 4–57, of the *Final Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2011g:4-49), which provides a revised annual average waste generation rate for LANL operations subsequent to the *LANL SWEIS* (DOE 2008f) and assuming the annual average generation rates continue for 30 years. Chemical waste is reported in pounds (using a 4,000-pounds-per-cubic-meter conversion factor) and is assumed to be hazardous waste for analysis purposes.

[b] Highest potential construction and operations generation volume from either the trench, borehole, or vault alternative as shown in Table 5.3.11-1 of the *Draft GTCC EIS* (DOE 2011a:5-89).

[c] Under the Removal with Off-Site Disposal Alternative, up to 76,500 cubic meters of solid hazardous and nonhazardous waste could be generated; half was assumed for each type of waste.

Note: Total may not equal the sum of the contributions due to rounding. To convert cubic meters to cubic feet, multiply by 35.314.

Generation rates of LLW, MLLW, hazardous waste, and solid nonhazardous waste are expected to remain relatively unchanged at LANL under all alternatives.

4.5.3.6.3 Transuranic Waste Disposal at WIPP

Because TRU waste from both SRS and LANL would be shipped to WIPP, the range of TRU volume generation needs to be evaluated considering both SRS and LANL inclusively, while avoiding double-counting for the same operations. Taking into account TRU generation at both sites, **Table 4–47** lists the ranges of cumulative TRU waste generation under all *SPD Supplemental EIS* alternatives and the impact this volume of TRU waste would have on WIPP capacities.

Table 4–47 Total Cumulative Transuranic Waste Generation at the Savannah River Site and Los Alamos National Laboratory (cubic meters)

Activity	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Subtotal baseline plus other actions at SRS [a]	*9,660* [b]				
Subtotal baseline plus other actions at LANL [a]	*10,200* [b]				
SPD Supplemental EIS alternatives	6,000	11,000 – 13,000	11,000 – 12,000	7,900 – 8,500	15,000 – 17,000
Percent of unsubscribed WIPP capacity [c]	*30*	58 – 67	57 – 63	40 – 43	78 – 88

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; MOX = mixed oxide; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant.

[a] TRU waste projections for SRS and LANL are from the *Annual Transuranic Waste Inventory Report – 2011* (DOE 2011k).

[b] Baseline TRU waste volumes at SRS and LANL are already included in the subscribed TRU waste projected in the *Annual Transuranic Waste Inventory Report – 2011* (DOE 2011k:Table 3-1); therefore, these quantities are not included in the percent of unsubscribed WIPP capacity calculations.

[c] WIPP unsubscribed capacity is approximately 19,700 cubic meters. The greatest impact on the WIPP unsubscribed capacity (about 88 percent) occurs under the WIPP Alternative, assuming generation of approximately 16,000 cubic meters of TRU waste at SRS and 1,200 cubic meters of TRU waste at LANL.

Note: To convert cubic meters to cubic feet, multiply by 35.314.

Significant quantities of TRU waste would be generated under all alternatives. At SRS, TRU waste would be packaged and stored at onsite storage pads in E-Area, pending shipment to WIPP. At LANL, TRU waste would be characterized, loaded into authorized shipping packages at the Radioassay and Nondestructive Testing Facility or the new TRU Waste Facility, and shipped to WIPP. Disposal of TRU waste at WIPP is discussed in Section 4.1.4 and Appendix B, Section B.3.

The total WIPP capacity for TRU waste disposal is set at 175,600 cubic meters (6.2 million cubic feet) pursuant to the Waste Isolation Pilot Plant Land Withdrawal Act, or 168,485 cubic meters (5.95 million cubic feet) of contact-handled TRU waste (DOE 2008k:16). Estimates in the *Annual Transuranic Waste Inventory Report – 2011* indicate that about 148,800 cubic meters (5.25 million cubic feet) of contact-handled TRU waste would be disposed of at WIPP (DOE 2011k:Table C–1), approximately 19,700 cubic meters (696,000 cubic feet) less than the current contact-handled TRU waste capacity. Depending on the alternative, the volume of TRU waste that could be generated would represent from 30 to 88 percent of this unsubscribed WIPP disposal capacity. Because the TRU waste projections from baseline activities at SRS and LANL are already included in the subscribed estimates for these sites, implementation of surplus plutonium disposition would leave approximately 2,700 cubic meters (95,000 cubic feet) to 13,700 cubic meters (480,000 cubic feet) of unsubscribed capacity at WIPP to support other activities. Under the MOX Fuel and WIPP Alternatives, less TRU waste would be generated, representing a smaller percentage of the unsubscribed WIPP disposal capacity, if the portion of non-pit plutonium inventory that is unirradiated FFTF fuel was direct-shipped as waste to WIPP, and if CCCs were used for packaging surplus plutonium for WIPP disposal rather than the assumed POCs.[14] Future decisions about the disposal of any significant quantities of TRU waste would be made in the context of the needs of the entire DOE complex.

4.5.3.7 Transportation

The assessment of cumulative impacts for past, present, and reasonably foreseeable future actions involving radioactive material transport concentrates on radiological impacts from offsite transportation throughout the nation that would result in potential radiation exposure to the general population, in addition to those impacts evaluated in this *SPD Supplemental EIS*. Cumulative radiological impacts from transportation are measured using the collective dose to the general population and workers because dose can be directly related to LCFs using a cancer risk coefficient.

In addition to the impacts addressed in Section 4.1.5, the cumulative impacts from transport of radioactive material consist of impacts from historical shipments of radioactive waste and used (irradiated) fuel; reasonably foreseeable actions that include transportation of radioactive material identified in Federal, non-Federal, and private environmental impact analyses; and general radioactive material transportation that is not related to a particular action. The timeframe of impacts was assumed to begin in 1943 and continue to some foreseeable future date. Projections for commercial radioactive material transport extend to 2073 based on available information.

Table 4–48 provides a summary of total collective radiation doses for workers and the general population and collective doses from past, present, and reasonably foreseeable future transportation activities. This table lists activities having documented transportation impacts and that are not related to those considered in this *SPD Supplemental EIS*.

Historical Shipments. The impact values provided for historical shipments related to SRS include shipments of used fuel from 1953 through 1993 (then called spent nuclear fuel). Used fuel data are available from 1970 through 1993. These data were linearly extrapolated to account for shipments from 1953, when SRS began operations, to 1969 (Jones and Maheras 1994).

There are considerable uncertainties in these historical estimates of collective dose. For example, the population densities and transportation routes used in the dose assessment were based on 1990 census data and the U.S. highway network as it existed in 1995. Using 1990 census data overestimates historical collective doses because the U.S. population has continuously increased over the time covered in this assessment. On the contrary, using interstate highway routes as they existed in 1996 may slightly underestimate doses for shipments that occurred in the 1950s and 1960s, because a larger portion of the transport routes would have been on non-interstate highways, where population may have been closer to the road. By the 1970s, the structure of the interstate highway system was largely fixed and most shipments would have been made using interstate routing.

Transportation impacts associated with the *SPD EIS* were assumed to be addressed in this *SPD Supplemental EIS*.

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[14] *If both options were implemented, the cumulative TRU waste volume under the MOX Fuel Alternative would drop from a maximum of 63 percent of the unsubscribed WIPP disposal capacity (assuming 2 metric tons [2.2 tons] of surplus plutonium are disposed of at WIPP) to approximately 53 percent. The cumulative TRU waste volume under the WIPP Alternative would drop from 88 percent of the unsubscribed WIPP disposal capacity to approximately 63 percent.*

Table 4–48 Transportation-Related Radiological Collective Doses and Risks Not Related to this Environmental Impact Statement Analysis

	Worker		***General Population***	
Category	***Collective Dose (person-rem)***	***Risk (LCF)***	***Collective Dose (Person-rem)***	***Risk (LCF)***
Site-Specific Historical Shipments (1953—1993) [a]				
Used fuel shipments to SRS	49	0.03	25	0.02
Subtotal	**49**	**0.03**	**25**	**0.02**
Past, Present, and Reasonably Foreseeable DOE Actions [b]				
Naval reactor disposal	5.8	0.00	5.8	0.00
Treatment of Mixed Low-Level Radioactive Waste EIS [c]	18	0.01	1.34	0.00
WM PEIS [d]	15,550	9.3	18,430	11.1
WIPP SEIS II	790	0.47	5,900	3.54
Idaho High-Level Waste and Facility Disposition Final EIS	520	0.31	2,900	1.74
Sandia National Laboratories SWEIS	94	0.06	590	0.35
Tritium Production in Commercial Light Water Reactor EIS	16	0.01	80	0.05
LANL SWEIS	910	0.55	287	0.17
Plutonium Residues at Rocky Flat EIS	2.1	0.00	1.3	0.00
Surplus Disposition HEU	400	0.24	520	0.31
Molybdenum-99 Production EIS	240	0.14	520	0.31
Import of Russian Plutonium-238 EA	1.8	0.00	4.4	0.00
Pantex SWEIS	250	0.15	490	0.29
Draft NNSS Site-Wide EIS [e]	5,550	3.33	1,360 [f]	0.82
Storage and disposition of fissile material	N/A	N/A	2,400 [f]	1.44
Stockpile stewardship	N/A	N/A	38 [f]	0.02
Container system for Naval used fuel	11	0.01	15	0.01
S3G and D1G Prototype Reactor Plant Disposal EIS	2.9	0.00	2.2	0.00
S1G Prototype Reactor Plant Disposal EIS	6.7	0.00	1.9	0.00
ETTP DUF_6 Transport to Portsmouth Gaseous Diffusion Plant	99	0.06	3.2	0.00
Spent Nuclear Fuel PEIS	360	0.22	810	0.49
Foreign Research Reactor Spent Nuclear Fuel EIS [g]	90	0.05	222	0.13
Private Fuel Storage Facility Final EIS [h]	30	0.02	190	0.11
Draft GTCC EIS [i]	500	0.3	160	0.09
Draft TC&WM EIS [j]	3,180	1.9	440	0.26
West Valley Waste Management EIS	520	0.31	410	0.25
West Valley Demonstration Project EA for the D&D and Removal of Certain Facilities	14	0.01	11	0.01
West Valley Decommissioning EIS [k]	400	0.24	72	0.04
Paducah DUF_6 Conversion Final EIS [l]	770	0.46	31	0.02
Portsmouth DUF_6 Conversion Final EIS [m]	520	0.31	29	0.02
Y-12 SWEIS [n]	Not listed	Not listed	309	0.2
Subtotal [o]	**30,900**	**18.5**	**36,200**	**21.7**
Past, Present, and Reasonably Foreseeable Non-DOE Actions				
Enrichment Facility in Lea County EIS [p]	1,500	0.90	450	0.27
Eagle Rock Enrichment Facility [q]	3,350	2.01	60,000	36
GE Global Laser Enrichment [r]	348.3	0.21	493.5	0.30
American Centrifuge Plant [s]	285	0.17	390	0.23
Vogtle Early Site Permit EIS [t]	0.51	0.00	0.90	0.00
Subtotal [o]	**5,480**	**3.29**	**61,300**	**36.8**
General Radioactive Material Transport				
1943–1982 [u]	230,000	138	170,000	102
1983–2073 [v]	154,000	92	168,000	101
Subtotal (1943–2073)	**384,000**	**230**	**338,000**	**203**
Total Impacts (up to 2073) [o]	**420,000**	**252**	**436,000**	**262**

D&D = decontamination and decommissioning; DUF_6 = depleted uranium hexafluoride; EA = Environmental Assessment; EIS = environmental impact statement; ETTP = Eastern Tennessee Technology Park; GTTC = greater-than-Class C; HEU = highly enriched uranium; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; N/A = not available

Category	Worker		General Population	
	Collective Dose (person-rem)	**Risk (LCF)**	**Collective Dose (Person-rem)**	**Risk (LCF)**

(the data are provided as a sum for workers and the public); NNSS = Nevada National Security Site; PEIS = programmatic environmental impact statement; SRS = Savannah River Site.

[a] Jones and Maheras 1994.

[b] Unless it is specified otherwise, all values are taken from the *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2008h).

[c] JEGI 1998.

[d] The values are for the low-level and mixed low low-level radioactive waste transportation impacts on NNSS, based on the amended ROD for the *WM PEIS*, 65 FR 10061, February 25, 2000.

[e] DOE 2011h.

[f] Includes worker and general population doses.

[g] DOE 1996d.

[h] NRC 2001.

[i] DOE 2011a.

[j] DOE 2009d.

[k] DOE 2010d. The impacts are expressed as a range to reflect all potential alternatives to complete closure that could be pursued after 2020.

[l] DOE 2004c.

[m] DOE 2004b.

[n] DOE 2011e.

[o] The summed values are rounded to three significant figures.

[p] NRC 2005e. The values presented in this table are for 30 years of operation.

[q] NRC 2011b.

[r] NRC 2010.

[s] NRC 2006.

[t] NRC 2008.

[u] These estimates are very conservative because few shipments were made in the 1950s and 1960s. Also, the non-exclusive shipment dose estimates are based on a very conservative method. See the text for the dose estimates for 1975 and 1983 shipments.

[v] The annual dose estimates are similar to those for the period 1975─1982.

Reasonably Foreseeable Actions. The values provided for reasonably foreseeable actions could lead to some double counting of impacts. For example, the LLW transportation impacts in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a) may also be included in the individual DOE facilities' sitewide EISs. Also, for foreseeable actions where no preferred alternative was identified or no ROD has been issued, the impact values are included for the alternative having the largest transportation impacts. Transportation impacts associated with the *Complex Transformation SPEIS* were assumed to be addressed in other NEPA documents listed in Table 4–48, such as the *LANL SWEIS* (DOE 2008f) and the *Final Site-Wide Environmental Impact Statement for the Y–12 National Security Complex* (DOE 2011e).

General Radioactive Materials Transports. General radioactive material transports are shipments not related to a particular action; they include shipments of radiopharmaceuticals, industrial and radiography sources, and uranium fuel cycle materials, as well as shipments of commercial LLW to commercial disposal facilities. The collective dose estimates from transportation of these types of materials were based on the following: (1) for the period 1943 through 1982, an NRC analysis documented in NUREG-0170 for shipments made in 1975 (NRC 1977); and (2) for the period 1983 through 2073, an analysis of unclassified shipments in 1983, documented in the *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995). The NRC report estimated collective doses to the workers and population of 5,600 and 4,200 person-rem, respectively, for transports in 1975. The modes of transportation included truck, rail, and plane. The collective doses to workers and population for 1943 through 1982 (39 years) were estimated to be 230,000 and 170,000 person-rem, respectively (NRC 1977). The collective doses to workers and populations for shipments in 1983 using a combination of truck and plane shipments were estimated to be 1,690 and 1,850 person-rem, respectively

(DOE 1995). These doses were calculated using more-refined models than those used in the 1977 NRC report. Even though the number of shipments was larger than those of the 1977 NRC report, the estimated doses are smaller by a factor of 2 to 3. The collective doses over 91 years, from 1983 through 2073, would be 154,000 and 168,000 person-rem for workers and the general population, respectively.

Table 4–49 provides impacts on transport workers and the general population from future transportation activities considered in this *SPD Supplemental EIS* in comparison to the cumulative impacts estimated in Table 4–48. The impacts from transportation in this *SPD Supplemental EIS* are quite small compared with overall cumulative transportation impacts. The collective worker dose from all types of shipments (the alternatives in this *SPD Supplemental EIS*, historical shipments, reasonably foreseeable actions, and general transportation) was estimated to be about 420,000 person-rem (252 LCFs) for the period 1943 through 2073 (131 years). The general population collective dose was estimated to be about 436,000 person-rem (262 LCFs). Worker and general population collective doses as estimated in this *SPD Supplemental EIS* range from about 240 to 560 person-rem, and from about 180 to 580 person-rem, respectively, with no LCFs expected. To place these numbers in perspective, the National Center for Health Statistics indicates that the annual average number of cancer deaths in the United States from 2004 through 2008 was about 560,000, with less than a 1 percent fluctuation in the number of deaths from one year to the next (CDC 2012). The total number of LCFs (among the workers and general population) estimated to result from radioactive material transportation over the period between 1943 and 2073 is 514, or an average of about 4 LCFs per year. The transportation-related LCFs represent about 0.0007 percent of the overall annual number of cancer deaths; therefore, their contribution is indistinguishable from the natural fluctuation in the total annual death rate from cancer. Note that the majority of the cumulative risks to workers and the general population would be due to the general transportation of radioactive material unrelated to activities evaluated in this *SPD Supplemental EIS*.

Table 4–49 Cumulative Transportation Impacts for this *SPD Supplemental EIS*

Category	*Collective Worker Dose (person-rem)*	*Collective General Population Dose (person-rem)*
Transportation Impacts in this *SPD Supplemental EIS*	**240 to 560**	**180 to 580**
Other Nuclear Material Shipments		
Historical (used fuel to SRS)	49	25
Past, present, and reasonably foreseeable DOE actions	30,900	36,200
Past, present, and reasonably foreseeable non-DOE actions	5,480	61,300
General radioactive material transport (1943 to 2073)	384,000	338,000
Total Collective Dose (up to 2073)	**420,000**	**436,000**
Total Latent Cancer Fatalities [a]	**252**	**262**

SRS = Savannah River Site.

[a] Total latent cancer fatalities are calculated assuming 0.0006 latent cancer fatalities per person-rem of exposure (DOE 2003b).

4.5.3.8 Environmental Justice

Cumulative environmental justice impacts occur when the net effect of regional projects or activities results in disproportionately high and adverse human health and environmental effects on minority or low-income populations.

4.5.3.8.1 Savannah River Site

The analysis of alternatives in this chapter indicates no high and adverse cumulative human health and environmental impacts on any population within the SRS ROI. Therefore, no cumulative disproportionately high and adverse human health and environmental effects on minority or low-income populations are expected as a result of implementing any of the alternatives considered in this *SPD Supplemental EIS*.

4.5.3.8.2 Los Alamos National Laboratory

Similar to SRS (Section 4.5.3.8.1), the analysis of alternatives in this chapter indicates no high and adverse cumulative human health and environmental impacts on any population within the LANL ROI. Therefore, no cumulative disproportionately high and adverse human health and environmental effects on minority or low-income populations are expected as a result of implementing any of the alternatives considered in this *SPD Supplemental EIS*.

4.5.4 Global Commons Cumulative Impacts

Cumulative effects may also occur on a global scale. Both ozone depletion and global climate change are addressed below as they relate to the alternatives.

4.5.4.1 Ozone Depletion

The alternatives addressed in this *SPD Supplemental EIS* are not expected to use or discharge substantial quantities of ozone-depleting substances (ODSs) as regulated under 40 CFR Part 82, "Protection of Stratospheric Ozone." Construction and operation of plutonium facilities would be accomplished using materials and equipment formulated to be compliant with laws and regulations to reduce the use of ODSs. Any release of ODSs would be incidental to the conduct of the analyzed activities. Emissions of ODSs would be very small and would represent a negligible contribution to the destruction of the Earth's protective ozone layer. DOE is working to reduce use of ODSs complex-wide based on Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and DOE Order 451A, *Environmental Protection Program*.

4.5.4.2 Global Climate Change

The "natural greenhouse effect" is the process by which part of terrestrial radiation is absorbed by gases in the atmosphere, warming the Earth's surface and atmosphere. This greenhouse effect and the Earth's radiation balance are affected largely by water vapor, carbon dioxide, and trace gases, which absorb infrared radiation and are referred to as "greenhouse gases."

The Intergovernmental Panel on Climate Change (IPCC) identifies increases in atmospheric concentrations of certain pollutants as a cause of changes in the Earth's atmospheric energy balance and an influence on global climate. Warming of the global climate is referred to as "global warming." Water vapor (approximately 1 percent of the atmosphere) is the most common and dominant greenhouse gas; only small amounts of water vapor are produced as the result of human activities. The principal greenhouse gases resulting from human activities are carbon dioxide, methane, nitrous oxide, and halocarbons. Halocarbons include chlorofluorocarbons; hydrofluorocarbons, which are replacing chlorofluorocarbons as refrigerants; and perfluorocarbons, which are byproducts of aluminum smelting. Other gases of concern include sulfur hexafluoride, which is widely used in insulation for electrical equipment. These gases are released in different quantities and have different potencies in their contributions to global warming (IPCC 2007; Justus and Fletcher 2006). Executive Order 13514 lists carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride as the priority greenhouse gases that Federal agencies are to reduce.

Sources of anthropogenic carbon dioxide include combustion of fossil fuels such as natural gas, oil, gasoline, and coal. The IPCC estimates that carbon dioxide atmospheric levels have risen by more than 35 percent since the preindustrial period (beginning in 1750) as a result of human activities. Emissions of other greenhouse gases have also risen. Annual global emissions of carbon dioxide from fossil fuel combustion in 2008 were 29.4 billion metric tons (32.4 billion tons), while preliminary estimates for 2010 were 33.5 billion metric tons (36.9 tons) (CDIAC 2011a, 2011b). Emissions of greenhouse gases are stated in terms of equivalent emissions of carbon dioxide based on their global warming potential.

The IPCC lists potential impacts from warming of the climate system, including expansion of seawater volume; decreases in mountain glaciers and snow cover resulting in sea-level rise; changes in arctic temperatures and ice; changes in precipitation, ocean salinity, and wind patterns; and changes in extreme weather (IPCC 2007:3–8).

The release of anthropogenic greenhouse gases and their potential contribution to climate change are inherently cumulative phenomena. Cumulative impacts of the emission of carbon dioxide and other greenhouse gases from the alternatives addressed in this *SPD Supplemental EIS*, and other activities at SRS and throughout the region, would contribute to the changes related to global climate discussed above. As described in this chapter, the alternatives considered in this *SPD Supplemental EIS* could produce various quantities of carbon dioxide from construction and operation of the plutonium facilities. Specifically, the emission estimates for the alternatives account for facility-specific fuel-burning sources from construction activity, mobile source emissions from material shipments, emissions from employee vehicles, and indirect emissions from increased electricity use.

The greenhouse gases emitted by operation of the surplus plutonium capabilities at SRS and LANL would add a relatively small increment to emissions of these gases in the United States and the world. Overall greenhouse gas emissions in the United States during 2010 totaled about 6,822 million metric tons (7,520 million tons) of carbon dioxide equivalent (EPA 2012). By way of comparison, the maximum annual operational emissions of carbon dioxide under the *SPD Supplemental EIS* alternatives would equal about 0.0025 percent of the United States' total emissions in 2010. Emissions from the proposed surplus plutonium capabilities at SRS and LANL contribute in a small way to the climate change impacts described above, in combination with past and future emissions from all other sources. At present there is no methodology that would allow DOE to estimate the specific impacts this increment of climate change would produce in the vicinity of the facility or elsewhere. Carbon dioxide emissions for all alternatives are presented in **Table 4–50**, including the emissions from shipment of MOX fuel to commercial nuclear power reactors. In addition to carbon dioxide, there may be emissions of other greenhouse gases.

Table 4–50 Annual Carbon Dioxide Emissions by Alternative from Operation of Plutonium Facilities

Alternative	*Emissions (metric tons per year)*		
	Emissions other than Unirradiated MOX Fuel Shipments [a]	*Emissions from Shipping Unirradiated MOX Fuel to TVA Reactors*	*Emissions from Shipping Unirradiated MOX Fuel to Generic Reactors* [b]
No Action	150,000	Not applicable	1,400
Immobilization to DWPF	170,000	160	1,600
MOX Fuel	150,000	170	1,700
H-Canyon/HB-Line to DWPF	150,000	160	1,600
WIPP	150,000	160	1,600

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; TVA = Tennessee Valley Authority; WIPP = Waste Isolation Pilot Plant.

[a] Includes emissions from fuel use; electricity use; employee vehicles; and shipments of waste, construction materials, and materials other than unirradiated MOX fuel based on the option having the highest emissions.

[b] Shipment of unirradiated MOX fuel to generic commercial nuclear power reactors assumed for analysis purposes to be located in the northwestern United States.

Note: To convert metric tons to tons, multiply by 1.1023.

Emissions of carbon dioxide and other greenhouse gases resulting from the nuclear energy life cycle are discussed in Section 3.16.1.2 of the *Draft Supplemental Environmental Impact Statement for Sequoyah Nuclear Power Plant Units 1 and 2, License Renewal, Hamilton County, Tennessee* (TVA 2010a). Electric generation from nuclear power plants produces no direct emissions of carbon dioxide.

The IPCC believes emissions of greenhouse gases and the impacts on global climate and the resulting environmental, economic, and social consequences could be significant (U.S. Global Change Research Program 2009:111-116). At present there is no consensus on methodology that would allow DOE to estimate quantitatively the specific impacts (if any) that incremental climate change would produce in the vicinity of SRS or elsewhere.

It has been projected, however, that regional climate changes in the southeastern United States, including at SRS, could include continued warming in all seasons and an increase in the rate of warming. The number of very hot days has been projected to rise at a greater rate than the average temperature. Climate models do not agree on changes in precipitation in most of the southeastern United States. However, the frequency, duration, and intensity of droughts may increase as a result of higher temperatures. Increased intensity of hurricanes may result in higher winds and rainfall. The increase in temperature could result in increased heat stress for people, decreased forest growth and crop productivity, damage to infrastructure, decline in dissolved oxygen in surface waters, increases in fish kills and loss of aquatic species diversity, and decline in production of livestock. Changes in the distribution of native plants and animals may occur, threatened and endangered species may be lost, native species may be displaced by invasive species, and more frequent and intense wildfires may occur (U.S. Global Change Research Program 2009:111-116). Some of these effects may eventually necessitate adaptation of activities at SRS.

4.6 Deactivation, Decontamination, and Decommissioning

The management of DOE physical assets, including the facilities addressed in this *SPD Supplemental EIS*, would be subject to the requirements of DOE Order 430.1B, *Real Property and Asset Management*, and related directives. After operations, the facilities would be dispositioned in accordance with a process that begins once DOE determines that a facility is no longer needed to support program missions and declares it surplus. Facility disposition would be performed in compliance with applicable DOE, other Federal agency, and state requirements. Depending on regulatory determinations, decisions about some facilities may require consideration of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). General discussions of deactivation and decontamination and decommissioning activities are provided in this section.

4.6.1 Deactivation

When missions have been completed and 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 or closure.

All feed materials, including chemicals and any remaining surplus plutonium, would be removed from the facilities to leave them in a low-cost condition for surveillance and maintenance. After completion of the initial deactivation effort, the facilities would be surveyed to ensure that any contamination is contained and worker and public safety is maintained. Finally, a formal closeout would be conducted using the procedures set forth in the *Multi-Agency Radiation Survey and Site Investigation Manual* (NRC/EPA/DOE 2000). Closeout activities would include inspection of support systems, such as heating, ventilating, and air conditioning and water systems, to determine if they are in a condition for reuse.

4.6.2 Decontamination and Decommissioning

DOE has anticipated the need for eventual decontamination and decommissioning of the proposed plutonium facilities, based on decades of experience with operation of nuclear facilities and implementation of pollution prevention and waste minimization initiatives. Process functions are compartmentalized, and equipment that constitutes a risk to health and safety is enclosed in concrete structures to allow for isolation from the environment. Protective coatings are applied to concrete surfaces in the process areas to reduce the amount of contamination adsorbed into the concrete. Stainless steel cell and area liners are provided in some areas to facilitate removal of contamination where accumulation of radioactive material could increase personnel radiation exposure. Ventilation of processing areas minimizes the contamination of surfaces by airborne contaminants. Process equipment is designed to minimize areas where radioactive materials can accumulate. For example, piping systems are designed to be fully drained.

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.

Decommissioning

Actions taken at the end of facility life to make it suitable for reuse or retire it from service, including surveillance, maintenance, decontamination, and dismantlement.

The nature, extent, and timing of future decontamination and decommissioning activities are not presently known. Although some choices currently exist, both technically and under environmental regulations for performing final decontamination and decommissioning, DOE expects that there will be additional options available in the future. DOE may decide to completely demolish and remove the facility, or to reuse the facility for some other purpose consistent with the site mission at that time.[15] For DOE facilities, a formal Decontamination and Decommissioning Plan must be developed to comply with applicable Federal and state requirements and regulations. For MFFF, current plans are for the operator to deactivate the facility and request that NRC terminate the license once the facility's mission for surplus plutonium disposition is completed. MFFF would then become the responsibility of DOE, and DOE may decide to reuse or decommission it.

No meaningful alternatives or analysis of impacts can be formulated at this time. Neither the means to conduct decontamination and decommissioning, nor the impacts of these actions, are foreseeable in the sense of being susceptible to meaningful analysis now. Accordingly, decontamination and decommissioning activities are not analyzed quantitatively in this *SPD Supplemental EIS*. Once proposals concerning decontamination and decommissioning activities are developed, DOE would at that time undertake any additional NEPA analysis that may be necessary or appropriate. It is noted, however, that NRC's *MFFF EIS* includes a preliminary analysis of the radiological impacts that could result from deactivating the facility. NRC's *MFFF EIS* also analyzes the radiological and other impacts that could result from completely decommissioning the facility pursuant to applicable NRC requirements, including 10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination." Impacts from decommissioning PDCF and WSB were included in the *MFFF EIS* (NRC 2005a:4-55).

Following completion of their missions, H-Canyon/HB-Line, DWPF, and the K-Area Complex at SRS, and PF-4 at LANL, would undergo a period of deactivation and stabilization, as would PDCF and PDC if either of these facilities is constructed and operated.[16] Major activities would include complete de-inventory of accountable material, flushing and cleaning of equipment, and disconnection of utilities. The facilities would be placed in a stable condition requiring minimal surveillance and referred to as "cold, dark, and dry." After completion of this period, the facilities would be maintained in a safe, minimal surveillance condition until a decision is reached on their ultimate disposition. At this time, both H-Canyon/HB-Line and the K-Area Complex are listed in Appendix K-1 of the SRS Federal Facility Agreement as facilities to be decommissioned. It was assumed in current end-state planning and associated cost estimation models for hardened structures such as H-Canyon and the K-Area Complex that these structures would be dispositioned in place. This does not, however, indicate that a decision has been made to implement this strategy. No decision on ultimate disposition would be made until the required review processes (which may include the CERCLA process) have been completed.

4.7 Irreversible and Irretrievable Commitments of Resources

This section describes the major irreversible and irretrievable commitments of resources that have been identified under each alternative. A commitment of resources is irreversible when primary or secondary impacts limit future options for a resource. A commitment of resources is irretrievable when resources that are used or consumed are neither renewable nor recoverable for future use. This section discusses the commitment of resources in four major categories: land, labor, utilities, and materials.

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[15] *To illustrate, the building housing K-Reactor was not demolished after the end of reactor operations, but was deactivated (in terms of its original mission), and the K-Area Complex was reused to store surplus plutonium and to house KIS.*

[16] *DWPF has been designed to facilitate decontamination for future decommissioning, and its operation facilitates the decommissioning of other SRS facilities such as the waste tank farms.*

Table 4–51 presents irreversible and irretrievable commitments of resources related to construction activities at SRS. Only construction that has not been started is considered a future commitment of resources. Construction of MFFF and WSB has been analyzed in previous NEPA documents (DOE 1999b, 2008i; NRC 2005a), and is under way. Construction of these facilities is, therefore, not considered in this *SPD Supplemental EIS*, except for optional minor modifications to MFFF to enable oxidation of metallic plutonium. Construction resource use is presented as a range for the Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives, reflecting the range of pit disassembly and conversion options addressed for each of these alternatives.

Table 4–51 Irreversible and Irretrievable Commitments of Construction Resources at the Savannah River Site [a]

Resource	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Land Use					
Disturbed land (acres)	50	2–52	0–50	0–50	0–50
Labor					
Full-time equivalent (person-year)	6,200	2,000–7,300	960–6,200	960–6,200	980–6,300
Utilities					
Electricity (megawatt-hours)	110,000	54,000–160,000	0–110,000	0–110,000	0–110,000
Diesel fuel, gasoline (gallons)	2,400,000	11,000–2,400,000	0–2,400,000	0–2,400,000	0–2,400,000
Water (gallons)	23,000,000	6,600–23,000,000	0–23,000,000	0–23,000,000	0–23,000,000
Materials					
Asphalt (tons)	0	800	0	0	0
Concrete (cubic yards)	120,000	0–120,000	0–120,000	0–120,000	0–120,000
Crushed stone, sand, and gravel (tons)	190,000	1,100–190,000	0–570,000	0–570,000	0–570,000
Lumber (board feet)	0	11,000	0	0	0
Soil (cubic yards)	130,000	9,500–140,000	0–130,000	0–130,000	0–130,000
Steel (tons)	22,000	1,700–23,000	0–22,000	0–22,000	0–22,000

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] WSB construction requirements are not included in this table because the facility has been analyzed in previous NEPA documents and is currently under construction. Except for the few resources required to optionally install metal oxidation furnaces for the action alternatives, MFFF construction requirements are also not included in this table because the facility has been analyzed in previous NEPA documents and is currently under construction.

Note: To convert acres to hectares, multiply by 0.40469; gallons to liters, multiply by 3.7854; cubic yards to cubic meters, multiply by 0.76456; tons to metric tons, multiply by 0.90718; board feet to cubic inches, multiply by 144; 1 full-time equivalent = 2,080 worker hours.

Source: DOE 1999b; SRNS 2012; WSRC 2008a.

The estimates in Table 4–51 for the MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives reflect the option of constructing PDC with a plutonium throughput of 3.5 metric tons (3.9 tons) per year. If a reduced-scale PDC is constructed, the commitment of resources attributable to PDC construction would be reduced (see Section 4.3). Under all action alternatives, there could be some minor additional commitment of resources at SRS to modify the K-Area Complex to enable pit disassembly, or to modify H-Canyon/HB-Line or MFFF to support pit conversion activities, if these facilities are optionally used for pit disassembly and conversion activities. Any modifications, however, to the K-Area Complex, H-Canyon/HB-Line, or MFFF would require little or no additional steel, asphalt, concrete, soil, lumber, or crushed stone, sand, and gravel. Assuming pit disassembly and conversion takes place at the K-Area Complex and H-Canyon/HB-Line, there would be no change in land use at K- or H-Area, and no to minimal land disturbance, but there would be minor commitments of labor and utilities to add equipment within existing structures. Assuming plutonium conversion takes place at MFFF, there would be no change in land use, and no to minimal land disturbance, but there would be some minor commitments of labor and utility resources to install additional metal oxidation furnaces, gloveboxes, and other equipment within MFFF.

Minor modifications to PF-4 at LANL under the No Action Alternative to enhance pit disassembly and conversion of 2 metric tons (2.2 tons) of plutonium are under way consistent with existing NEPA analysis (See Appendix B, Section B.2.1). Assuming pit disassembly and conversion of up to 35 metric tons (38.6 tons) of plutonium takes place at PF-4 under two pit disassembly and conversion options under the action alternatives, there would be no change in LANL land use. Installing equipment to enable an enhanced pit disassembly and conversion capability would require about 320 full-time equivalents. There would be minimal use of additional steel, asphalt, concrete, lumber, or crushed stone, sand, and gravel. There could be some movement or disturbance of soil covering up to approximately 2 acres (0.8 hectares). The use of diesel fuel and water during equipment installation is estimated to be about 800 gallons (3,000 liters) for each resource.

Table 4–52 presents irreversible and irretrievable commitments of resources related to facility operations, over the projected periods of operation, of the pit disassembly and conversion, plutonium disposition, and principal plutonium support facilities at SRS. The totals do not include utility resource use for operations at H-Canyon/HB-Line or E-Area. The annual utility resource use at H-Canyon/HB-Line and E-Area would not significantly change, depending on the mix of plutonium activities that may take place. For DWPF, for which proposed plutonium activities would represent only a portion of facility operations, only the incremental commitment of resources necessary to implement each alternative is considered. For the Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives, uses of labor, utility, and materials are frequently presented as ranges, reflecting the range of pit disassembly and conversion options addressed for each alternative.

Table 4–52 Irreversible and Irretrievable Commitments of Operations Resources at the Savannah River Site [a]

Resource	*Alternative*				
	No Action	*Immobilization to DWPF [b]*	*MOX Fuel [b]*	*H-Canyon/HB-Line to DWPF [b]*	*WIPP [b]*
Labor					
Full-time equivalent (person-years)	30,000	31,000–36,000	29,000–35,000	27,000–33,000	28,000–33,000
Utilities					
Electricity (megawatt-hours)	4,800,000	4,100,000–5,200,000	4,200,000–5,300,000	4,000,000–5,100,000	4,000,000–5,100,000
Diesel fuel, gasoline (gallons)	9,500,000	6,000,000–6,400,000	6,500,000–8,500,000	6,400,000–8,400,000	6,400,000–8,400,000
Water (gallons)	750,000,000	680,000,000–870,000,000	590,000,000–780,000,000	570,000,000–760,000,000	570,000,000–760,000,000
Materials					
Absorbents (pounds)	0	6,300	0	0	0
Aluminum nitrate (pounds)	28,000	260–120,000	47,000–160,000	62,000–180,000	0–120,000
Aluminum sulfate (pounds)	21,000	0–25,000	0–25,000	0–25,000	0–25,000
Argon (cubic feet)	320,000,000	290,000,000–330,000,000	340,000,000–370,000,000	320,000,000–360,000,000	330,000,000–360,000,000
Argon-methane (P-10) (cubic feet)	8,500,000	8,300,000	9,500,000	9,100,000	9,200,000
Bentonite (pounds)	11,000	0–13,000	0–13,000	0–13,000	0–13,000
Boric acid (pounds)	0	140–150	0–8	71–78	0–8
Carbon dioxide (cubic feet)	390,000	690,000–730,000	53,000–92,000	350,000–390,000	150,000–190,000
Chlorine (cubic feet)	22,000	0–26,000	0–26,000	0–26,000	0–26,000
Cleaning solvents (pounds)	3,100	0–3,700	0–3,700	0–3,700	0–3,700
Copper formate (pounds)	0	1,200–1,300	0–67	600–670	0–67
Corrosion inhibitor (pounds)	0	1,300	0	0	0
Dodecane (gallons)	38,000	38,000	43,000	41,000	41,000
Fly ash (pounds)	2,000,000	27,000,000–28,000,000	2,300,000–3,700,000	15,000,000–16,000,000	2,200,000–3,600,000
Formic acid (pounds)	0	46,000–49,000	0–2,600	23,000–26,000	0–2,600
Gadolinium nitrate (pounds)	38,000	0–160,000	64,000–220,000	11,000–170,000	0–160,000

Resource	***Alternative***				
	No Action	***Immobilization to DWPF*** [b]	***MOX Fuel*** [b]	***H-Canyon/HB-Line to DWPF*** [b]	***WIPP*** [b]
Glass frit (pounds)	0	8,000,000–8,100,000	11,000–38,000	240,000–270,000	0–27,000
Helium (cubic feet)	9,800,000	8,000,000–10,000,000	9,300,000–11,000,000	8,700,000–11,000,000	9,500,000–12,000,000
Hydraulic fluid (gallons)	0	270	0	0	0
Hydrazine (pounds)	33,000	33,000	37,000	36,000	36,000
Hydrogen (cubic feet)	8,600,000	8,400,000–8,600,000	9,600,000–9,800,000	9,200,000–9,400,000	9,200,000–9,400,000
Hydrogen peroxide (pounds)	32,000	32,000	36,000	35,000	35,000
Hydroxylamine nitrate (pounds)	200,000	200,000	220,000	210,000	210,000
Inert materials (pounds)	0	0	0–48,000	0	0–140,000
Liquid nitrogen (pounds)	37,000	6,400–36,000	7,000–36,000	7,000–36,000	7,000–36,000
Lubricating oils (gallons)	3,000	960–4,100	0–6,200	0–6,200	0–6,200
Manganese nitrate (pounds)	220	220	250	240	240
Nitric acid (pounds)	1,700,000	430,000–6,200,000	2,700,000–8,400,000	2,000,000–7,700,000	360,000–6,100,000
Nitrogen (cubic feet)	3,400,000,000	3,500,000,000–7,600,000,000	3,800,000,000–10,000,000,000	3,700,000,000–10,000,000,000	3,700,000,000–10,000,000,000
Nitrogen tetroxide (cubic feet)	3,100,000	3,100,000	3,500,000	3,400,000	3,400,000
Oxalic acid dehydrate (pounds)	290,000	380,000–500,000	350,000–460,000	350,000–470,000	290,000–410,000
Oxygen (cubic feet)	1,100,000	1,200,000–1,300,000	1,300,000–1,400,000	1,300,000–1,400,000	1,400,000–1,500,000
Phosphoric acid (pounds)	5,300	0–6,300	0–6,300	0–6,300	0–6,300
Polyelectrolyte (pounds)	95	95	95	95	95
Polyphosphate (pounds)	0	1,100	0	0	0
Porogen (pounds)	6,500	6,500	7,400	7,100	7,100
Portland cement (pounds)	7,000,000	13,000,000	8,000,000–8,300,000	10,000,000–11,000,000	7,700,000–8,000,000
Potassium fluoride (pounds)	19,000	0–80,000	32,000–110,000	6,000–90,000	0–80,000
Potassium fluoride solution (gallons)	0	0	0	1,400	0
Potassium nitrate (pounds)	0	140–150	0–8	71–78	0–8
Silver nitrate (pounds)	22,000	22,000	26,000	24,000	24,000
Sodium carbonate (pounds)	9,000	9,000	10,000	9,900	9,900
Sodium hydroxide (pounds)	1,800,000	1,600,000–6,700,000	2,600,000–7,700,000	1,500,000–6,600,000	620,000–5,700,000
Sodium hypochlorite (pounds)	0	750	0	0	0
Sodium nitrite (pounds)	0	140,000	0–7,700	68,000–76,000	0–7,700
Sodium sulfite (pounds)	16,000	16,000	18,000	17,000	17,000
Sodium titanate (pounds)	0	10,000–11,000	0–590	5,300–5,900	0–590
Sodium tetraphenylborate (pounds)	0	170,000–180,000	0–9,700	86,000–96,000	0–9,700
Slag (pounds)	0	25,000,000–26,000,000	0–1,400,000	13,000,000–14,000,000	0–1,400,000
Steel (pounds)	2,300,000	2,700,000	5,100,000–7,500,000	2,500,000	9,900,000–17,000,000
Sulfuric acid (pounds)	10,000	0–12,000	0–12,000	0–12,000	0–12,000
Tributyl phosphate (gallons)	15,000	15,000	17,000	16,000	16,000
Uranyl nitrate (gallons)	80,000	77,000	88,000	84,000	84,000
Zinc stearate (pounds)	9,700	9,700	11,000	11,000	11,000
Zirconium oxide (pounds)	1,600,000	1,600,000	1,800,000	1,700,000	1,700,000

	Alternative				
Resource	***No Action***	***Immobilization to DWPF*** [b]	***MOX Fuel*** [b]	***H-Canyon/HB-Line to DWPF*** [b]	***WIPP*** [b]

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] The base annual resource requirements under all alternatives include those for operating MFFF and WSB for a minimum of 34 metric tons of pit, metal, and oxide plutonium originally declared surplus, and for storage of surplus plutonium at the K-Area Complex. The table includes resource use at SRS for pit disassembly and conversion, plutonium disposition, and the principal plutonium support facilities.

[b] Uses of labor, utility, and resources under the Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives are frequently presented as ranges reflecting the pit disassembly and conversion options addressed under each alternative.

Note: To convert pounds to kilograms, multiply by 0.45359; gallons to liters, multiply by 3.7854; cubic feet to cubic meters, multiply by 0.028317; metric tons to tons, multiply by 1.1023; 1 full-time equivalent = 2,080 worker hours.

Source: DCS 2002, 2004; DOE 1994, 1999b, 2008i; SRNS 2012; SRR 2010; WSRC 2008a.

Table 4–53 presents for each alternative the irreversible and irretrievable commitments of resources related to facility operations, over the projected periods of operation, of pit disassembly and conversion activities at LANL. Resource use for the No Action Alternative reflects a total PF-4 throughput of 2 metric tons (2.2 tons), while that for each action alternative reflects a total PF-4 throughput ranging from 2 metric tons (2.2 tons) to 35 metric tons (38.6 tons). The listed values reflect only those resources required for pit disassembly and conversion, rather than those for operation of the entire PF-4 facility.

Table 4–53 Irreversible and Irretrievable Commitments of Operational Resources at Los Alamos National Laboratory [a]

	Alternative				
Resource	***No Action*** [b]	***Immobilization to DWPF*** [b]	***MOX Fuel*** [b]	***H-Canyon/ HB-Line to DWPF*** [b]	***WIPP*** [b]
Labor					
Full-time equivalent	600	600-5,600	600-5,600	600-5,600	600-5,600
Utilities					
Electricity (megawatt-hours)	6,700	6,700–42,000	6,700–42,000	6,700–42,000	6,700–42,000
Diesel fuel, gasoline (gallons) [c]	N/A	N/A	N/A	N/A	N/A
Water (gallons)	3,300,000	3,300,000–26,000,000	3,300,000–26,000,000	3,300,000–26,000,000	3,300,000–26,000,000
Materials					
Argon (cubic feet)	26,000,000	26,000,000–450,000,000	26,000,000–450,000,000	26,000,000–450,000,000	26,000,000–450,000,000
Helium (cubic feet)	19,000,000	19,000,000–330,000,000	19,000,000–330,000,000	19,000,000–330,000,000	19,000,000–330,000,000
Hydrogen (cubic feet)	14	14–250	14–250	14–250	14–250
Isotonic solution (gallons)	80	80–1,400	80–1,400	80–1,400	80–1,400
Liquid nitrogen (pounds)	64,000	64,000–1,100,000	64,000–1,100,000	64,000–1,100,000	64,000–1,100,000
Nitric acid (pounds)	21	21–370	21–370	21–370	21–370
Nitrogen (cubic feet)	780	780–14,000	780–14,000	780–14,000	780–14,000
Oxygen (cubic feet)	3,400,000	3,400,000–60,000,000	3,400,000–60,000,000	3,400,000–60,000,000	3,400,000–60,000,000
Sodium nitrate (pounds)	1	1–15	1–15	1–15	1–15
Sodium sulfate (pounds)	1	1–15	1–15	1–15	1–15
Steel (pounds)	1,900	1,900–34,000	1,900–34,000	1,900–34,000	1,900–34,000
Sulfuric acid (pounds)	12	12–220	12–220	12–220	12–220

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Additional resources would be used at SRS under each alternative. See Table 4–52.

[b] Uses of labor, utility, and resources under the Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives are presented as ranges reflecting PF-4 conversion of 2 to 35 metric tons of plutonium to plutonium oxide.

[c] Diesel fuel is used at PF-4 for testing diesel generators. Diesel generator testing is independent of the particular mix of activities that take place at PF-4.

Note: To convert pounds to kilograms, multiply by 0.45359; gallons to liters, multiply by 3.7854; cubic feet to cubic meters, multiply by 0.028317; metric tons to tons, multiply by 1.1023; 1 full-time equivalent = 2,080 worker hours.

Source: LANL 2012a.

4.8 Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

The relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity for key environmental resources is described in the following paragraphs:

- Land would be disturbed at SRS and LANL to construct or modify new or existing plutonium facilities. After construction or modification, the plutonium facilities would occupy land, but less land than that disturbed during construction. At SRS, the proposed locations for any new facilities would be within or adjacent to developed industrial landscapes at F- and K-Areas. The new facility proposed under existing NEPA documentation for the No Action Alternative (PDCF) would disturb approximately 50 acres (20 hectares) of land, but would ultimately increase the SRS industrial landscape by less than 23 acres (9.3 hectares). Under the Immobilization to DWPF Alternative, 2 to 50 acres (0.8 to 20 hectares) of land would be disturbed at SRS during construction, depending on the pit disassembly and conversion option, but the SRS industrial landscape would ultimately increase by 2 to 25 acres (0.8 to 10 hectares). Under the MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives, 30 or 50 acres (12 or 20 hectares) of land would be disturbed during construction, if PDC or PDCF is constructed, but the SRS industrial landscape would increase by 18 or 23 acres (7.3 or 9.3 hectares), respectively. If neither facility is constructed, pit disassembly and conversion would be performed using existing facilities, such as H-Canyon/HB-Line, DWPF, and MFFF. At LANL, pit disassembly and conversion would occur within the existing PF-4; depending on the pit disassembly and conversion option, up to 2 acres (0.8 hectares) of land would be temporarily disturbed.
- After the operational life of the plutonium facilities, DOE could deactivate, decontaminate, and decommission the facilities in accordance with applicable regulatory requirements and then close in place or restore the areas occupied by the facilities to brownfield sites that would be available for other industrial use. Appropriate CERCLA and/or NEPA reviews would be conducted before initiation of decontamination and decommissioning actions. In all likelihood, none of the sites would be restored to a natural terrestrial habitat. Deactivation, decontamination, and decommissioning processes are described in Section 4.6.
- Groundwater would be used to meet process and sanitary water needs over the short-term impact period. After use and treatment, this water would be released through permitted outfalls into surface water streams. The withdrawal, use, and treatment of water are not likely to affect the long-term productivity of this resource.
- Air emissions associated with implementation of any of the alternatives would add small amounts of radiological and nonradiological constituents to the air of the SRS or LANL region. During the short-term impact period, these emissions would result in additional radioactive exposure or air loading, but are not expected to affect compliance by SRS or LANL with radiation exposure or air quality standards. No significant residual environmental effects on long-term environmental productivity are expected.
- The management and disposal of LLW and solid and liquid wastes would require energy and space at treatment, storage, or disposal facilities at SRS (e.g., Z-Area Saltstone Facility, E-Area Vaults, Three Rivers Regional Landfill) and LANL (e.g., waste management facilities at TA-54, the Radioactive Liquid Waste Treatment Facility). Land used at SRS for LLW and solid waste disposal, or at LANL for LLW disposal, would require a long-term commitment of terrestrial resources.

Activities at depleted uranium supply, depleted uranium conversion, and commercial nuclear power reactor sites would be conducted at existing facilities in accordance with ongoing operations. Therefore, future use of these facilities would not be related to surplus plutonium activities, but would be dictated by other ongoing activities. The short-term use of these facilities for surplus plutonium disposition activities is not expected to change their planned closure dates and, therefore, should not result in an incremental change in the potential long-term productivity of these sites.

4.9 Mitigation

This section summarizes mitigation measures that could be implemented to avoid or reduce potential environmental impacts that could result from implementing the alternatives. As specified in the Council on Environmental Quality's NEPA regulations (40 CFR 1508.20), mitigation includes:

- Avoiding the impact altogether by not taking a certain action or parts of an action
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action
- Compensating for the impact by replacing or providing substitute resources or environments

All of the alternatives have the potential to affect one or more resource areas. If mitigation measures above and beyond those required by regulations are needed to reduce impacts, DOE is required to describe mitigation commitments in the ROD and prepare a Mitigation Action Plan (10 CFR 1021.331). The Mitigation Action Plan would explain how, before implementing a proposed action, certain measures would be planned and implemented to mitigate adverse environmental impacts.

Table 4–54 summarizes potential mitigation measures that are discussed in more detail in the following sections. The table identifies a series of potential mitigation measures in the first column, and in the remaining columns, those environmental resource areas that could benefit from the potential mitigation measure. In general, activities associated with construction and operation of plutonium facilities would follow standard practices such as BMPs for minimizing impacts on environmental resources as required by regulation, permit, or guidelines. No potential adverse impacts have been identified that would require additional mitigation measures beyond those required by regulation or achieved through BMPs, as discussed in previous sections of this chapter. For any alternative, stewardship practices that are protective of the air, water, land, and other natural and cultural resources affected by DOE operations would be implemented in accordance with an environmental management system established pursuant to DOE Order 436.1, *Departmental Sustainability*, which was prepared to incorporate the requirements of Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*.

4.9.1 Land Use and Visual Resources

Several measures could be considered for mitigating impacts on land use and visual resources, including the following:

- The requirements of the site land use and permitting process would be followed.
- Existing facilities and buildings would be used whenever possible, such as H-Canyon/HB-Line, DWPF, and the K-Area Complex at SRS, and PF-4 at LANL, or facilities already under construction, such as MFFF.
- The disturbance of new land at SRS would be largely limited to areas already designated for industrial use (e.g., F- and K-Areas).
- Connected actions and interdependent facilities would be collocated to reduce land disturbance at SRS (e.g., WSB located adjacent to MFFF; if constructed, PDCF located adjacent to MFFF).
- Existing infrastructure and rights-of-way would be used at SRS and LANL.
- An environmental supervisor may be designated for construction activities to ensure protection of vegetation and adherence to ground disturbance limits.
- Restoration and landscaping of open areas would occur upon completion of construction-related activities.

Table 4–54 Potential Mitigation Measures [a]

	Resource Area											
Mitigation Measure	**Land Use and Visual Resources**	**Geology and Soils**	**Water Resources**	**Air Quality and Noise**	**Ecological Resources**	**Human Health**	**Cultural Resources**	**Socioeconomics**	**Infrastructure**	**Waste Management**	**Transportation**	**Environmental Justice**
Potential Mitigation Measures During Facility Construction												
Use of existing facilities in industrial areas [b]	●	●	●	●	●		●		●	●		
Erosion and sediment control plans		●	●		●							
Sequencing or scheduling of work		●		●	●			●	●		●	
Spill prevention control and countermeasures		●	●			●				●		●
Use of low-sulfur, more-refined fuels				●	●	●						●
Dust suppression measures		●		●	●	●						
High-efficiency particulate air filters, ventilation systems				●	●	●						●
Silencers/mufflers, hearing protection programs				●		●						
Preconstruction characterization/surveys of site		●	●		●		●					
Personal protective equipment				●		●						
Potential Mitigation Measures During Facility Operations												
Water conservation practices			●						●	●		
Spill prevention control and countermeasures		●	●		●	●				●		
Personal protective equipment				●		●						
Confinement and shielding systems				●		●						
Ventilation and filter systems			●	●	●	●						
Emergency preparedness and response plans						●					●	●
Radiological Protection and As Low As Reasonably Achievable Program						●						
High-efficiency electric equipment/off-peak use									●			
Pollution prevention and waste minimization									●	●	●	
Public outreach and training						●						●
Scheduling								●	●		●	

[a] This *SPD Supplemental EIS* does not quantitatively analyze activities for deactivation and decommissioning of facilities.

[b] If implemented under the MOX Fuel, H-Canyon/HB-Line to DWPF, or WIPP Alternatives, PDC would be constructed within existing facilities at K-Area. If implemented under any alternative, PDCF would be new construction at F-Area collocated with MFFF. Implementing the immobilization capability under the Immobilization to DWPF Alternative would involve limited new construction at K-Area. H-Canyon/HB-Line and DWPF are operational facilities at H- and S-Areas, respectively, while PF-4 is an operational facility at LANL.

In addition, impacts on visual resources could be mitigated by using soil berms and vegetation to screen buildings and roadways, reducing building sizes and stack heights, or using directional or lower intensity exterior lighting.

4.9.2 Geology and Soils

Facility construction or modification may disturb soil. At all areas at SRS or LANL used for construction or facility modification, adherence to BMPs for soil erosion and sediment control during land-disturbing activities would minimize soil erosion and loss. In general, limiting the amount of time soils are exposed, limiting the area disturbed during any phase of a construction project, and applying protective coverings to denuded areas during construction (e.g., mulching and/or geotextiles) until such time as disturbed areas could be revegetated or otherwise covered by facilities would reduce the potential for soil loss. Soil loss would be further reduced by the use of appropriate sedimentation and erosion control measures as weather conditions dictate, including silt fences, earth dikes, velocity dissipaters, drainage swales, sediment traps, check dams, temporary or permanent sediment basins, sod stabilization, temporary reseeding, vegetative buffer strips, protection of trees, and preservation of mature vegetation. Stockpiles of soil removed during construction would be covered with a geotextile or temporary vegetative covering and enclosed by a silt fence to prevent loss by erosion.

4.9.3 Water Resources

The locations for new facilities at SRS were selected to avoid the disturbance of wetlands or other surface water bodies. In addition, there would be no direct discharge of effluents to surface waters or groundwater during facility construction or operations; therefore, no appreciable impacts on water quality are expected.

Wastewater from construction at SRS would be collected, temporarily stored, treated, and/or disposed of as required by SCDHEC regulations. All sanitary wastewater from operations would be treated at the SRS CSWTF before being released under existing NPDES permits, minimizing impacts on surface waters.

Potential impacts from stormwater discharges during construction would be mitigated by compliance with the SWPPP required by SCDHEC to receive a construction general permit. SWPPP practices might include, but not necessarily be limited to, use of appropriate sedimentation and erosion control measures, such as those summarized in Section 4.9.2.

Surface waters would be protected from spills of hazardous materials by the development and implementation of Spill Prevention, Control, and Countermeasure and Oil Removal Contingency Plans in instances where hazardous materials are being handled. These plans would include provisions for storage of hazardous materials and refueling of construction equipment within the confines of protective berms, secondary containment, recovery plans, and notification and activation protocols. Spills would also be reduced by keeping vehicles and equipment in good working order to prevent oil and fuel leaks, and by training to reduce spills resulting from human error.

Groundwater use for facility construction and operations would be well within available SRS capacity; therefore, no mitigation would be required. Water conservation practices (e.g., using rainwater for irrigation) would be implemented as part of LEED certification.

At LANL, modifications to PF-4 would not result in direct discharge of effluents to surface waters or groundwater. Wastewater would be collected, treated, and disposed of in accordance with existing capabilities and regulatory requirements. Surface waters would be protected by implementing the same types of mitigation measures as those described above for SRS.

Although groundwater use for facility modification and operations would be within available LANL capacity, the total water demand within LANL and Los Alamos County has increased in recent years. Water reduction goals at LANL include reducing the use of potable water by at least 16 percent of the 2007 level by fiscal year 2015 (DOE 2011g). As addressed in Chapter 3, Section 3.2.9, NNSA has initiated a number of conservation and water-reuse projects at LANL, including installation of systems intended to gather data on water usage for various site applications.

4.9.4 Air Quality and Noise

At both SRS and LANL, construction or modification of facilities or capabilities under all alternatives would result in some emissions of criteria and hazardous air pollutants, of which particulate matter would be a primary concern. Construction equipment criteria pollutant emissions would be minimized by using more-refined fuels (e.g., low-sulfur diesel fuel) and by maintaining equipment to ensure that emissions control systems and other components are functioning at peak efficiency. Soils and unconsolidated sediments exposed in excavations and slope cuts during new facility construction would be subject to wind or rain erosion if left exposed. In addition, fugitive dust emissions would result from land disturbed by heavy equipment and motor vehicles, causing suspension of soil particles into the air. Construction emissions would be mitigated using water and/or surfactants to control dust emissions from exposed areas, revegetation of exposed areas, watering of roadways, and minimizing construction activities under dry or windy conditions. No open burning would be conducted.

Facility operations would result in airborne emissions of various pollutants, including radionuclides, and organic and inorganic constituents. These emissions would be controlled using Best Available Control Technology to ensure that emissions are compliant with applicable standards. Impacts would be mitigated by use of glovebox confinement and air filtration systems (e.g., double HEPA filters, sand filters) to remove radioactive particulates before discharging process exhaust air to the atmosphere, and internal scrubbers to reduce chemical gas concentrations.

Construction and operations workers could be exposed at both sites to noise levels higher than acceptable limits, particularly for confined areas, as specified in Occupational Safety and Health Administration noise regulations. DOE has implemented hearing protection programs that meet or exceed Occupational Safety and Health Administration standards to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, sequencing and scheduling work shifts, administrative controls, engineering controls, and personal hearing protection (DOE 1999b).

At SRS, noise impacts on the public would be mitigated by locating the plutonium facilities away from SRS boundaries. Noise impacts on ecological resources would be mitigated by locating the facilities away from ecologically sensitive areas. At LANL, there would be some temporary additional noise from modification of PF-4, much of it due to additional worker traffic. Subsequent operation of PF-4 would not increase noise levels over existing activities, although there could be some additional noise due to additional worker traffic to support additional activities.

4.9.5 Ecological Resources

At SRS, ecological impacts during facility construction would be mitigated using techniques such as avoidance of undisturbed habitat and timing land-disturbing activities to avoid the breeding period of wildlife and the migration period in the case of migratory avifauna. The selected sites for construction of new facilities would be predominantly in previously disturbed or developed areas. The new facility construction would not be located near ecologically sensitive areas harboring threatened or endangered species.

Clearing of vegetation would be conducted in accordance with the *Natural Resources Management Plan for the Savannah River Site* developed by the U.S. Forest Service (DOE 2005b). Compliance with this plan would minimize impacts on ecological resources. Following construction, the cleared and graded areas not covered with facilities, parking lots, or roads would be landscaped. This landscaping would provide habitat for some wildlife species, mitigating some loss of habitat caused by construction.

Implementation of soil erosion and sediment control and SWPPPs would prevent runoff and dust from entering sensitive habitats and nearby streams. Construction disturbance of nearby streams would be avoided. Accidentally scarred or damaged trees would be replaced consistent with the *Natural Resources*

Management Plan for the Savannah River Site (DOE 2005b). Construction crews would also receive environmental briefings, as appropriate, to alert them to nearby ecologically sensitive areas.

At LANL, although some ground disturbance may occur as part of installation of a construction trailer and a temporary parking area, the Permit Requirements Identification process would be used to ensure that all permits are in place and no natural resources are impacted. Erosion and runoff control measure would be implemented. Detailed resource maps would be used with global positioning system overlays to evaluate the impacts of alternative sites for the trailer and parking area. TA-55 is a well characterized industrial area, and priority would be given to previous trailer locations, where pads already exist along with adequate parking and utility access (LANL 2012a). Threatened and endangered species would be protected in accordance with the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 2011a).

4.9.6 Human Health and Safety

At SRS and LANL, construction workers would be limited to a radiological dose of 100 millirem per year because they are categorized as members of the public. Potential exposure from excavation of contaminated soil would be prevented by sampling the soil for radioactive contamination before excavation begins. If contaminated soil is discovered, appropriate techniques would be applied in accordance with an Operations and Management Plan to remediate the conditions and ensure worker safety.

Several features have been incorporated into the design of the proposed plutonium disposition facilities to mitigate radiation exposures to workers and the public. These include, but are not limited to, confinement (e.g., gloveboxes), shielding, ventilation, and air filtration systems.

At both sites, mitigation measures to ensure radiation protection would include formal analysis by workers, supervisors, and radiation protection personnel of methods to reduce exposure of workers to the lowest practicable level. For all activities involving radiation work, the principle of maintaining ALARA doses would be followed. Examples of ALARA measures include minimizing time spent in high-radiation areas, maximizing distances from sources of radiation, using shielding, and/or reducing the radiation source. The radiological limit for an individual worker is 5,000 millirem per year; as part of the ALARA program, however, the maximum dose to a worker involved in operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (10 CFR Part 835).

SRS adheres to programs used to ensure mitigation of human health and safety impacts to the maximum extent practicable. The Radiological Protection Program provides mitigation by ensuring that radiological exposures and doses to all personnel are maintained to ALARA levels and by providing job-specific instructions in job hazard analyses to the facility workers regarding the use of personal protective equipment. The Emergency Preparedness Program mitigates accident consequences by ensuring that appropriate organizations (e.g., fire department, operations, medical, and security) are available to respond to emergency situations and take appropriate actions to recover from anticipated events while reducing the spread of contamination and protecting facility personnel and the public (WSRC 2007h:8-142).

At LANL, a Health, Safety, and Radiation Protection Program is conducted addressing the possible impacts that could result from working with ionizing radiation, hazardous and chemical materials, and biohazard materials. An Emergency Management and Response Program combines Federal and local emergency response capabilities and provides planning, preparedness, and response capabilities that can aid in containing and remediating the effects of accidents or adverse operational impacts. A Fire Protection Program ensures that personnel and property are adequately protected against fire or related incidents (DOE 2008f: 5-26).

At both SRS and LANL, occupational safety risks to workers would be mitigated by adherence to Federal and state laws; Occupational Safety and Health Administration regulations; DOE requirements including regulations and orders; and plans and procedures for performing work. DOE regulations addressing worker health and safety include 10 CFR Part 851, "Worker Safety and Health Program," and 10 CFR Part 850, "Chronic Beryllium Disease Prevention Program." Workers are protected from specific hazards by training, monitoring, use of personal protective equipment, and administrative controls (i.e., job hazard analyses).

4.9.7 Cultural Resources

As described in Section 4.1.7.6, archaeological surveys were previously performed at SRS in anticipation of PDCF being constructed. At both SRS and LANL, current surveys would be performed before necessary land disturbance associated with new construction. DOE could mitigate potential impacts by locating laydown yards on previously disturbed land to avoid known archaeological sites. If the site cannot be avoided, a data recovery plan for impact mitigation would be developed and approved for implementation by the South Carolina and New Mexico SHPOs. Given the highly disturbed areas proposed for construction, in the unlikely event of a cultural resources discovery, it would be handled in accordance with 36 CFR 800.11 (for historic properties) and 43 CFR 10.4 (for American Indian human remains, funerary objects, objects of cultural patrimony, and sacred objects), as required. Mitigation actions would also conform to the terms of the programmatic memorandums of agreement in place at SRS (SRARP 1989, Appendix C) and LANL (DOE 2006b). Further, implementing requirements and procedures would be followed in accordance with applicable SRS and LANL Cultural Resources Management Plans (DOE 2005a, 2006b; LANL 2006c; SRARP 1989).

4.9.8 Infrastructure

Under the *SPD Supplemental EIS* alternatives, new plutonium facilities would be constructed, or existing facilities modified, in areas with existing utility infrastructure. At both SRS and LANL, under all alternatives, consumption of energy, fuel, and water resources would be within the capabilities of the existing infrastructure. Impacts on the regional electrical grid would be minimized by incorporating high-efficiency motors, pumps, lights, and other energy-saving equipment into the design of new facilities, and by scheduling some operations during off-peak times. Impacts on water use would be mitigated by using water-conserving processes and equipment. Impacts on fuel use would be mitigated by using fuel-efficient processes, equipment, and vehicles (e.g., hybrids).

Pursuant to DOE Order 436.1, *Departmental Sustainability*, and Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, DOE has established goals for energy efficiency and water conservation improvements at DOE sites, including reductions in energy and potable water consumption, use of advanced electric metering systems, use of sustainable building materials and practices, and use of innovative renewable and clean energy sources (DOE 2010a). Working to implement these goals by incorporation of LEED principles would further reduce impacts on site infrastructure.

4.9.9 Waste Management

Waste management impacts would primarily be mitigated through waste minimization efforts designed to minimize the volumes and hazardous nature of waste generated for shipment to offsite locations. The No Action Alternative provides the lowest projected cumulative waste generation in the short term, but waste generation is expected to increase over the long term when the plutonium is removed from storage for permanent disposition.

In response to the Hazardous and Solid Waste Amendments of 1984 and the Pollution Prevention Act of 1990, DOE has implemented successful pollution prevention and waste minimization programs at SRS and LANL.[17] Although some of the plutonium facilities are still being constructed, or are 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 procurement processes that preferentially procure "green" products made from recycled materials (i.e., sustainable acquisition). The facility

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[17] *Impetus was given to the DOE pollution prevention and waste minimization program by the October 5, 2009, Executive Order 13514,* Federal Leadership in Environmental, Energy, and Economic Performance.

designs would minimize the size of radiologically controlled areas, thereby minimizing generation of radioactive waste. To the extent practicable, the facilities would not use solvents regulated by the Resource Conservation and Recovery Act, minimizing the generation of hazardous and mixed wastes. Wastewater would be recycled to the extent possible to minimize effluent discharge (DOE 1999b).

Additional waste minimization or mitigation may be required for the volumes of TRU waste that could be generated under some alternatives. Particularly under the WIPP Alternative, the volume of TRU waste projected to be generated is expected to constitute a large fraction of the identified remaining disposal capacity at WIPP. Projected waste volumes could be possibly reduced by modifying process methods.

4.9.10 Transportation

Measures that could be used to mitigate transportation impacts include transporting materials and wastes only during periods of light traffic volume, providing vehicle escorts, avoiding high-population areas, avoiding high-accident areas, and training drivers and emergency response personnel. As described in Appendix E, Section E.3.2, the Department of Homeland Security is responsible for coordinating the response to accidents involving radioactive materials and waste, with DOE maintaining many of the resources that would be used if such an event were to occur.

4.9.11 Environmental Justice

No mitigation measures are expected to be necessary under any of the alternatives because no disproportionately high and adverse impacts on minority or low-income populations have been identified.

CHAPTER 5
REGULATIONS, PERMITS, AND CONSULTATIONS

5.0 REGULATIONS, PERMITS, AND CONSULTATIONS

Surplus plutonium disposition activities must be performed in a manner that ensures the protection of public health, safety, and the environment through compliance with all applicable Federal, state, and local laws, regulations, and other requirements. Laws, regulations, Executive Orders, and U.S. Department of Energy Orders are described in Section 5.2. Other regulatory activities, environmental permits, and consultations are described in Sections 5.3, 5.4, and 5.5, respectively.

5.1 Overview

This chapter identifies the statutory requirements and environmental standards that are potentially applicable to the surplus plutonium disposition activities addressed in this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)*. These requirements and standards originate from a number of sources. Federal and state statutes define broad environmental and safety programs and provide authorization to agencies to carry out the mandated programs. More-specific requirements are established through regulations, at both the Federal and state level. Federal agencies, such as the U.S. Department of Energy (DOE), and the Tennessee Valley Authority (TVA), receive additional direction in complying with executive policy through Executive Orders. In addition, DOE has established regulations and management directives (DOE Orders) that are applicable to DOE activities, facilities, and contractors. Regulations often include requirements for permits and consultations, which provide an in-depth, facility-specific review of the activities proposed.

5.2 Laws, Regulations, Executive Orders, and DOE Orders

The complexity of managing nuclear materials is reflected in the regulatory scheme governing these activities. Multiple Federal agencies regulate specific aspects of nuclear materials management for surplus plutonium disposition. The U.S. Nuclear Regulatory Commission (NRC) regulates the Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF) licensing under 10 CFR Part 70 and will regulate its operations and some aspects of its nuclear materials storage, transportation, and disposal. DOE imposes its own standards on many aspects of nuclear materials management through regulations, orders and contract requirements related to facility design and operation, radioactive waste management, and health and safety, including radiation protection. The U.S. Department of Transportation (DOT) regulates the offsite transportation of hazardous and radioactive materials.

The U.S. Environmental Protection Agency (EPA) regulates many aspects of surplus plutonium disposition activities, including air emissions, hazardous waste management, water quality, and emergency management. In many cases, EPA has delegated all or part of its environmental protection authorities to states, including South Carolina and New Mexico, but retains oversight authority. In this delegated role, the South Carolina Department of Health and Environmental Control (SCDHEC) and New Mexico Environment Department (NMED) regulate air emissions; discharges to surface water and groundwater; drinking water quality; and hazardous and nonhazardous waste treatment, storage, and disposal.

The National Defense Authorization Act for Fiscal Year 2002 (50 U.S.C. 2567) requires that, prior to beginning the ongoing consolidation of surplus plutonium to the Savannah River Site (SRS), DOE submit to Congress a plan identifying a disposition path for plutonium that would have been disposed of by the proposed Plutonium Immobilization Plant that DOE decided not to build. The plan was submitted to Congress on September 5, 2007.

Section 3137 of the National Defense Authorization Act for Fiscal Year 2001 (Public Law 106-398), as amended by Section 3115 of the National Defense Authorization Act for Fiscal Year 2004 (Public Law 108-136), states "[t]he Secretary of Energy shall continue operations and maintain a high state of readiness at the H-Canyon facility at the Savannah River Site, Aiken, South Carolina, and shall provide technical staff necessary to operate and so maintain such facility."

Table 5–1 lists environmental laws, regulations, and other requirements that are potentially applicable to DOE's proposed action.

Table 5–1 Environmental Laws, Regulations, Executive Orders, and DOE Orders

Law, Regulation, Executive Order, DOE Order	*Description*
Environmental Quality	
National Environmental Policy Act of 1969 42 U.S.C. 4321 et seq.	Act establishes a national policy of environmental protection and directs all Federal agencies to utilize a systematic, interdisciplinary approach incorporating environmental values into decisionmaking.
Farmland Protection Policy Act of 1981, as amended, 7 U.S.C. 4201 et seq., 7 CFR Part 658	Act requires the avoidance of any adverse effects on prime and unique farmlands. Its purpose is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. Would apply if the proposed plutonium disposition facilities were being built on or were projected to have an adverse impact on such farmlands.
Council on Environmental Quality, *Regulations for Implementing NEPA* 40 CFR Parts 1500-1508	Regulations defining actions that Federal agencies must take to comply with NEPA, including the development of environmental impact statements.
DOE National Environmental Policy Act Implementing Procedures, 10 CFR Part 1021	DOE guidelines for implementing the procedural provisions of NEPA.
Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, 10 CFR Part 51	NRC procedures for implementing the National Environmental Policy Act of 1969, as amended. Contains environmental protection regulations applicable to NRC's domestic licensing and related regulatory functions. Pertains to licensing of MFFF.
TVA Instruction IX Environmental Review - Procedures for Compliance with the National Environmental Policy Act	TVA procedures for implementing the procedural provisions of NEPA.
Executive Order 11514, *Protection and Enhancement of Environmental Quality* (03/05/70)	Executive Order requires Federal agencies to direct their policies, plans, and programs so as to meet national environmental goals established by NEPA.
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (02/11/94)	Executive Order requires each Federal agency to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.
Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (04/21/97)	Executive Order requires each Federal agency to identify and assess environmental health risks and safety risks that may disproportionately affect children and ensure that its policies, programs, activities, and standards address these disproportionate risks.
Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (10/8/09)	Executive Order requires Federal agencies to increase their energy efficiency; measure, report, and decrease their greenhouse gas emissions; preserve and protect water resources; and construct, maintain, and operate high-performance sustainable buildings. Could impact construction methods and operation of proposed plutonium disposition facilities.
DOE Order 231.1B, *Environment, Safety, and Health Reporting* (06/27/11)	Requirements to ensure timely collection, reporting, analysis, and dissemination of information on environment, safety, and health issues as required by law or regulations or as needed by DOE.

Law, Regulation, Executive Order, DOE Order	***Description***
DOE Order 436.1, *Departmental Sustainability* (05/02/11)	Order defines requirements and responsibilities for managing sustainability within DOE.
DOE Policy 450.4A, *Integrated Safety Management Policy* (04/25/11)	Sets forth the framework for identifying, implementing, and complying with environmental safety and health requirements so that work is performed in the DOE complex in a manner that ensures adequate protection of workers, the public, and the environment.
DOE Order 451.1B, *National Environmental Policy Act Compliance Program*, (10/26/00; Change 2, (06/25/10; Change 3, 01/19/12)	Requirements and responsibilities for applying NEPA and implementing regulations.
Environmental Audit Privilege and Voluntary Disclosure SC Code §48- 57-10, et. seq.	Environmental audit privilege is established to promote voluntary internal environmental audits of compliance programs.
Air Quality and Noise	
Clean Air Act of 1970 as amended 42 U.S.C. 7401 et seq.	Comprehensive legislation to protect and enhance the nation's air quality. Requires Federal agencies to comply with air quality regulations. EPA has delegated authority for most Clean Air Act provisions to SCDHEC for activities in South Carolina and NMED for activities in New Mexico, which would issue permits or modify permits as needed for the proposed plutonium disposition activities at SRS or LANL, as appropriate.
Title V Permitting 40 CFR Part 70 SC Regulation 61-62.70 20.2.70 NMAC 20.2.72 NMAC 20.2.74 NMAC	Permitting program for most large sources of air pollution. Defines minimum permit requirements, including air pollution control, reporting, monitoring, and compliance certification requirements. Would pertain to proposed plutonium disposition activities.
Ambient Air Quality Standards/State Implementation Plans 40 CFR Parts 51 and 58 SC Regulation 61-62.5, Standard 2 20.2.3 NMAC	Standards are divided into primary and secondary categories for the following pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, sodium dioxide, and particulate matter. Proposed plutonium disposition activities would add to site emissions, which are then compared to the standards.
New Source Performance Standards 40 CFR Part 60 SC Regulation 61-62.60 20.2.77 NMAC	Industry- and process-specific standards that may apply to any new, modified, or reconstructed sources of air pollution.
National Emission Standards for Hazardous Air Pollutants and for Source Categories 40 CFR Parts 61 and 63 SC Regulation 61-62.61 and 62.63 20.11.64 NMAC	Standards for air emissions, including hazardous air pollutants, such as radionuclides, benzene, dioxins, mercury, and asbestos. Maximum achievable control technologies are identified by industry or process. Proposed plutonium disposition activities would add to site emissions, which are then compared to the standards.
Prevention of Significant Deterioration 40 CFR 51.166 SC Regulation 61-62.5, Standard 7 20.2.74 NMAC	Program designed to maintain air quality in areas already in compliance with ambient air quality standards (attainment areas). Requires comprehensive preconstruction review and the application of best-available control technology to major stationary sources.
South Carolina Pollution Control Act (1972) SC Code §48-1-10 et seq. SC Regulation 61-62	State statute defining regulatory authority for air quality permitting and regulation, pertains to activities at SRS that are permitted by the state.
New Mexico Air Quality Control Act NMSA 1978 § 74.2 (2002)20.2 NMAC (revised 10/31/02)	Establishes air quality standards and requires a permit prior to construction or modification of an air contaminant source. Also requires an operating permit for major producers of air pollutants and imposes emission standards for hazardous air pollutants.

Law, Regulation, Executive Order, DOE Order	***Description***
Noise Control Act of 1972, 42 U.S.C. 4901 et seq. as amended by the Quiet Communities Act of 1978	Statute to protect the health and safety of the public from excessive noise levels. Requires Federal agencies to comply with Federal, state, and local noise abatement requirements. Could pertain to the proposed plutonium disposition activities if the noise were projected to be excessive.
Water Resources	
Federal Water Pollution Control Act (Clean Water Act), 33 U.S.C. 1251 et seq.	National program to restore and maintain the chemical, physical, and biological integrity of navigable waters by prohibiting the discharge of toxic pollutants in significant amounts. Requires Federal agencies to comply with Federal, state, and local water quality requirements. EPA has delegated primary enforcement authority for the Clean Water Act to SCDHEC and NMED (except for NPDES permits in New Mexico).
National Pollutant Discharge Elimination System 40 CFR Part 122 SC Regulation 61-9.122	Permit program for point-source discharges of pollutants to waters of the United States. Permits establish effluent limits to ensure that water quality standards are met. Program pertains to permits issued at SRS.
Dredge and Fill Permits 40 CFR Part 230 33 CFR Part 320 - 330 SC Regulation 19-450	Permit program for dredging, filling, and construction activities in navigable waters and wetlands.
State Water Quality Certification 33 U.S.C. 1251 et seq. SC Regulation 61-101	State certification process provides opportunity for a state to review and certify a Federal permit or license for an activity that results in discharges to navigable waters.
South Carolina Pollution Control Act SC Code § 48-1-10 et seq.	State statute establishing wide-ranging water protection program, including some provisions not addressed by the Clean Water Act (for example, permit requirements for construction of wastewater treatment plants). SCDHEC may need to issue or modify permits related to the proposed plutonium disposition activities at SRS.
New Mexico Water Quality Act NMSA Chapter 74, Article 6, “Water Quality,” and implementing regulations found in NMAC Title 20, “Environmental Protection,” Chapter 6, “Water Quality” (revised 02/16/06)	Establishes water quality standards and requires a permit prior to the construction or modification of a water discharge source.
Safe Drinking Water Act of 1974 42 U.S.C. 300f et seq.	National program to ensure quality of drinking water in public water systems. EPA has delegated primary enforcement authority to SCDHEC and NMED.
South Carolina Safe Drinking Water Act SC Code § 44-55-10 et seq.	State program regulating public water systems.
New Mexico Environmental Improvement Act NMSA 1978 §74-1	State program to ensure compliance with the federal Safe Drinking Water Act.
Primary Drinking Water Standards 40 CFR Part 141 SC Regulation 61-58 20.7.10 NMAC	Standards for maximum contaminant levels for pollutants in drinking water. Also used as groundwater protection standards.
Oil Pollution Prevention 40 CFR Part 112	Program to prevent the discharge of oil into navigable waters. Facility owner/operator is required to prepare a Spill Prevention, Control, and Countermeasure Plan. Such plans would need to be developed for the proposed plutonium disposition facilities.
South Carolina Groundwater Use and Reporting Act of 2000, SC Code § 49-5-10 to § 49-5-150	Establishes state standards to restrict groundwater use.

Law, Regulation, Executive Order, DOE Order	***Description***
Surface Water Withdrawal, Permitting Use, and Report Act of 2010, SC Code § 49-4-10 to § 49-4-180	Mandates that any person withdrawing groundwater or surface water for any purpose in excess of 3 million gallons (11 million liters) during any one month from a single or multiple wells or intakes under common ownership and within one-mile (1.6-kilometer) of an existing or proposed well or intake must register with, annually report to, and be permitted by South Carolina Department of Health and Environmental Control
New Mexico Groundwater Protection Act NMSA Chapter 74, Article 6B, "Groundwater Protection."	Establishes state standards for protection of groundwater from leaking underground storage tanks.
DOE Compliance with Floodplain and Wetlands Environmental Review Requirements 10 CFR Part 1022	DOE regulation establishing policy and procedures for implementing responsibilities for protection of floodplains and wetlands.
Procedures for Decisionmaking (Permitting) 40 CFR Part 124	This part contains EPA procedures for issuing, modifying, revoking and reissuing, or terminating all RCRA, PSD, and NPDES permits.
Executive Order 11990, *Protection of Wetlands* (05/24/77)	Executive Order directs Federal agencies to avoid construction in wetlands and to mitigate impacts of any use of wetlands. Would apply if any of the proposed plutonium disposition facilities were built in areas that impacted wetlands.
Executive Order 11988, *Floodplain Management* (05/29/77)	Executive Order directs Federal agencies to consider the effects of flood hazards and avoid impacts on floodplains, if practicable. Would apply if any of the proposed plutonium disposition facilities were built in areas that included floodplains.
Ecological Resources	
Endangered Species Act of 1973, 16 U.S.C. 1531 et seq.	Program for the conservation of threatened and endangered species and their ecosystems. Requires Federal agencies to assess whether actions could adversely affect threatened or endangered species or their habitat.
South Carolina Nongame and Endangered Species Conservation Act SC Code § 50-15-10-90 SC Regulation 123-150	State statute and regulation protecting state-listed threatened and endangered species. Could pertain to the proposed plutonium disposition activities if they were found to potentially impact state-designated endangered species or species of concern.
New Mexico Endangered Plant Species Act, NMSA 1978 § 75-6-1	Requires coordination with the State of New Mexico.
Threatened and Endangered Species of New Mexico, 19.33.6 NMAC (revised 12/29/06)	Establishes the list of state-designated threatened and endangered species.
New Mexico Endangered Plant Species, 19.21.2 NMAC (revised 11/30/06)	Establishes plant species list and rules for collection. Could pertain to the proposed plutonium disposition activities if they were found to potentially impact state-designated endangered species or species of concern.
New Mexico Wildlife Conservation Act, NMSA 1978 § 17-2-3	Requires a permit and coordination if a project may disturb habitat or otherwise affect threatened or endangered species.
Migratory Bird Treaty Act of 1918, 16 U.S.C. 703 et seq.	Act implements a number of international treaties related to the protection of migratory birds. Could pertain to the proposed plutonium disposition activities if they were found to potentially impact migrating bird populations.
Bald and Golden Eagle Protection Act, 16 U.S.C. 668-668d	Act imposes criminal and civil penalties for the possession or taking of bald or golden eagles. Could pertain to the proposed plutonium disposition activities if they were found to potentially impact eagle nesting areas.
Hawks, vultures and owls; taking, possessing, trapping, destroying, maiming or selling prohibited; exception by permit; penalty, NMSA 1978 §17-2-14	Makes it unlawful to take, attempt to take, possess, trap, ensnare, injure, maim, or destroy any of the species of hawks, owls, and vultures.

Law, Regulation, Executive Order, DOE Order	***Description***
Fish and Wildlife Coordination Act of 1934, 16 U.S.C. 661 et seq.	Act requires involvement of state and Federal wildlife agencies to evaluate impacts of proposed projects that may result in the construction, modification, or control of bodies of water in excess of 10 acres in surface area.
Anadromous Fish Conservation Act of 1965, 16 U.S.C. 757	Act authorizes the Secretary of the Interior to enter into agreements with states and other non-Federal entities to protect and enhance resources of anadromous fish (fish that return to rivers from the sea to spawn).
Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds* (01/10/01)	Executive Order requires each Federal agency whose actions have or are likely to have a measurable negative effect on migratory birds to enter into a memorandum of understanding with the U.S. Fish and Wildlife Service defining protective measures.
Executive Order 13112, *Invasive Species* (2/3/99)	Executive Order directs each Federal agency whose actions may affect the status of invasive species to take action to prevent the introduction of invasive species and promote restoration of native species and natural habitat.
Cultural Resources	
National Historic Preservation Act of 1966, 16 U.S.C. 470 et seq.	Program protecting historic properties. Act requires consultation with the State Historic Preservation Officer prior to any action that could affect historic resources. This consultation is being accomplished for the proposed plutonium disposition activities, as needed.
Protection of Historic Properties, 36 CFR Part 800	Procedures for Federal agencies to meet National Historic Preservation Act obligations.
South Carolina Institute of Archaeology and Anthropology, SC Code § 60-13-210	Establishes and recommends methods and standards for archaeological and anthropological research on behalf of the state, in use at SRS.
New Mexico Cultural Properties Act, NMSA 18-6-1 through 18-6-23	Establishes the State Historic Preservation Office and requirements to prepare an archaeological and historic survey and consult with the State Historic Preservation Officer.
Archaeological Resources Protection Act of 1979, 16 U.S.C. 470aa – mm	Act protects archaeological resources and sites on Federal and American Indian lands. Could apply if such resources were to be disturbed by activities associated with the proposed plutonium disposition facilities.
Archaeological and Historic Preservation Act of 1974, as amended, 16 U.S.C. 469 et seq.	Act requires the preservation of historical and archeological data (including relics and specimens) that might otherwise be irreparably lost or destroyed as the result of Federal construction projects, such as those proposed for plutonium disposition at SRS.
American Antiquities Act of 1906, 16 U.S.C. 431 et seq.	Act protects prehistoric American Indian ruins and artifacts on Federal lands and authorizes the President to designate historic areas as national monuments.
Historic Sites Act of 1935, 16 U.S.C. 461	Act provides for the preservation of historic American sites, buildings, objects, and antiquities of national significance, and serves other purposes.
Manhattan Project National Historical Park Study Act Public Law 108-340	Act directs the Secretary of the Interior to conduct a study on the preservation and interpretation of the historic sites of the Manhattan Project for potential inclusion in the National Park System.
Executive Order 11593, *Protection and Enhancement of the Cultural Environment* (05/13/71)	Executive Order requires preservation of historic and archaeological information prior to construction activities such as those associated with the proposed plutonium disposition facilities.
Executive Order 13287, *Preserve America* (03/03/03)	Executive Order promotes the protection of Federal historic properties and cooperation among governmental and private entities in preserving cultural heritage.

Law, Regulation, Executive Order, DOE Order	***Description***
Curation of Federally-Owned and Administered Archeological Collections, 36 CFR Part 79	Establishes definitions, standards, procedures and guidelines to be followed by Federal agencies to preserve collections of prehistoric and historic material remains, and associated records, recovered under the authority of the American Antiquities Act (16 U.S.C. 431- 433), the Reservoir Salvage Act (16 U.S.C. 469-469c), Section 110 of the National Historic Preservation Act (16 U.S.C. 470h-2), or the Archaeological Resources Protection Act (16 U.S.C. 470aa-mm).
National Register of Historic Places, 36 CFR Part 60	These regulations set forth the procedural requirements for listing properties on the National Register of Historic Places.
Determinations of Eligibility for Inclusion in the National Register of Historic Places, 36 CFR Part 63	Regulation identifies the process for evaluating the eligibility of properties for inclusion in the National Register of Historic Places.
Protection of Archeological Resources, 43 CFR Part 7	Implements provisions of the Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470aa-mm) by establishing the uniform definitions, standards, and procedures to be followed by all Federal land managers in providing protection for archaeological resources located on public lands and American Indian lands of the United States.
American Indian Religious Freedom Act of 1978, 42 U.S.C. 1996	Act protects and preserves for American Indians their inherent right of freedom to believe, express, and exercise their traditional religions, including access to sites.
Native American Graves Protection and Repatriation Act of 1990, 25 U.S.C. 3001 et seq. 43 CFR Part 10	Act protects American Indian burial remains and funerary objects found on Federal or tribal land. Could apply if such resources were to be disturbed by activities associated with the proposed plutonium disposition facilities.
Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments* (11/06/00)	Executive Order requires consultation and coordination with American Indian tribes prior to taking actions that affect federally recognized tribal governments.
Executive Order 13007, *Indian Sacred Sites* (05/24/96)	Executive Order requires Federal agencies to accommodate, to the extent practicable, access to American Indian sacred sites and avoid adverse impacts on such sites.
Executive Order 13195, *Trails for America in the 21st Century* (01/18/01)	Executive Order requires Federal agencies to—to the extent permitted by law and where practicable, and in cooperation with tribes, states, local governments, and interested citizen groups—protect, connect, promote, and assist trails of all types throughout the United States.
DOE Policy 141.1, *Department of Energy Management of Cultural Resources* (5/2/01)	Policy ensures that DOE programs and field elements integrate cultural resources management into their mission and activities.
DOE Order 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy*, (01/16/09; Change 1, 11/06/09)	DOE policy committing to consultation with American Indian tribal governments to solicit input on DOE issues.
Accords with the Pueblos of Cochiti, Jemez, Santa Clara, and San Ildefonso and DOE (restated 2005 and 2006)	Set forth the specifications for maintaining a government-to-government relationship between DOE and each of the four pueblos closest to LANL.

Law, Regulation, Executive Order, DOE Order	*Description*
Waste Management and Pollution Prevention	
Solid Waste Disposal Act of 1965 as amended by the Resource Conservation and Recovery Act of 1976 and the Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. 6901 et seq.	Act establishes comprehensive management system for hazardous wastes, addressing generation, transportation, storage, treatment, and disposal. Section 3006 of RCRA (42 U.S.C. 6926) allows states to establish and administer permit programs with EPA approval. SCDHEC administers the RCRA program in South Carolina and issues SRS's RCRA operating permit. The New Mexico Hazardous Waste Bureau administers the RCRA program in New Mexico.
New Mexico Solid Waste Act, NMSA 1978 § 74-9-1 through 43 20.9 NMAC (revised November 27, 2001)	Act requires permit prior to construction or modification of a solid waste disposal facility.
Hazardous Waste Management Regulations 40 CFR Part 260-273 SC Regulation 61-79 (revised May 28, 2010) 20.4.1 NMAC	Regulations governing the generation, transportation, treatment, storage, and disposal of hazardous waste.
South Carolina Hazardous Waste Management Act SC Code §44-56-10-840	State statute regulating the generation, transportation, treatment, storage, and disposal of hazardous waste.
New Mexico Hazardous Waste Act, NMSA 1978 § 74-4	Contains requirements for an application for a permit pursuant to the New Mexico Hazardous Waste Act.
New Mexico Hazardous Waste Management, 20.4.1.500 NMAC	Incorporates the requirements of the regulations of the EPA set forth in 40 CFR Part 264 except as otherwise provided in the section.
Federal Facility Compliance Act of 1992, 42 U.S.C. `6961 et seq.	Act waives sovereign immunity for Federal facilities under RCRA and requires DOE to conduct an inventory and develop a treatment plan for mixed wastes.
Federal Facility Compliance Act Consent Order October 1995 (issued to both DOE and LANL)	Order used by the New Mexico Environment Department to enforce the Federal Facility Compliance Act. It requires compliance with the approved LANL Site Treatment Plan, which documents the development and use of treatment capacities and technologies, as well as use of offsite facilities for treating mixed radioactive waste stored at LANL.
Compliance Order on Consent March 1, 2005 [a]	Order was entered into by the State of New Mexico, DOE, and the University of California. Order requires site investigations of known or potentially contaminated sites at LANL and cleanup in accordance with a specified process and schedule.
Byproduct Material, 10 CFR Part 962	Regulation defines byproduct material as identified in the Atomic Energy Act, and clarifies that the hazardous portion of mixed radioactive waste is subject to RCRA.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601 et seq.	Act provides broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.
Toxic Substances Control Act of 1976, 15 U.S.C. 2601 et seq.	Act gives EPA the authority to screen and regulate new and existing chemicals to protect the public from the risks of exposure to chemicals. Specific provisions address polychlorinated biphenyls, asbestos, radon, and lead-based paint.
Pollution Prevention Act of 1990, 42 U.S.C. 13101 et seq.	Act establishes requirement to prevent pollution by emphasizing source reduction and recycling. EPA is charged with developing measures for source reduction and evaluating regulations to promote source reduction.
Nuclear Waste Policy Act of 1982, 42 U.S.C. 10101 et seq.	Act establishes national program for the disposal of defense high-level radioactive waste and commercial used nuclear fuel.

Law, Regulation, Executive Order, DOE Order	***Description***
Waste Isolation Pilot Plant Land Withdrawal Act of 1992, Public Law 102-579, as amended by Public Law 104-201	Act establishes national program for the disposal of TRU waste at WIPP in New Mexico. Prior to sending any TRU waste from SRS to WIPP, DOE must determine whether the waste meets all statutory and regulatory requirements for disposal at WIPP.
DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980, Public Law 96-164, 93 Stat. 1259	Act includes information related to the authorization basis of WIPP for the disposal of contact-handled and remote-handled TRU waste.
Low-Level Radioactive Waste Policy Act of 1980, 42 U.S.C. 2021 et seq.	Act specifies that the Federal Government is responsible for the disposal of low-level radioactive waste generated by its activities and that states are responsible for the disposal of commercially generated low-level radioactive waste. Pertains to waste that could be generated by the proposed plutonium disposition activities.
Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes, 40 CFR Part 191	Applies to radiation doses received by members of the public as a result of the management (except for transportation) and storage of used nuclear fuel or TRU or high-level radioactive wastes. Pertains to storage of TRU waste at WIPP.
Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations, 40 CFR Part 194	This part specifies criteria for the certification or any re-certification, or subsequent actions relating to the terms or conditions of certification of WIPP's compliance with the disposal regulations found at 40 CFR Part 191 and pursuant to Section 8(d)(1) and Section 8(f) of the Waste Isolation Pilot Plant Land Withdrawal Act.
Executive Order 12580, *Superfund Implementation* (01/23/87)	Executive Order delegates responsibility to a Federal agency for hazardous substance response activities when the release is from, or the sole source of the release is located in, any facility or vessel under the control of that agency.
Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (01/24/07)	Executive Order promoting environmentally and economically efficient and continuously improving manner for all environment-, energy-, and transportation-related activities of executive agencies. Requires agencies to reduce greenhouse gas emissions and water consumption. Could impact how the proposed plutonium disposition facilities would be constructed and operated.
DOE Order 435.1, *Radioactive Waste Management* (07/09/99; Change 1, 08/28/01)	Requirements to ensure that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety and the environment.
Management of Nuclear Materials	
Atomic Energy Act of 1954, as amended 42 U.S.C. 2011 et seq.	Act provides fundamental jurisdictional authority to DOE and NRC over governmental and commercial use, respectively, of nuclear materials. Authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE jurisdiction, such as the proposed plutonium disposition activities at SRS. DOE has issued a series of orders to establish a system of standards and requirements to ensure safe operation of DOE facilities.
Standards for Protection Against Radiation 10 CFR Part 20	Standards for protection against ionizing radiation from NRC-licensed activities, covering both workers and the public.
Rules of General Applicability to Domestic Licensing of Byproduct Material 10 CFR Part 30	Rules governing domestic licensing of byproduct material under the Atomic Energy Act of 1954.
Domestic Licensing of Source Material 10 CFR Part 40	Procedures and criteria for the issuance of licenses to receive title to, deliver, receive, possess, use, or transfer source materials.

Law, Regulation, Executive Order, DOE Order	***Description***
Domestic Licensing of Production and Utilization Facilities, 10 CFR Part 50	Procedures and criteria provide for the licensing of production and utilization facilities. Nuclear reactors are licensed under this regulation.
Licenses, Certifications, and Approvals For Nuclear Power Plants, 10 CFR Part 52	Procedures for issuance of early site permits, standard design certifications, combined licenses, standard design approvals, and manufacturing licenses for nuclear power facilities licensed under Section 103 of the Atomic Energy Act of 1954, as amended (68 Stat. 919), and Title II of the Energy Reorganization Act of 1974 (88 Stat. 1242).
Domestic Licensing of Special Nuclear Material, 10 CFR Part 70	Procedures and criteria for the issuance of licenses to receive title to, own, acquire, deliver, receive, possess, use, or transfer special nuclear material, such as plutonium. MFFF will be licensed under this regulation.
Strom Thurmond National Defense Authorization Act for Fiscal Year 1999, Public Law 105–261, 112 Stat. 2247	Act amends the Energy Reorganization Act (42 U.S.C. 5842) to provide NRC with regulatory and licensing authority over MFFF.
Price-Anderson Amendments Act, 42 U.S.C. 2210	Act allows DOE to indemnify its contractors if the contract involves the risk of public liability from a nuclear incident. Applies to operation of the proposed plutonium disposition activities at SRS and to nuclear reactor operators.
Energy Policy Act of 2005, Public Law 109-58	Among other provisions, this act extended the Price-Anderson Nuclear Industries Indemnity Act through 2025.
National Defense Authorization Act for Fiscal Year 2002, Public Law 107-107, 50 U.S.C. 2567	Establishes requirements for consultation regarding any decisions or plans of DOE related to the disposition of surplus defense plutonium and defense plutonium materials located at the Savannah River Site, Aiken, South Carolina.
Procedural Rules for DOE Nuclear Facilities 10 CFR Part 820	Procedures to govern the conduct of persons involved in DOE nuclear activities and, in particular, to achieve compliance with DOE nuclear safety requirements.
Nuclear Safety Management, 10 CFR Part 830	Requirements governing the conduct of DOE contractors, DOE personnel, and other persons conducting activities (including providing items and services) that affect, or may affect, the safety of DOE nuclear facilities, such as the proposed plutonium disposition facilities.
DOE Order 410.2, *Management of Nuclear Materials* (08/17/09)	Requirements and procedures for the lifecycle management of nuclear materials within DOE.
DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities,* (04/16/10)	Requirements for DOE/NNSA for verifying readiness for startup of new nuclear facilities and for the restart of existing nuclear facilities that have been shut down.
DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities* (04/21/10)	Selection, qualification, and training requirements for management and operating contractor personnel involved in the operation, maintenance, and technical support of DOE/NNSA reactors and nonreactor nuclear facilities.
DOE Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities* (04/21/10)	Safety management program required by 10 CFR Part 830 for maintenance and the reliable performance of structures, systems, and components that are part of the safety basis at Hazard Category 1, 2, and 3 DOE nuclear facilities.
DOE Order 458.1, *Radiation Protection of the Public and the Environment* (02/11/11; Change 1, 03/08/11; Change 2, 06/06/11)	Establishes requirements to protect the public and the environment against undue risk from radiation associated with radiological activities conducted under the control of DOE pursuant to the Atomic Energy Act of 1954, as amended.
DOE Policy 470.1A, *Safeguards and Security Program* (12/29/10)	Ensures that DOE efficiently and effectively meets all its obligations to protect special nuclear material, other nuclear materials, classified matter, sensitive information, government property, and the safety and security of employees, contractors, and the general public.

Law, Regulation, Executive Order, DOE Order	***Description***
DOE Order 470.4B, *Safeguards and Security Program* (07/26/11)	Identifies roles and responsibilities for the DOE Safeguards and Security Program.
Worker Safety and Health	
Occupational Safety and Health Act of 1970, 29 U.S.C. 651 et seq.	Act ensures worker and workplace safety, including a workplace free from recognized hazards, such as exposure to toxic chemicals, excessive noise levels, and mechanical dangers.
Occupational Safety and Health Standards 29 CFR Part 1910 29 CFR Part 1926	Standards to protect workers from hazards encountered in the workplace (Part 1910) and construction site (Part 1926).
Worker Safety and Health Program, 10 CFR Part 851	DOE's health and safety program to control and monitor hazardous materials to ensure that workers are not being exposed to health hazards, such as toxic chemicals, excessive noise, and ergonomic stressors.
Occupational Radiation Protection, 10 CFR Part 835	Radiation protection standards, limits, and program requirements for protecting workers from ionizing radiation resulting from DOE activities.
New Mexico Radiation Protection Act, NMSA 1978 § 74-3 20.3 NMAC (revised April 30, 2009)	Establishes state requirements for worker protection.
DOE Policy 420.1, *Department of Energy Nuclear Safety Policy* (02/08/11)	Documents DOE's nuclear safety policy.
DOE Order 420.1B, *Facility Safety* (12/22/05; Change 1, 04/19/10)	Facility and programmatic safety requirements for DOE facilities, including nuclear and explosives safety design criteria, fire protection, criticality safety, natural phenomena hazards mitigation, and the System Engineer Program.
DOE Order 430.1B, *Real Property Asset Management* (9/24/03)	Establish a corporate, holistic, and performance-based approach to real property life-cycle asset management that links real property asset planning, programming, budgeting, and evaluation to program mission projections and performance outcomes. To accomplish the objective, this Order identifies requirements and establishes reporting mechanisms and responsibilities for real property asset management.
DOE Order 440.1B, *Worker Protection Program for DOE (including the National Nuclear Security Administration) Federal Employees* (05/17/07)	Program to protect workers and reduce accidents and losses; adopts occupational safety and health standards.
Transportation	
Hazardous Materials Transportation Act of 1975, 49 U.S.C. 5101 et seq.	Act provides DOT with authority to protect against the risks associated with transportation of hazardous materials, including radioactive materials, in commerce.
Hazardous Materials Regulations, 49 CFR Parts 171–180	DOT requirements for classification, packaging, hazard communication, incident reporting, handling, and transportation of hazardous materials.
Packaging and Transportation of Radioactive Material, 10 CFR Part 71	NRC requirements for packaging, preparation for shipment, and transportation of licensed materials, including reactor fuel.
DOE Order 460.1C, *Packaging and Transportation Safety* (05/14/10)	Safety requirements for the proper packaging and transportation of DOE/NNSA offsite shipments and onsite transfers of hazardous materials.
DOE Order 460.2A, *Departmental Materials Transportation and Packaging Management* (12/22/04)	Requirements and responsibilities for management of DOE/NNSA materials transportation and packaging to ensure the safe, secure, and efficient packaging and transportation of materials, both hazardous and nonhazardous.

Law, Regulation, Executive Order, DOE Order	***Description***
DOE Order 461.1B, *Packaging and Transportation for Offsite Shipment of Materials of National Security Interest* (12/20/10)	Makes clear that the packaging and transportation of all offsite shipments of materials of national security interest for DOE, including plutonium and pits, must be conducted in accordance with DOT and NRC regulations that would be applicable to comparable commercial shipments, except where an alternative course of action is identified in the Order.
DOE Order 461.2, *Onsite Packaging And Transfer Of Materials Of National Security Interest* (11/01/10)	Establishes safety requirements and responsibilities for onsite packaging and transfers of materials of national security interest to ensure safe use of Transportation Safeguards System (TSS), non-TSS Government- and contractor-owned and/or leased resources.
Emergency Management	
Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11001 et seq. 40 CFR Parts 350-372	Act establishes an emergency response system to help local communities protect public health and safety and the environment from unplanned releases of hazardous materials. SRS and LANL are required to provide the needed information to local and state emergency response planning authorities regarding operations at SRS and LANL. Would need to include the proposed plutonium disposition facilities, once operational or additional activities that may take place in existing facilities, as appropriate.
New Mexico Hazardous Chemicals Information Act, NMSA Chapter 74, Article 4E-1	Implements the hazardous chemical information and toxic release reporting requirements of the Emergency Planning and Community Right-to-Know Act of 1986 (SARA Title III) for covered facilities.
Radiological Emergency Planning and Preparedness, 44 CFR Part 351	Requires emergency plans for DOE nuclear facilities; additional DOE responsibilities defined for assisting the Federal Emergency Management Agency. Emergency plans for SRS would need to include the proposed plutonium disposition facilities, once operational.
Emergency Planning and Notification, 40 CFR Part 355	Emergency planning provisions for facilities in possession of an extremely hazardous substance in a quantity exceeding a specified threshold quantity. Could apply to substances to be used in the proposed plutonium disposition capabilities.
Hazardous Chemical Reporting: Community Right-To-Know, 40 CFR Part 370	Establishes reporting requirements for providing the public with important information on the hazardous chemical inventories in their communities.
Toxic Chemical Release Reporting: Community Right-To-Know, 40 CFR Part 372	Establishes reporting requirements for providing the public with important information on the release of toxic chemicals in their communities.
Executive Order 12656, *Assignment of Emergency Preparedness Responsibilities* (11/18/88)	Executive Order to have sufficient capabilities to meet defense and civilian needs during national emergency. DOE is the lead agency responsible for energy-related emergency preparedness and for assuring the security of DOE nuclear materials and facilities.
Environmental Oversight and Monitoring Agreement Agreement in Principle Between DOE and the State of New Mexico, November 2000	Provides DOE support for state activities in environmental oversight, monitoring, access, and emergency response.
DOE Order 151.1C, *Comprehensive Emergency Management System* (11/02/05)	Order establishes policy and assigns and describes roles and responsibilities for the DOE Emergency Management System. The Emergency Management System provides the framework for development, coordination, control, and direction of all emergency planning, preparedness, readiness assurance, response, and recovery actions.

Law, Regulation, Executive Order, DOE Order	***Description***
DOE Order 153.1, *Departmental Radiological Emergency Response Assets* (06/27/07)	Requirements and responsibilities for the DOE/NNSA national radiological emergency response assets and capabilities and Nuclear Emergency Support Team assets.

CFR = *Code of Federal Regulations*; DOT = U.S. Department of Transportation; EPA = U.S. Environmental Protection Agency; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; NEPA = National Environmental Policy Act; NMAC = New Mexico Administrative Code; NMED = New Mexico Environment Department; NMSA = New Mexico Statutes Annotated; NNSA = National Nuclear Security Administration; NPDES = National Pollutant Discharge Elimination System; NRC = U.S. Nuclear Regulatory Commission; PSD = prevention of significant deterioration; RCRA = Resource Conservation and Recovery Act; SARA = Superfund Amendments and Reauthorization Act; SC = South Carolina; SCDHEC = South Carolina Department of Health and Environmental Control; SRS = Savannah River Site; TRU = transuranic; TVA = Tennessee Valley Authority; U.S.C. = *United States Code*; WIPP = Waste Isolation Pilot Plant.

[a] Source: NMED 2005.

5.3 Regulatory Activities

The proposed surplus plutonium disposition facilities must be designed, constructed and operated in accordance with a variety of applicable laws and regulations. Below is a brief discussion of the major laws and regulations that would apply to the proposed facilities.

5.3.1 Pit Disassembly and Conversion, and Plutonium Disposition Capabilities

Any new pit disassembly and conversion, and plutonium disposition capabilities would be designed, constructed, and operated in accordance with DOE regulations and requirements, although the capability may, as a matter of policy, take into account any appropriate NRC standards. These capabilities are categorized as nonreactor nuclear facilities. The major DOE design criteria may be found in DOE Order 6430.1A, *General Design Criteria*, and its successive Orders 420.1B, Change 1, *Facility Safety*, and 430.1B, Change 1, *Real Property Asset Management*, which delineate applicable regulatory and industrial codes and standards for both conventional facilities designed to industrial standards and “special facilities,” defined as nonreactor nuclear facilities and explosive facilities. The facilities would also comply with all the requirements of 10 CFR Part 830, “Nuclear Safety Management.” Part 830 provides both quality assurance requirements and safety basis requirements that would be imposed on both the design and operations of the facility. These would include a Documented Safety Analysis and Technical Safety Requirements that would provide the safety basis and controls for design and operation of the facility. The design of the facilities would be accomplished in stages that allow for adequate review and assurance that all required standards are met. Prior to operation, the facilities would undergo cold and hot startup testing and an operational readiness review in accordance with the requirements of DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*. Prior to startup, DOE would prepare a Safety Evaluation Report to evaluate the proposed safety basis and controls for the new facility. Once these conditions of operation were found to be acceptable, startup and operation would require the approval of the Program Secretarial Officer or designee.

While there are a number of areas or buildings that would be designed to conventional codes and standards, plutonium processing and storage areas, and other areas where quantities of plutonium or other special nuclear materials in excess of a minimum quantity could be present, would be required to meet the more stringent requirements for facility integrity and safeguards and security. Applicable regulations include 10 CFR Part 820, “Procedural Rules for DOE Nuclear Facilities.” Other applicable regulations and standards are related to worker health and safety and environmental protection, including DOE’s radiation protection standard (10 CFR Part 835, “Occupational Radiation Protection”) and 10 CFR Part 851, “Worker Safety and Health Program.” The industrial safety aspects of chemical risks to workers are regulated by the Occupational Safety and Health Administration and the protection of the environment from chemical risks is regulated by EPA, SCDHEC, and NMED.

5.3.2 MOX Fuel Fabrication Facility

The following discussion is presented for completeness and to provide the reader with an understanding of the regulations that will be followed by MFFF. The decision made by DOE, documented in a January 2000 Record of Decision (ROD), to build MFFF at SRS (65 FR Part 1608) is not being reconsidered or reevaluated in this *SPD Supplemental EIS*.

MFFF will be licensed by NRC under its regulations in 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." Construction of MFFF is ongoing pursuant to a construction authorization from NRC, and the National Nuclear Security Administration's (NNSA's) contractor has filed an application for a Part 70 license to possess and use special nuclear material, which is needed to bring plutonium to the MFFF and subsequently operate the facility. Any need to operate the facility beyond the initial operating license would also be subject to the appropriate NRC licensing process. Because the facility would be located at a DOE site and operated by a NNSA contractor, certain DOE requirements affecting site interfaces and infrastructure would also be applicable. In addition, certain Federal or state regulations implementing the Clean Water Act and the Clean Air Act would also be applicable. These regulations are implemented through permits, mainly through SCDHEC. Prior to MFFF operations, an evaluation would be required to determine whether MFFF emissions and activities require modification to its existing permits and the acquisition of additional air and water permits. A full discussion of MFFF permits is presented in Chapter 6 of NRC's *Environmental Impact Statement on the Construction and Operation of a Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina* (NUREG-1767) (NRC 2005a).

Safety and environmental analyses, documented in the MFFF Integrated Safety Analysis, support the license application for MFFF. The NRC regulations also afford opportunities for public hearings before NRC's Atomic Safety Licensing Board prior to issuance of a construction authorization and an operating license.

5.3.3 Commercial Nuclear Power Reactors

Revisions to each reactor's operating license would be required prior to MOX fuel being brought to the reactor sites and loaded into the reactors. Nuclear power reactors undergo a rigorous NRC licensing process under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," or 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" beginning before facility construction and operation. This process includes preparation of safety analysis and environmental reports, including the appropriate National Environmental Policy Act (NEPA) reviews under 10 CFR Part 51. The final safety analysis report remains a living document that serves as the licensing basis for the facility and is updated throughout the life of the facility. Public meetings are regularly held in conjunction with facility construction and operation, and opportunities are available for public hearings before NRC's Atomic Safety Licensing Board prior to any license being issued. Once issued, operating licenses may be amended only after evaluation, review, and approval as specified in 10 CFR 50.90. This process requires demonstration that a proposed change does not involve an unreviewed environmental or safety question and provides for public notice and opportunity to comment before issuance of the license amendment. Minor license amendments can be processed fairly expeditiously, but more-involved amendments can require multiple submittals to NRC before NRC is confident that the proposed action would not reduce the margin of safety of the facility. These license amendment requests also provide an opportunity for public hearings. All submittals, except the very limited portion that contain proprietary information, are available to the public.

The regulatory process for requesting reactor license amendments to use MOX fuel would be the same as that for any 10 CFR Part 50 or Part 52 operating license amendment request. This process is initiated by the reactor licensee submitting an operating license amendment request in accordance with 10 CFR 50.90. The license amendment request would need to include a discussion of all potential impacts and changes in reactor operation that could be important to safety or the environment. The need for modifications to site permits would be evaluated by the individual facilities.

5.3.4 Waste Isolation Pilot Plant

In 1992, President G. H. W. Bush signed into law the Waste Isolation Pilot Plant Land Withdrawal Act (Public Law 102-579, 106 Stat. 4777, 1992 [as amended by Public Law 104-201, 1996]), which transferred jurisdiction of the land upon which the Waste Isolation Pilot Plant (WIPP) was built to DOE and included a number of other provisions, including a prohibition on the disposal of high-level radioactive waste and used nuclear fuel there and giving EPA responsibility for determining compliance with Federal radioactive waste disposal regulations. The Waste Isolation Pilot Plant Land Withdrawal Act required EPA to certify WIPP's compliance with the long-term disposal regulations of 40 CFR Part 191, "Environmental Radiation Protection for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes," Subparts B and C, prior to the commencement of disposal operations. To comply with this requirement, DOE submitted the Compliance Certification Application in October 1996 demonstrating compliance with the disposal standards and the criteria for compliance established at 40 CFR Part 194, "Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations." The Compliance Certification Application demonstrated how the geological, hydrological, physical, chemical, and environmental characteristics of the site, along with engineered features of the facility, would safely contain radioactive waste for the 10,000-year regulatory time period. After a thorough review of the Compliance Certification Application, EPA certified WIPP's compliance with these regulations in May 1998, paving the way for waste disposal operations, which began on March 26, 1999. The submittal of a recertification application for WIPP is required by Section 8(f) of the Waste Isolation Pilot Plant Land Withdrawal Act to occur not later than 5 years after initial receipt of transuranic (TRU) waste for disposal at the repository, and every 5 years thereafter until the decommissioning of the facility is completed. EPA recertified WIPP's continuing compliance with the disposal regulations on March 29, 2006. DOE's second recertification application was submitted in March 2009 and was approved by EPA on November 18, 2010.

Congress passed the Resource Conservation and Recovery Act (RCRA) in 1976 to establish requirements for the management of hazardous waste. Much of the waste that is disposed of at WIPP is mixed waste, meaning that it contains both hazardous and radioactive components. Therefore, WIPP must comply with RCRA to dispose of mixed waste. Under RCRA, which amended the Solid Waste Disposal Act of 1965, EPA defines and identifies hazardous waste; establishes standards for its transportation, treatment, storage, and disposal; and requires permits for persons engaged in hazardous waste activities. Section 3006 of RCRA allows states to establish and administer these permit programs with EPA approval. NMED is authorized by EPA to implement the hazardous waste program in New Mexico pursuant to the New Mexico Hazardous Waste Act (New Mexico Statutes Annotated [NMSA] 1978§74-4-1, et seq.). The technical standards for hazardous waste treatment, storage, and disposal facilities in New Mexico are outlined in 20.4.1.500 *New Mexico Administrative Code* (NMAC), which adopts, by reference, 40 CFR Part 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." The hazardous waste management permitting program is administered through 20.4.1.900 NMAC, which adopts, by reference, 40 CFR Part 270, "EPA Administered Permit Programs: The Hazardous Waste Permit Program." NMED issued the initial WIPP Hazardous Waste Facility Permit on October 27, 1999, and it became effective November 26, 1999, for a 10-year term. The Hazardous Waste Facility Permit authorized the WIPP facility to receive, store, and dispose of contact-handled TRU mixed waste. NMED modified the Hazardous Waste Facility Permit on October 16, 2006, to also allow receipt, storage, and disposal of remote-handled TRU mixed waste. NMED issued the first renewal of the WIPP Hazardous Waste Facility Permit on November 30, 2010, to become effective on December 30, 2010.

The authorization basis of WIPP for the disposal of contact-handled and remote-handled TRU waste includes the DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Public Law 96-164, 93 Stat. 1259), and the Waste Isolation Pilot Plant Land Withdrawal Act. DOE has established a set of waste acceptance criteria for WIPP that meets the requirements and associated criteria imposed by these acts and RCRA, as amended, for the TRU waste destined for disposal at WIPP.

These criteria are laid out in a DOE report, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-02-3122), which is periodically updated. The latest revision is Revision 7.2, which became effective on June 13, 2011.

Before any TRU waste from the proposed plutonium disposition activities at SRS or Los Alamos National Laboratory (LANL) can be sent to WIPP for disposal, SRS and LANL must prepare or modify Waste Certification Plans, Quality Assurance Plans, Transuranic Waste Authorized Methods for Payload Control, and quality assurance project plans, as applicable. Methods of compliance with each requirement and associated criterion to be implemented at the site shall be described or specifically referenced and shall include procedural and administrative controls consistent with the Carlsbad Field Office Quality Assurance Program Document. TRU waste sites, such as SRS, are required to submit these program documents to the Carlsbad Field Office for review and approval prior to their implementation. SRS would then certify that each TRU waste payload container meets the waste acceptance criteria contained in DOE/WIPP-02-3122.

DOE is considering the possibility of disposing of surplus plutonium and other TRU wastes in the DOE Type B certified Hanford Unirradiated Fuel Packages (HUFPs) and Criticality Control Containers (CCCs) at the WIPP facility. A modification to the current Hazardous Waste Facility Permit would be required to handle and emplace waste in the HUFPs, but may not be required to handle and emplace waste in the CCCs. Three classes of permit modifications are identified in the RCRA regulations. Class 1, the least significant of the permit modifications, covers minor modifications, such as the correction of typographical errors, changes to conform to agency guidelines or regulations, or procedural changes. Class 1 modifications may require approval of NMED prior to implementation, or may only require notification to NMED within 7 days after the change has been made. Class 2 modifications are more extensive and significant and apply to changes needed to allow timely response to common variations in the types and quantities of wastes managed, technological advancements, and changes in the regulations. Class 2 modifications require submittal of a permit modification request to NMED, which has up to 120 days to act on the modification request. Class 3 modifications are the most significant and potentially impactful and substantially alter the facility or its operation. Similar to a Class 2 modification, a Class 3 modification requires submittal of a permit modification request to NMED; however, for a Class 3 modification request there is no specified regulatory timeframe by which the agency must issue its decision.

DOE would prepare the required planned change requests and permit modification requests for shipping, receipt, handling, and emplacement of the HUFPs and possibly the CCCs. Based on past WIPP experience regarding requests for the use of new shipping and waste containers, DOE anticipates that these proposed changes would not significantly impact the facility or its operation, would not require an EPA rulemaking, and would be appropriately addressed in Class 2 modifications to WIPP's Hazardous Waste Facility Permit.

The effort to develop and license the CCCs is not dependent on a ROD for this *SPD Supplemental EIS*. DOE is already well along in the design process, and testing and submittal of a revision to the license for the TRUPACT-II (the shipping container that would be used for the CCCs) is planned to be completed in 2012, with NRC approval expected in 2013. DOE would begin discussions about the approval process required with NMED and EPA immediately upon receipt of the NRC license revision for the CCC. Waste receipt and handling and emplacement of a CCC would be essentially identical to that employed at WIPP currently for typical 55-gallon drums of contact-handled TRU waste.

Conversely, the effort to obtain an NRC license for the HUFPs is dependent on reaching a ROD to dispose of them at WIPP. If a decision is made in the *SPD Supplemental EIS* ROD to dispose of TRU waste in the HUFPs at WIPP, the process for identifying required facility modifications, and for preparation, submittal, and agency action on the planned change/modification requests is estimated to take up to 1 year to complete. Waste receipt and handling and emplacement of a HUFP would be significantly different than other contact-handled waste containers. In consideration of safeguards guidelines, special measures may be needed that would result in new handling equipment and emplacement methods. A fully loaded HUFP would fit onto the WIPP waste hoist conveyance without modification; however, specialized fixtures would likely be required for safe and secure operations. These handling equipment and emplacement modifications would be addressed in a Class 2 permit modification request to NMED and a planned change request to EPA.

5.4 Permits

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, and may need to be issued, extended, or modified. The need for modifications to reactor site permits would be evaluated by the individual sites. The changes are expected to result in minimal changes in effluents, emissions, and wastes if MOX fuel is used in either the Browns Ferry or Sequoyah Nuclear Plants.

Many of the activities addressed by this *SPD Supplemental EIS* would be performed within existing structures in developed areas of SRS, would utilize existing infrastructure, and would operate under existing permits. SRS complies with over 400 environmental permits covering air quality, water quality and wetlands, hazardous waste, sanitary waste, and underground storage tanks. The *Savannah River Site Environmental Report for 2010* contains a compilation of permits for the site (SRNS 2011).

Drinking water at SRS is regulated by SCDHEC under the Safe Drinking Water Act of 1974 (42 USC 300f et. seq.). Permits for domestic water supplies cover 17 separate systems across SRS; new permits would be required for tie-ins to the existing domestic water supplies for the Pit Disassembly and Conversion Facility (PDCF) in F-Area and for modifications that may be required related to the pit disassembly and conversion capability or immobilization capability in K-Area.

Drinking water at LANL is regulated by NMED under the Safe Drinking Water Act of 1974. Modification to an existing permit may be required related to the proposed pit disassembly and conversion activities at the Technical Area 55 (TA-55) Plutonium Facility (PF-4).

Wastewater discharges at SRS are regulated by four permits under the National Pollutant Discharge Elimination System (NPDES) Program, a Clean Water Act (33 U.S.C. 1251 et. seq.) program administered by SCDHEC under authority delegated by EPA. The NPDES permits include two permits for industrial wastewater (SC0000175 and SC0047431) and two permits for general stormwater discharges (SCR000000 for industrial site discharges and SCR100000 for construction sites) (WSRC 2008a). In addition to these permits, there is a "no discharge" water pollution control land application permit (ND0072125) that regulates land application of sludge, and related sampling at onsite sanitary wastewater treatment facilities. Wastewaters (i.e., stormwater, sanitary wastewaters, cooling water, and production effluents) from existing facilities are covered under permits already in place. During construction of the proposed plutonium disposition facilities and associated buildings, stormwater is managed under the SRS general stormwater permit. A Notice of Intent and Storm Water Pollution Prevention Plan address facility-specific stormwater measures. Sanitary and industrial wastewater treatment and disposal are regulated under a number of permits for facilities across SRS. For sanitary wastewaters, the proposed facilities and associated buildings would tie in to existing SRS systems; permits are required for both the construction and operations phases for these tie-ins. Due to its function as a wastewater treatment facility, the Waste Solidification Building (WSB) has been permitted by SCDHEC as an Industrial Wastewater Treatment Plant (WSRC 2008a).

Wastewater discharges at LANL are also regulated under the NPDES Program; however, in this instance, the program is administered by EPA. The LANL NPDES permit includes 15 permitted outfalls consisting of 1 sanitary outfall (for the Sanitary Wastewater Systems Plant) and 14 industrial outfalls (including 1 at PF-4). Should any construction be required in support of the proposed plutonium disposition activities at LANL, stormwater would be managed under the LANL NPDES construction general permit program. A Notice of Intent and Storm Water Pollution Prevention Plan would address facility-specific stormwater control measures. The NPDES Industrial Storm Water Permit Program at

LANL regulates stormwater discharges from identified regulated industrial activities and their associated facilities, including PF-4.

Air emissions from SRS facilities, including both radioactive and nonradioactive criteria and toxic air pollutant emissions, are regulated under the SRS air quality operating permit, issued under Title V of the Clean Air Act (42 USC 7401 et. seq.) and administered by SCDHEC. Changes resulting from surplus plutonium disposition activities would necessitate modifications to the Title V permit. For MFFF and WSB, now under construction, all air quality permit requirements have been met for the construction phase. Permit revisions will be made as required prior to startup of operations. If an alternative using the K-Area Complex for pit disassembly and conversion, or immobilization is selected or the alternative to add PDCF in F-Area is retained, consultations would be initiated with SCDHEC to determine what air quality permit changes are needed to address a new source of radioactive emissions. If an alternative involving the MFFF oxidation furnace is selected, consultations would be initiated with SCDHEC to revise the Bureau of Air Quality construction permit, and with EPA to obtain a revision to the Alternate Calculation Methodology for 40 CFR 61 Subpart H, NESHAP compliance.

Air emissions from LANL facilities, including both radioactive and nonradioactive criteria and toxic air pollutant emissions, are regulated under the LANL air quality operating permit, issued under Title V of the Clean Air Act and administered by NMED. Changes resulting from surplus plutonium disposition activities at PF-4 could necessitate modifications to the Title V permit. Permit revisions, if needed, would be made as required based on consultations with NMED prior to startup of operations.

Hazardous waste management activities at SRS and LANL are regulated under RCRA Part A/Part B permits. In the case of TRU waste being shipped to WIPP for disposal, the waste would need to meet the waste acceptance criteria and waste permit requirements for WIPP.

Although most DOE activities are conducted under the authority of the Atomic Energy Act of 1954, as amended (42 USC 2011 et. seq.), Congress, through enactment of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999 (Public Law 105-261), assigned responsibility for licensing MFFF at SRS to NRC. MFFF received a construction authorization from NRC in March 2005, completing the first phase of the licensing process (NRC 2005b). NRC also issued an environmental impact statement in 2005, *Environmental Impact Statement on the Construction and Operation of a Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina* (NRC 2005a). The second phase of the two-step NRC licensing process, issuance of an operating license, is under way.

The need for new permits or modifications to existing permits would depend on the alternative selected. Prior to project implementation of any of the alternatives, required environmental permits would be obtained in accordance with Federal, state, and local requirements.

5.5 Consultations

Consultations with other Federal, state, and local agencies and federally recognized American Indian groups are usually conducted prior to the disturbance of any land and are usually related to biotic, cultural, and American Indian resources.

5.5.1 Consultations Related to Proposed Activities at the Savannah River Site

Consultations were initiated in 1998 during preparation of the *Surplus Plutonium Disposition Environmental Impact Statement (SPD EIS).* These consultations included affected parties in South Carolina and addressed tribal, cultural resource, and endangered species concerns (DOE 1999b). Additional consultations were undertaken during the NRC environmental review for MFFF (NRC 2005a). Consultations were undertaken with the U.S. Fish and Wildlife Service and the South Carolina Department of Natural Resources to evaluate impacts on threatened and endangered species under their respective jurisdictions. Both agencies issued declarations indicating they anticipated no impacts on threatened and endangered species as a result of construction and operation of MFFF and associated F-Area facilities, which included the site of WSB and the standalone PDCF (NRC 2005a, USFWS 2001).

As discussed in Chapter 4, establishing and operating the pit disassembly and conversion capability or immobilization capability in K-Area are not expected to have any impact on threatened and endangered species because none are known to forage, breed, nest, or occur on any of the land required. If it is determined that any activities associated with the implementation of these alternatives could impact threatened or endangered species, consultations would be reinitiated.

In consultation with the South Carolina State Historic Preservation Office (SHPO), archaeological surveys of F-Area in the vicinity of the standalone PDCF, MFFF, and WSB were undertaken prior to construction. Fifteen prehistoric sites were identified that could be affected by facility construction and seven were deemed eligible for listing on the National Register of Historic Places (NRHP). As discussed in Chapter 4, Section 4.1.7.6.1, two of the sites would be directly affected by construction activities in F-Area, so a data recovery plan was submitted and approved by the South Carolina SHPO. Subsequently, the Savannah River Archaeological Research Program (SRARP) excavated the sites to mitigate impacts caused by the construction of MFFF and WSB, and potential construction of PDCF (NRC 2005a). Additional consultations would be conducted, as necessary, prior to any additional activity that might affect cultural resources in F-Area should DOE decide to build the standalone PDCF there.

Potential construction of the pit disassembly and conversion capability or immobilization capability in K-Area, under the various alternatives being considered in this *SPD Supplemental EIS*, would take place within existing facilities or in the built-up portion of the area. Previous archeological reviews did not reveal any identified sites of interest in the areas where land disturbance would occur. As a result, impacts on cultural resources are unlikely. As discussed in Chapter 4, Section 4.1.7.6.2, the K-Reactor building is an NRHP-eligible structure. There are also supporting structures in K-Area that were determined to be eligible for listing on the NRHP as contributing members of the Cold War Historic District (DOE 2005b). As such, proposed changes to the historic fabric of these buildings and structures, or to any intact historically significant equipment, would be studied, discussed with the South Carolina SHPO, and avoided, mitigated, or minimized should DOE decide to place any of the proposed plutonium disposition activities in K-Area (DOE 2005b).

Six American Indian groups with ties to the SRS vicinity were consulted during preparation of the *SPD EIS* (DOE 1999b). These groups included the National Council of the Muskogee Creek; the Ma Chis Lower Alabama Creek Indian Tribe; the Indian People's Muskogee Tribal Town Confederacy; the Pee Dee Indian Association; the Yuchi Tribal Organization, Inc.; and the United Keetoowah Band. American Indian representatives have identified concerns related to the Native American Religious Freedom Act within the central Savannah River Valley, specifically with respect to some sensitive American Indian resources and plants traditionally used in ceremonies and as medicinal plants. However, no significant concerns were raised by American Indian groups through the *SPD EIS* consultation process (DOE 1999b). Preliminary consultations were conducted concerning MFFF construction. During these consultations, it was decided that impacts on American Indian resources from MFFF are considered unlikely. Inadvertent discoveries of American Indian resources would be handled in accordance with the requirements of 43 CFR Part 10, "Native American Graves Protection and Repatriation Regulations," regarding American Indian human remains, funerary objects, objects of cultural patrimony, and sacred objects (DCS 2002a).

5.5.2 Consultations Related to Proposed Activities at Los Alamos National Laboratory

LANL has its own plans and guidelines for biotic, cultural, and American Indian resources. Should any adverse impacts be identified as a result of the proposed surplus plutonium disposition activities at PF-4, consultations would occur with the appropriate Federal agencies and tribal governments.

Habitat that is either occupied by federally-protected species or potentially suitable for use by these species in the future has been delineated within LANL and is protected by the *Threatened and Endangered Species Habitat Management Plan for Los Alamos National Laboratory* (*Habitat Management Plan*) (LANL 2011a). The *Habitat Management Plan* facilitates DOE compliance with the Endangered Species Act and related Federal regulations. Site plans and monitoring plans are defined in the *Habitat Management Plan* to provide guidance to ensure that LANL operations do not adversely affect threatened or endangered species or their habitats. The updated plan includes habitat boundary changes implemented in 2005 and removed species that are no longer federally listed as threatened or endangered. Should any adverse affects on threatened and endangered species habitat be identified, a biological assessment would be prepared and submitted for consultation with U.S. Fish and Wildlife for concurrence, following provisions of 50 CFR Part 402 (Section 7), "Interagency Cooperation – Endangered Species Act of 1973, as amended."

A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico (Cultural Resources Management Plan) (LANL 2006c) is a comprehensive institutional plan that defines the responsibilities, requirements, and methods for managing cultural resources at LANL. It provides an overview of the cultural resources program and establishes procedures for effective compliance with the National Historic Preservation Act, as well as with other historic preservation laws specific to the cultural heritage of LANL. The *Cultural Resources Management Plan* provides a framework for consultation with and visitation of resources by local pueblos and tribes. The *Cultural Resources Management Plan* and its associated implementing Programmatic Agreement were approved by the Los Alamos Site Office, the New Mexico State Historic Preservation Officer, and the Advisory Council on Historic Preservation in 2000. An updated *Cultural Resources Management Plan* was approved and a new Programmatic Agreement was signed in 2006. Should any adverse impacts at LANL be identified as a result of activities evaluated in this *SPD Supplemental EIS*, NNSA would work with the SHPO, as well as any of the culturally affiliated pueblos and tribes, to resolve any adverse effects. In accordance with the *Cultural Resources Management Plan*, a cultural resource assessment would be made of areas, if any occur, that may be disturbed by the proposed activities. In addition, the pueblos and tribes that are culturally affiliated with the affected area now occupied by LANL would be notified, as discussed below.

DOE is in compliance with Executive Order 13175, which requires all Federal agencies to engage in consultation and coordination with tribal governments on matters of mutual concern. Consistent with that order, DOE promulgated DOE Order 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy,* to provide further amplifying guidance. Acting under that order, the Los Alamos Site Office continues its long-standing practice of engaging area tribal authorities through several mechanisms. These mechanisms include specific accords between DOE and four pueblo governments (Cochiti, San Ildefonso, Jemez, and Santa Clara) whose lands are adjacent to or near LANL. The accords set forth the specifications for maintaining a government-to-government relationship between DOE and each of the four pueblos. These accords have been in place since 1992, and are renewed periodically. Beyond engagement with these four pueblos, continuous liaison is maintained with member tribes of the Eight Northern Indian Pueblos Council, the All Indian Pueblo Council, and others as relevant to the programs and activities of the site. In addition to addressing environmental and other concerns, these formal interactions have led to mutually beneficial economic engagements. In fiscal year 2010, LANL awarded over $100 million in contracts to American Indian and tribally owned businesses and additional, substantial contracts have been awarded in fiscal year 2011.

CHAPTER 6

GLOSSARY

6.0 GLOSSARY

3013 container—A container that meets the specifications in DOE Standard 3013, *Stabilization, Packaging, and Storage of Plutonium-Bearing Materials*, DOE-STD-3013-2012.

accident—An unplanned event or sequence of events resulting in undesirable consequences, such as the release of radioactive or hazardous material to the environment.

acute exposure—A single, short-term exposure to radiation, a toxic substance or other stressors that may result in biological harm. Pertaining to radiation, the exposure incurred during and shortly after a radiological release. Acute exposure involves the absorption or intake of a relatively large amount of radiation or radioactive material.

air pollutant—Generally, an airborne substance that could, in high enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated or for which maximum guideline levels have been established due to potential harmful effects on human health and welfare.

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.

airborne release fraction (ARF)—The fraction of material at risk that becomes airborne due to an accident.

alternative—With respect to surplus plutonium disposition, a discrete sequence of disposition actions carried out in a group of facilities.

alternate feedstock—Surplus non-pit plutonium in, or capable of being converted into, an oxide form, which, after processing to remove impurities and transformed into an oxide, may be fabricated into mixed oxide fuel.

ambient air—The atmosphere external to buildings around humans, other animals, plants, and structures.

ambient air quality standards—Regulations prescribing the levels of airborne pollutants that may not be exceeded during a specified time within a defined area. (See National Ambient Air Quality Standards.)

amended Record of Decision—A modification to some aspect of a decision published in an earlier Record of Decision. The environmental impacts of the modification may be evaluated in a supplement analysis or in a supplemental or new environmental impact statement. (See Record of Decision.)

anadromous—Migrating from saltwater to freshwater for the purpose of spawning.

anthropogenic—Caused or produced by humans.

aquifer—A body of rock or sediment that is capable of transmitting groundwater and yielding usable quantities of water to wells or springs.

aquitard—A less-permeable, or impermeable, geologic unit in a stratigraphic sequence. Aquitards separate aquifers.

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 humans and of archaeological or historical interest.

as low as reasonably achievable (ALARA)—An approach to radiation protection to manage and control worker and public exposures (both individual and collective) and releases of radioactive material to the environment to as far below applicable limits as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit, but a process for minimizing doses to as far below limits as is practicable.

attainment area—An area that the U.S. Environmental Protection Agency has designated as being in compliance with one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others. (See National Ambient Air Quality Standards, nonattainment area, and particulate matter.)

background radiation—Radiation from (1) cosmic sources; (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material); and (3) global fallout as it exists in the environment (e.g., from the testing of nuclear explosive devices).

badged worker—A worker who has the potential to be exposed to occupational radiation, and is equipped with a dosimeter to measure his/her dose.

baseline—For National Environmental Policy Act evaluations, baseline is defined as the existing environmental conditions against which impacts of the Proposed Action and its alternatives can be compared.

basin—Geologically, a circular or elliptical downwarp in whose center younger beds occur. Topographically, a depression into which water from the surrounding area drains.

beyond-design-basis accident—This term is used as a technical way to discuss accident sequences that are possible but were not fully considered in the design process because they were judged to be too unlikely. (In that sense, they are considered beyond the scope of design-basis accidents [e.g., fire, earthquake, spill, explosion] that a nuclear facility must be designed and built to withstand.) As the regulatory process strives to be as thorough as possible, "beyond-design-basis" accident sequences are analyzed to fully understand the capability of a design. These accidents are typically very low-probability, but high-consequence events. (See design-basis accident.)

calcareous—Containing calcium carbonate (e.g., 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.

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 radioactive waste glass.

canyon—As used at the Savannah River Site, a large heavily shielded concrete building containing a remotely operated plutonium and uranium processing facility.

capable fault—In general, “capable fault” means a geologic fault along which it is mechanically feasible for sudden slip (i.e., earth motion) to occur. U.S. Nuclear Regulatory Commission reactor siting regulations define a capable fault as a fault that 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 that has been instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; and/or (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.

carbon dioxide—A colorless, odorless gas that is a normal component of ambient air and a product of fossil fuel and biomass combustion, animal expiration, the decay of animal or vegetable matter, and industrial processes. It is the principal anthropogenic greenhouse gas that may affect the Earth’s radiative balance and is the reference gas against which other greenhouse gases are measured. It is an asphyxiant at concentrations of 10 percent or more and has other health effects with exposure at lower concentrations (e.g., hyperventilation, vision damage, lung congestion, central nervous system injury, abrupt muscle contractions, elevated blood pressure, and/or shortness of breath).

carbon monoxide—A colorless, odorless gas that is toxic, due to the formation of carboxyhemoglobin in the bloodstream, if breathed in high concentrations over an extended period.

carcinogenic—Producing or tending to produce cancer.

Carolina bay—Closed, elliptical depressions capable of holding water, common to the state of South Carolina. A Carolina bay is a type of wetland. (See wetlands.)

ceramic—Surplus plutonium and other materials processed to form a porcelain end product.

chain reaction—A reaction that initiates its own repetition. In nuclear fission, a chain reaction occurs when a neutron induces a nucleus to fission and the fissioning nucleus releases one or more neutrons, which induce other nuclei to fission.

cladding—The outer metal jacket of a nuclear fuel element or target. It prevents fuel corrosion and retains fission products during reactor operation and subsequent storage, as well as providing structural support. Zirconium alloys, stainless steel, and aluminum are common cladding materials. In general, a metal coating bonded onto another metal.

***Code of Federal Regulations* (CFR)—**A publication in codified form of all Federal regulations in force.

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. DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* defines conceptual design as the exploration of concepts, specifications, and designs for meeting the mission needs, and the development of alternatives that are technically viable, affordable, and sustainable. The conceptual design provides sufficient detail to produce a more refined cost estimate range and to evaluate the merits of the project. See also DOE-STD-1189-2008.

contact-handled waste—Radioactive waste or waste packages whose external dose rate is low enough to permit contact handling by humans during normal waste management activities. (See remote-handled waste.)

conversion—An operation for changing material from one form, use, or purpose to another.

cosmic radiation—A source of natural background radiation that originates in outer space and is composed of penetrating ionizing radiation (both particulate and electromagnetic). The sun and stars send a constant stream of cosmic radiation to Earth, much like a steady drizzle of rain. Differences in elevation, atmospheric conditions, and the Earth's magnetic field can change the amount (or dose) of cosmic radiation that we receive. Secondary cosmic rays, formed by interactions in the Earth's atmosphere, account for about 45 to 50 millirem of the 300 to 360 millirem of natural background radiation that an average individual receives in a year.

Council on Environmental Quality regulations—Regulations at 10 CFR Parts 1500–1508 that direct Federal agencies in complying with the procedures of and achieving the goals of the National Environmental Policy Act.

criteria pollutant—An air pollutant that is regulated under the National Ambient Air Quality Standards. The U.S. Environmental Protection Agency must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the standard for each regulated pollutant. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter (that is less than 10 micrometers [0.0004 inches] in diameter, and that is less than 2.5 micrometers [0.0001 inches] in diameter). New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. (See National Ambient Air Quality Standards.)

critical habitat—Habitat essential to the conservation of an endangered species or threatened species that has been designated as critical by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR Part 424). The lists of critical habitats can be found in 50 CFR 17.95 (fish and wildlife), 50 CFR 17.96 (plants), and 50 CFR Part 226 (marine species). (See endangered species and threatened species.)

criticality—The condition in which a system undergoes a sustained nuclear chain reaction.

critical mass—The smallest mass of fissionable material that will support a self-sustaining nuclear chain reaction.

cultural resources—Protected resources, including archaeological sites, architectural features, traditional-use areas, and American Indian sacred sites.

cumulative impacts—Impacts on the environment that result when the incremental impact of a proposed action is added to the impacts from other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes the 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 (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

damage ratio (DR)—The fraction of material at risk exposed to the effects of the energy, force, or stress generated by an event or accident that results in a release of radioactive material.

deactivation—The placement of a facility in a radiologically and industrially safe shutdown condition that is suitable for a long-term surveillance and maintenance phase prior to final decontamination and decommissioning.

decay (radioactive)—The decrease in the amount of any radioactive material with the passage of time, due to spontaneous nuclear disintegration (i.e., emission from atomic nuclei of charged particles, photons, or both).

decibel (dB)—A unit for expressing the relative intensity of sounds on a logarithmic scale from zero for the average least perceptible sound to about 130 for the average level at which sound causes pain to humans. For traffic and industrial noise measurements, the A-weighted decibel (dBA), a frequency-weighted noise unit, is widely used. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.

decommissioning—The process of safely closing a nuclear power plant (or other facility where nuclear materials are handled) to retire it from service after its useful life has ended. This process primarily involves decontaminating the facility to reduce residual radioactivity and then releasing the property for unrestricted or (under certain conditions) restricted use. This often includes dismantling the facility or dedicating it to other purposes. Decommissioning begins after the nuclear fuel, coolant, and radioactive waste are removed.

decontamination—A process used to reduce, remove, or neutralize radiological, chemical, or biological contamination to reduce the risk of exposure. Decontamination may be accomplished by cleaning or treating surfaces to reduce or remove the contamination; filtering contaminated air or water; subjecting contamination to evaporation and precipitation; or covering the contamination to shield or absorb the radiation. The process can also simply allow adequate time for natural radioactive decay to decrease the radioactivity.

depleted uranium—Uranium whose content of the fissile isotope uranium-235 is less than 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium.

deposition—In geology, the laying down of potential rock-forming materials—i.e., 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").

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 for controlling parameters for reference bounds for design. These values may be (1) restraints derived from generally accepted, state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on 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—An accident postulated for the purpose of establishing functional and performance requirements for safety structures, systems, and components. (See beyond-design-basis accident.)

direct employment—The number of jobs required to implement an alternative.

dismantlement—The process of taking apart a nuclear warhead and removing the subassemblies, components, and individual parts.

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 (i.e., dissolving) of a solid throughout a liquid medium.

dose—A generic term meaning absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or committed equivalent dose. For ionizing radiation, the energy imparted to matter by ionizing radiation per unit mass of the irradiated material (e.g., biological tissue). The units of absorbed dose are the rad and the gray. In many publications, the rem is used as an approximation of the rad.

drinking water standard—The level of constituents or characteristics in a drinking water supply specified in regulations under the Safe Drinking Water Act as the maximum permissible.

earnings—Wages and benefits received by workers for services performed.

economic output—A measure of economic activity that represents the market value of all goods and services produced by an activity, whether final or intermediate for further use.

ecosystem—A community of organisms and their physical environment interacting as an ecological unit.

effective dose equivalent—The dose value obtained by multiplying the dose equivalents received by specified tissues or organs of the body by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all of the resulting products. It includes the dose from radiation sources internal and external to the body. The effective dose equivalent is expressed in units of rem or sieverts.

effluent—A waste stream flowing into the atmosphere, surface water, groundwater, or soil. Most frequently the term applies to wastes discharged to surface waters.

emission standards—Legally enforceable limits on the quantities or kinds of air contaminants that can be emitted into the atmosphere.

endangered species—Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR Part 424). The lists of endangered species can be found in 50 CFR 17.11 for wildlife, 50 CFR 17.12 for plants, and 50 CFR 222.23(a) for marine organisms. (See critical habitat and threatened species.)

enriched uranium—Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) found in natural uranium. (See highly enriched uranium and low-enriched uranium.)

environmental assessment (EA)—A concise public document that a Federal agency prepares under the National Environmental Policy Act (NEPA) to provide sufficient evidence and analysis to determine whether a proposed agency action would require preparation of an environmental impact statement (EIS) or a finding of no significant impact. A Federal agency may also prepare an EA to aid its compliance with NEPA when no EIS is necessary or to facilitate preparation of an EIS when one is necessary.

environmental impact statement (EIS)—The detailed written statement that is required by Section 102(2)(C) of the National Environmental Policy Act (NEPA) for a proposed major Federal action significantly affecting the quality of the human environment. A U.S. Department of Energy (DOE) EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality NEPA regulations in 40 CFR Parts 1500–1508, and DOE NEPA regulations in 10 CFR Part 1021. The statement includes, among other information, discussions of the environmental impacts of the Proposed Action and reasonable alternatives, adverse environmental effects that cannot be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources.

environmental justice—The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies. Executive Order 12898 directs Federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations. (See minority population and low-income population.)

ethnohistory—The study of native or non-Western peoples from a combined historical and anthropological viewpoint, using written documents, oral literature, material culture, and ethnographic data.

exclusion area—The area surrounding a reactor in which the reactor licensee has the authority to determine all activities, including exclusion or removal of personnel and property from the area. This area may be traversed by a highway, railroad, or waterway, provided these are not so close to the facility as to interfere with normal operations of the facility and provided appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway, in case of emergency, to protect the public health and safety. Residence within the exclusion area is normally prohibited. In any event, residents are subject to ready removal in case of necessity. Activities unrelated to operation of the reactor may be permitted in an exclusion area under appropriate limitations, provided that no significant hazards to the public health and safety will result (10 CFR 100.3).

fault—A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred.

Finding of No Significant Impact (FONSI)—A public document issued by a Federal agency briefly presenting the reasons why an action for which the agency has prepared an environmental assessment has no potential to have a significant effect on the human environment and, thus, will not require preparation of an environmental impact statement. (See environmental assessment and environmental impact statement.)

fissile material—Although sometimes used as a synonym for fissionable material, this term has acquired a more restricted meaning; namely, any material fissionable by low-energy (i.e., thermal or slow) neutrons. Fissile materials include uranium-233 and -235, and plutonium-239 and -241.

fission—A nuclear transformation that is typically characterized by the splitting of the nucleus of a heavy nucleus into at least two other nuclei, the emission of one or more neutrons, and the release of a relatively large amount of energy. Fission of heavy nuclei can occur spontaneously or be induced by neutron bombardment.

fission products—Nuclei (i.e., fission fragments) formed by the fission of heavy elements, in addition to the nuclides formed by the fission fragments' radioactive decay.

floodplains—The lowlands and relatively flat areas adjoining inland and coastal waters and the flood-prone areas of offshore islands. Floodplains include, at a minimum, that area with at least a 1 percent chance of being inundated by a flood in any given year. Such a flood is known as a 100-year flood.

fresh fuel—Reactor fuel that has been manufactured, but not irradiated in a reactor.

frit—Finely ground glass used as feedstock for vitrification.

fuel-grade plutonium—Plutonium with approximately 7 to 19 percent plutonium-240, as defined in the DOE Factsheet, "Additional Information Concerning Underground Nuclear Weapon Test of Reactor-Grade Plutonium."

fugitive emissions—(1) Emissions that do not pass through a stack, vent, chimney, or similar opening where they could be captured by a control device, or (2) any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps; valves; flanges; seals; area sources such as ponds, lagoons, landfills, and piles of stored material (such as coal); and road construction areas or other areas where earthwork is occurring.

geology—The earth science that deals with the study of the materials, processes, environments, and history of the Earth, including rocks and their formation and structure.

glass—An amorphous material formed by the melting of silica.

glovebox—Enclosure that separates workers from equipment used to process hazardous material, while allowing the workers to be in physical contact with the equipment; normally constructed of stainless steel, with large acrylic/lead glass windows. Workers have access to equipment through the use of heavy-duty, lead-impregnated rubber gloves, the cuffs of which are sealed in portholes in the glovebox windows.

groundwater—Water below the ground surface in a zone of saturation.

half-life (radiological)—Time in which one-half of the atoms of a particular radionuclide disintegrate into another nuclear form. Half-lives for specific radionuclides vary 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—A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 CFR 261.20–24 (i.e., ignitability, corrosivity, reactivity, or toxicity), or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31–33.

hazardous air pollutants (HAPs)—Air pollutants not covered by ambient air quality standards, but that may present a threat of adverse human health or environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, HAPs are any of the 189 pollutants listed in or pursuant to Section 112(b) of the Clean Air Act. Very generally, HAPs are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

high-efficiency particulate air (HEPA) filter—An air filter capable of removing at least 99.97 percent of particles 0.3 micrometers (about 0.00001 inches) in diameter. These filters include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.

high-level radioactive waste (HLW)—Defined by statute (the Nuclear Waste Policy Act) to mean the highly radioactive waste material resulting from the reprocessing of used nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that the U.S. Nuclear Regulatory Commission (NRC), consistent with existing law, determines by rule requires permanent isolation. NRC has not defined sufficient concentrations of fission products or identified other highly radioactive material that requires permanent isolation. NRC defines high-level radioactive waste to mean irradiated (used) reactor fuel, as well as liquid waste resulting from the operation of the first cycle solvent extraction system, the concentrated wastes from subsequent extraction cycles in a facility for reprocessing irradiated reactor fuel, and solids into which such liquid wastes have been converted.

highly enriched uranium (HEU)—Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). Highly enriched uranium can be used in making nuclear weapons and also as fuel for some isotope-production, research, naval propulsion, and power reactors. (See enriched uranium and low-enriched uranium.)

historic resources—Archaeological sites, architectural structures, and objects dating from 1492 or later, after the arrival of the first Europeans in the Americas.

immobilization—A process by which plutonium is converted to a chemically stable solid form for disposal.

incident-free—Normal transport or operation.

indirect employment—Jobs generated or lost in related industries within a regional economic area as a result of a change in direct employment.

interbedded—Geologically speaking, occurring between beds (i.e., layers) or lying in a bed parallel to other beds of a different material.

interim action—An action within the scope of an environmental impact statement that is taken before a Record of Decision is issued.

interim status—Period during which treatment, storage, and disposal facilities subject to the Resource Conservation and Recovery Act are temporarily allowed to operate while awaiting the issuance or denial of a permit.

interim storage—Safe, secure storage supportive of continuing operations until long-term storage or disposition actions are implemented.

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—Particles (alpha, beta, neutrons, and other subatomic particles) or photons (i.e., gamma, x-rays) emitted from the nucleus of unstable atoms as a result of radioactive decay. Such radiation is capable of displacing electrons from atoms or molecules in the target material (such as biological tissues), thereby producing ions.

isotope—Any of two or more variations of an element in which the nuclei have the same number of protons (and thus the same atomic number), but different numbers of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties, but often different physical properties; e.g., carbon-12 and -13 are stable; carbon-14 is radioactive.

job control waste—Plastic sheeting, paper, small pieces of wood and metal, glass, gloves, protective clothing, and/or pieces of small equipment that were used in a radioactive process.

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.

landscape character—The arrangement of a particular landscape as formed by the variety and intensity of the landscape features (e.g., land, water, vegetation, and structures) and the four basic elements (i.e., form, line, color, and texture). These factors give an area a distinctive quality that distinguishes it from its immediate surroundings.

latent cancer fatalities (LCFs)—Deaths from cancer resulting from, and occurring some time after, exposure to ionizing radiation or other carcinogens.

lead assemblies—Small quantities of nuclear fuel inserted into commercial nuclear power reactors to confirm that a new fuel design will perform safely and predictably.

leak protection factor (LPF)—A factor that accounts for the action of removal mechanisms (e.g., containment systems, filtration, deposition) to reduce the amount of airborne radioactivity ultimately released to the environment.

low-enriched uranium (LEU)—Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to more than 0.7 percent but less than 20 percent by weight. Most nuclear power reactor fuel contains low-enriched uranium containing 3 to 5 percent uranium-235. (See enriched uranium and highly enriched uranium.)

low-income population—Defined in terms of U.S. Census Bureau annual statistical poverty levels (Current Population Reports, Series P-60 on Income and Poverty), a population may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (e.g., migrant workers or American Indians), where the population experiences common conditions of environmental exposure or effect. (See environmental justice and minority population.)

low-level radioactive waste (LLW)—Radioactive waste that is not classified as high-level radioactive waste, transuranic waste, used nuclear fuel, or byproduct tailings from processing of uranium or thorium ore.

magazine—With respect to the can-in-canister approach to plutonium immobilization, a structure or housing used to facilitate inserting an array of cans into the canister and securing that array in place.

marsh—An area of low-lying wetland dominated by grass-like plants. (See wetlands.)

material at risk (MAR)—The amount of radionuclides in curies of activity or grams for each radionuclide available for release when acted upon by a given physical insult, stress, or accident. The material at risk is specific to a given process in the facility of interest. It is not necessarily the total quantity of material present, but it is that amount of material in the scenario of interest postulated to be available for release.

maximally exposed individual (MEI)—A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (i.e., inhalation, ingestion, direct exposure, resuspension).

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.

migration—The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

minority population—Minority populations exist where either: (1) the minority population of the affected area exceeds 50 percent, or (2) the minority population percentage of the affected area is meaningfully greater than in the general population or other appropriate unit of geographic analysis (such as a governing body's jurisdiction, a neighborhood, census tract, or other similar unit). "Minority" refers to individuals 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 populations" include either a single minority group or the total of all minority persons in the affected area. They may consist of groups 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 the population experiences common conditions of environmental exposure or effect. (See environmental justice and low-income population.)

mitigation—Mitigation includes (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

mixed low-level radioactive waste (MLLW)—Waste that contains both hazardous waste, as defined under the Resource Conservation and Recovery Act, and source, special nuclear, or byproduct material subject to the Atomic Energy Act.

mixed oxide (MOX)—Reactor fuel made with a physical blend of different fissionable materials, such as uranium dioxide and plutonium dioxide.

mixed transuranic waste—Waste that contains both nonradioactive hazardous waste and transuranic waste, as defined in this glossary.

mutagenic—Capable of inducing mutation in the cells of living organisms (e.g., human or animal receptors).

National Ambient Air Quality Standards (NAAQS)—Standards defining the highest allowable levels of certain pollutants in the ambient air (the outdoor air to which the public has access). Because the U.S. Environmental Protection Agency must establish the criteria for setting these standards, the regulated pollutants are called *criteria* pollutants. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter (that less than or equal to 10 micrometers [0.0004 inches] in diameter and that less than or equal to 2.5 micrometers [0.0001 inches] in diameter). Primary standards are established to protect public health; secondary standards are established to protect public welfare (such as visibility, crops, animals, buildings). (See criteria pollutant.)

National Emission Standards for Hazardous Air Pollutants (NESHAPs)—Emissions standards set by the U.S. Environmental Protection Agency for air pollutants that are not covered by National Ambient Air Quality Standards and that may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR Parts 61 and 63. NESHAPs are given for many specific categories of sources (e.g., equipment leaks, industrial process cooling towers, dry cleaning facilities, petroleum refineries). (See hazardous air pollutants.)

National Environmental Research Park—An outdoor laboratory established for research into the environmental impacts of energy developments. Such parks were established by the U.S. Department of Energy 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 Pollutant Discharge Elimination System (NPDES)—A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the U.S. Environmental Protection Agency, a state, or, where delegated, a tribal government on an American Indian reservation. The National Pollutant Discharge Elimination System permit lists either permissible discharges, the level of cleanup technology required for wastewater, or both.

National Priorities List (NPL)—The U.S. Environmental Protection Agency's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under the Comprehensive Environmental Response, Compensation, and Liability Act. The list is based primarily on the score a site receives from the Hazard Ranking System described in 40 CFR Part 300, Appendix A. The U.S. Environmental Protection Agency must update the National Priorities List at least once a year.

National Register of Historic Places (NRHP)—The official list of the Nation's cultural resources that are worthy of preservation. The National Park Service maintains the list under direction of the Secretary of the Interior. Districts, sites, buildings, structures, and objects are included in the NRHP for their importance in American history, architecture, archaeology, culture, or engineering. Properties included on the NRHP range from large-scale, monumentally proportioned buildings to smaller-scale, regionally distinctive buildings. The listed properties are not just of nationwide importance; most are significant primarily at the state or local level. Procedures for listing properties on the NRHP are found in 36 CFR Part 60.

natural phenomena hazard—A category of events (e.g., earthquake, severe wind, tornado, flood, and lightning) that must be considered in the U.S. Department of Energy facility design, construction, and operations, as specified in DOE Order 420.1B.

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 issue, as they contribute to acid deposition and the formation of atmospheric ozone. Also known as NO_x.

noise—Any sound that is undesirable because it interferes with speech and hearing, is intense enough to damage hearing, or is otherwise annoying (i.e., unwanted sound).

nonattainment area—An area that the U.S. Environmental Protection Agency has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, or both sizes of particulate matter (i.e., that with an aerodynamic diameter less than or equal to 10 or 2.5 micrometers [0.0004 or 0.0001 inches]). An area may be in attainment for some pollutants, but not for others. (See attainment area, National Ambient Air Quality Standards, and particulate matter.)

nonhazardous waste—Any garbage or refuse; sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility; and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities that is not otherwise characterized as radioactive or hazardous.

non-pit plutonium—Plutonium-239 was made in nuclear reactors for use in nuclear weapons. Historically, the United States operated weapons material production reactors at the Savannah River Site and the Hanford Reservation. The term "non-pit plutonium" refers to plutonium that is not in the metal pit form that is the core of a nuclear weapon. Non-pit plutonium may be in metal or oxide form, or may be associated with other materials that were used in the process of manufacturing and fabrication of plutonium for use in nuclear weapons. The non-pit plutonium discussed in this environmental impact statement was in some phase of the production cycle when the Cold War ended and the United States ceased production of plutonium. Some non-pit plutonium was generated during research and development activities that support weapons production. Most surplus non-pit plutonium is currently stored at the Savannah River Site.

nonproliferation—Preventing the spread of nuclear weapons, nuclear weapons materials, or nuclear weapons technology to rogue nations, terrorists, and countries that have not signed nonproliferation agreements.

Notice of Availability—A formal notice, published in the *Federal Register*, that announces the issuance and public availability of a draft or final environmental impact statement. The U.S. Environmental Protection Agency Notice of Availability is the official public notification of an environmental impact statement; a U.S. Department of Energy Notice of Availability is an optional notice used to provide information to the public.

Notice of Intent (NOI)—Public announcement that an environmental impact statement will be prepared and considered. It describes the Proposed Action, possible alternatives, and scoping process, including whether, when, and where any scoping meetings will be held. The Notice of Intent is usually published in the *Federal Register* and in the local media. The scoping process includes holding at least one public meeting and requesting written comments on issues and environmental concerns that an environmental impact statement should address.

nuclear criticality—See criticality.

nuclear facility—A facility that is subject to requirements intended to control potential nuclear hazards. Defined in U.S. Department of Energy directives as any nuclear reactor or any other facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees and/or the general public.

nuclear weapon—The general name given to any weapon in which the explosion results from the energy released by reactions involving atomic nuclei.

option—With respect to surplus plutonium disposition, a discrete sequence of pit disassembly and conversion, or plutonium disposition actions carried out in a facility or group of facilities. Pit disassembly and conversion and plutonium disposition options are combined to form surplus plutonium disposition alternatives. (See alternative.)

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 (i.e., valence) is correspondingly increased.

oxide—A compound formed when an element (e.g., plutonium) is bonded to oxygen.

ozone—The tri-atomic form of oxygen (O_3), which 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 U.S. Department of Transportation 49 CFR Parts 171–180 and U.S. Nuclear Regulatory Commission 10 CFR Part 71 regulations.

particulate matter (PM)—Any finely divided solid or liquid material, other than uncombined (i.e., pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, PM_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inches) in diameter; $PM_{2.5}$ includes only those particles equal to or less than 2.5 micrometers (0.0001 inches) in diameter. Particulate matter can result in increased respiratory symptoms, decreased lung function, aggravated asthma, development of chronic bronchitis, irregular heartbeat, nonfatal heart attacks, and premature death in people with heart or lung disease. $PM_{2.5}$ is a major cause of reduced visibility. Particulate matter can contribute to acidification of streams and lakes, changes in nutrient balance of coastal waters and larger river basins, depletion of nutrients in soil, damage to forests and crops, and damage to stone and other building materials.

perched groundwater—A body of groundwater of small lateral dimensions separated from an underlying body of groundwater by an unsaturated zone.

person-rem—A unit of collective radiation dose applied to populations or groups of individuals; that is, a unit for expressing the dose when summed across all persons in a specified population or group. One person-rem equals 0.01 person-sieverts.

pit—The core element of a nuclear weapon's "primary" or fission component. The pit contains a potentially critical mass of fissile material, such as plutonium-239 or highly enriched uranium, arranged in a subcritical geometry and surrounded by some type of casing.

plume—The elongated volume of contaminated air or water originating at a pollutant source such as an outlet pipe, a smokestack, or a hazardous waste disposal site. A plume eventually diffuses into a larger volume of less-contaminated material as it is transported away from the source.

plutonium—A heavy radioactive, metallic element with the atomic number 94. It is produced artificially by neutron bombardment of uranium and is used in the production of nuclear weapons. Plutonium has 15 isotopes with atomic mass numbers ranging from 232 to 246 and half-lives from 20 minutes to 76 million years. Its most important isotope is fissile plutonium-239. Weapons-usable plutonium consists mainly of plutonium-239, which has a radiological half-life of 24,110 years. (See half-life [radiological].)

pollution prevention—The use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and waste into land, water, and air. For the U.S. Department of Energy, this includes recycling activities. (See waste minimization and pollution prevention.)

potable water—Water that is fit to drink, meeting Safe Drinking Water Act maximum contaminant levels.

pounds per square inch (psi)—A measure of pressure. Normal atmospheric pressure at sea level is about 14.7 pounds per square inch.

power reactor-grade plutonium (also referred to as "reactor-grade plutonium")—Plutonium of which 19 percent or greater is plutonium-240, as defined in the DOE Factsheet, "Additional Information Concerning Underground Nuclear Weapon Test of Reactor-Grade Plutonium." Power reactor-grade plutonium is weapons-usable.

precipitate—To cause a solid substance to become separate from a solution.

prevention of significant deterioration (PSD)—Regulations established to prevent significant deterioration of air quality in areas that already meet National Ambient Air Quality Standards. Specific details of prevention of significant deterioration are found in 40 CFR 51.166. Among other provisions, cumulative increases in levels of sulfur dioxide, nitrogen dioxide, and particulate matter equal to or less than 10 micrometers (0.0004 inches) in diameter after specified baseline dates must not exceed specified maximum allowable amounts. These allowable increases, also known as increments, are especially stringent in areas designated as Class I areas (such as national parks, wilderness areas) where the preservation of clean air is particularly important. All areas not designated as Class I are currently designated as Class II. Maximum increments in pollutant levels are also given in 40 CFR 51.166 for Class III areas, if any such areas should be so designated by the U.S. Environmental Protection Agency. Class III increments are less stringent than those for Class I or Class II areas. (See National Ambient Air Quality Standards.)

prime farmland—Land with the best combination of physical and chemical characteristics (i.e., 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 *United States Code* [U.S.C] 4201 et seq.). Land classified as prime farmland includes crop land, pasture land, range land, and forest land, but not urban or built-up land or land covered with water. Prime farmlands are designated by the Natural Resources Conservation Service.

process—Any method or technique designed to change the physical or chemical character of the product.

Programmatic Environmental Impact Statement (PEIS)—A broad-scoped document that evaluates the environmental impacts of a Federal program. PEISs may be prepared, and are sometimes required, for broad Federal actions such as the adoption of new agency programs or regulations. Agencies shall prepare PEISs on broad actions so that they are relevant to policy and are timed to coincide with meaningful points in agency planning and decisionmaking.

proliferation—The spread of nuclear, biological, or chemical capabilities and the weapons (i.e., missiles) capable of delivering them.

rad—A unit of radiation-absorbed dose (e.g., in body tissue). One rad is equal to an absorbed dose of 0.01 joules per kilogram.

radiation—See ionizing radiation.

radioactive waste—In general, waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or byproduct material is subject to regulation as radioactive waste under the Atomic Energy Act. Also, waste material that contains accelerator-produced radioactive material or a high concentration of naturally occurring radioactive material may be considered radioactive waste.

radioactivity—

> Defined as a *process*: The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation.
>
> Defined as a *property*: The property of unstable nuclei in certain atoms to spontaneously emit ionizing radiation during nuclear transformations.

radioisotopes—Radioactive nuclides of the same element (i.e., 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 manmade or naturally occurring, have a long life, and have potentially mutagenic, teratogenic, or carcinogenic effects on the human body.

radon—A radioactive element that is one of the heaviest gases known. Its atomic number is 86. It is a daughter product of radium. Radon occurs naturally in the environment and can collect in enclosed, unventilated areas, such as basements. Exposures to large concentrations of radon can cause lung cancer in humans.

Record of Decision (ROD)—A concise public document that records a Federal agency's decision(s) concerning a Proposed Action for which the agency has prepared an environmental impact statement. The ROD is prepared in accordance with the requirements of the Council on Environmental Quality National Environmental Policy Act regulations (40 CFR 1505.2). A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced by the agency in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not. (See environmental impact statement.)

region of influence (ROI)—The physical area that bounds the environmental, sociological, economic, or cultural features of interest for the purpose of analysis.

rem—See roentgen equivalent man.

remote-handled waste—In general, refers to radioactive waste that must be handled at a distance to protect workers from unnecessary exposure. (See contact-handled waste.)

repository—A facility for disposal of radioactive waste.

reprocessing—The process to chemically separate used reactor fuel into uranium, transuranic elements, and fission products.

respirable fraction—The fraction of airborne material at risk with a particle size with an aerodynamic diameter equivalent to 10 micrometers or less that could be retained in the respiratory system following inhalation.

risk—The probability of a detrimental effect from exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (i.e., the product of these two factors). However, separate presentation of probability and consequence is often more informative.

risk assessment (chemical or radiological)—The qualitative and quantitative evaluation performed in an effort 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-ray or gamma radiation equal to or producing 1 electrostatic unit of charge per cubic centimeter of air. It is approximately equal to 1 rad.

roentgen equivalent man (rem)—A unit of dose equivalent. The dose equivalent in rem equals the absorbed dose in rad in tissue multiplied by the appropriate quality factor and possibly other modifying factors. Rem refers to the dosage of ionizing radiation that will cause the same biological effect as one roentgen of x-ray or gamma ray exposure. One rem equals 0.01 sieverts.

runoff—The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

Safe Secure Trailer (SST)—A specially modified semi-trailer, pulled by an armored tractor truck, which DOE uses to transport nuclear weapons, nuclear weapons components, or special nuclear material over public highways.

Safeguards Transporter (SGT)—A specially designed part of an 18-wheel rig that incorporates various deterrents to prevent unauthorized removal of cargo. The trailer has been designed to protect the cargo against damage in the event of an accident. Escort vehicles accompany the tractor-trailers during transportation activities. These tractors and escort vehicles are equipped with communications, electronic, and other equipment that further enhance en-route safety and security.

safety analysis report (SAR)—A report that systematically identifies potential hazards within a nuclear facility, describes and analyzes the adequacy of measures to eliminate or control identified hazards, and analyzes potential accidents and their associated risks. Safety analysis reports are used to ensure that a nuclear facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. Safety analysis reports (or documented safety analyses per 10 CFR Part 830) are required for U.S. Department of Energy (DOE) nuclear facilities and as a part of applications for U.S. Nuclear Regulatory Commission (NRC) licenses. The NRC regulations or DOE orders and technical standards that apply to the facility type provide specific requirements for the content of safety analysis reports. (See nuclear facility.)

saltstone—Concrete block formed by mixing the low-radioactivity fraction of high-level radioactive waste with cement, ash, and slag.

sanitary wastes—Nonhazardous, nonradioactive liquid and solid wastes generated by normal housekeeping activities.

scoping—An early and open process, including public notice and involvement, for determining the scope of issues to be addressed in an environmental impact statement and for identifying the significant issues related to a Proposed Action. The scoping period begins after publication in the *Federal Register* of a Notice of Intent to prepare an environmental impact statement. The public scoping process is that portion of the process where the public is invited to participate. The U.S. Department of Energy's scoping procedures are found in 10 CFR 1021.311.

scraps and residues—Material containing plutonium that was generated during the separation and purification of plutonium or during the manufacture of plutonium-bearing components for nuclear weapons.

secure transportation asset—A U.S. Department of Energy (DOE) asset managed and operated by the National Nuclear Security Administration, Office of Secure Transportation. The asset is a network of specially modified transport vehicles, special agents and other personnel, and specialized infrastructure, that provide for the safe and secure movement of weapons, weapon components and selected materials for DOE, the U.S. Department of Defense, and other customers, within the continental United States.

security—An integrated system of activities, systems, programs, facilities, and policies for the protection of Restricted Data and other classified information or matter, nuclear materials, nuclear weapons and nuclear weapons components, and/or U.S. Department of Energy or contractor facilities, property, and equipment.

seismic—Pertaining to any Earth vibration, especially that of an earthquake.

sewage—The total organic waste and wastewater generated by an industrial establishment or a community.

shielding—Any material or obstruction (e.g., bulkhead, wall, or other structure) that absorbs radiation, and thus tends to protect personnel or materials from the effects of ionizing radiation.

shutdown—That condition in which a U.S. Department of Energy facility has ceased operation and has officially declared that it does not intend to operate it further.

sinter—To form a solid mass by heating powder at an elevated temperature below the material's melting point.

solid waste—For purposes under the Resource Conservation and Recovery Act, solid waste is any garbage; refuse; sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and/or other discarded material. Solid waste includes 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 or irrigation return flows or industrial discharges, which are point sources subject to permits under Section 402 of the Clean Water Act. Finally, solid waste does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act. A more detailed regulatory definition of solid waste can be found in 40 CFR 261.2.

special nuclear material—A category of material subject to regulation under the Atomic Energy Act, consisting primarily of fissile materials. It is defined to mean plutonium, uranium-233, uranium enriched in the isotopes uranium-233 or -235, and any other material that the U.S. Nuclear Regulatory Commission determines to be special nuclear material, but it does not include source material.

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 (used) nuclear fuel.

spent nuclear fuel—See used nuclear fuel.

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.

State Historic Preservation Office—State office charged with the identification and protection of prehistoric and historic resources in accordance with the National Historic Preservation Act.

stormwater—stormwater runoff, snow melt runoff, and surface runoff and drainage (40 CFR 122.26(b)(13)).

sulfur dioxide—A heavy, pungent colorless gas formed in the combustion of fossil fuels and considered a major air pollutant. During its long-range transport, it can combine with water vapor to form sulfuric acid, which contributes to the formation of acid rain, which damages trees, crops, and buildings and makes soils, lakes, and streams acidic. It also contributes to reduced visibility and can irritate the upper respiratory tract and cause lung cancer.

Supplement Analysis (SA)—A document prepared under the U.S. Department of Energy's National Environmental Policy Act Implementing Guidelines (10 CFR 1021.314(c)) to provide the information and analysis of proposed activities necessary to determine whether a supplemental or new environmental impact statement is required.

Supplemental Environmental Impact Statement (SEIS)—A document prepared as a supplement to an environmental impact statement, required when a change in a Proposed Action is substantial and relevant to environmental concerns or when new circumstances or information relevant to environmental concerns are significant.

surface water—All bodies of water on the surface of the Earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

surplus plutonium—Plutonium that has no identified programmatic use within the U.S. Department of Energy and does not fall into one of the categories of national security reserves.

teratogenic—Tending to cause developmental malformations (i.e., birth defects).

threatened species—Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set out in the Endangered Species Act and its implementing regulations (50 CFR Part 424). The list of threatened species can be found at 50 CFR 17.11 (wildlife), 17.12 (plants), and 227.4 (marine organisms). (See critical habitat and endangered species.)

toxic air pollutants—See hazardous/toxic air pollutants.

transuranic (TRU)—Of, relating to, or being any element whose atomic number is higher than that of uranium (i.e., atomic number 92), including neptunium, plutonium, americium, and curium. All transuranic elements are produced artificially and are radioactive.

transuranic waste—Radioactive waste that is not classified as high-level radioactive waste and that contains more than 100 nanocuries (3,700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years, except for waste that the U.S. Department of Energy has determined, with the concurrence of the U.S. Environmental Protection Agency, does not need the degree of isolation called for by 40 CFR Part 191; or waste that the U.S. Nuclear Regulatory Commission has approved for disposal case-by-case in accordance with 10 CFR Part 61 (DOE Order 435.1).

treatment—An operation necessary to prepare material for storage, disposal, or transportation.

tritium—A radioactive isotope of the element hydrogen whose nucleus contains two neutrons and one proton.

uranium—A radioactive, metallic element with the atomic number 92; the heaviest naturally occurring element. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission, and uranium-238 is transformed into fissionable plutonium-239 following its capture of a neutron in a nuclear reactor.

used nuclear fuel—Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated. Also known as spent nuclear fuel.

value added—Measure of economic activity that represents the market value of all final goods and services produced by an activity, directly comparable to the gross domestic product. Measures of value added exclude intermediate goods and services.

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 (VRM)—A process devised by the Bureau of Land Management to assess the aesthetic quality of a landscape, and consistent with the results of that analysis, to design proposed activities so as to minimize their visual impact on that landscape. The process consists of a rating of visual quality followed by a measurement of the degree of contrast between proposed development activities and the existing landscape. Four classifications are employed to describe different degrees of modification to landscape elements: Class I, areas where the natural landscape is preserved, including national wilderness areas and the wild sections of national wild and scenic rivers; Class II, areas with very limited land development activity, resulting in visual contrasts that are seen but do not attract attention; Class III, areas in which development may attract attention, but the natural landscape still dominates; and Class IV, areas in which development activities may dominate the view and may be the major focus in the landscape.

vitrification—A process by which finely ground glass (e.g., borosilicate glass) is used to immobilize radioactive wastes. (See frit.)

volatile organic compounds (VOCs)—A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures (e.g., benzene, chloroform, and methyl alcohol). With respect to air pollution, any non-methane organic compound that participates in atmospheric photochemical reaction, except for those designated by the U.S. Environmental Protection Agency as having negligible photochemical reactivity.

Waste Isolation Pilot Plant (WIPP)—A U.S. Department of Energy facility designed and authorized to permanently dispose of defense-related contact-handled and remote-handled transuranic radioactive waste in a mined underground facility in deep geologic salt beds. It is located in southeastern New Mexico, 26 miles (42 kilometers) east of the city of Carlsbad.

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. (See pollution prevention.)

wastewater—Water originating from human sanitary water use (i.e., domestic wastewater) and from a variety of industrial processes (i.e., industrial wastewater).

water quality standards—Limits on the concentrations of specific constituents or on the characteristics of water, often based on water use classifications (e.g., drinking water, recreation, propagation of fish and aquatic life, agricultural and industrial use). Water quality standards are legally enforceable under the Clean Water Act (33 U.S.C. 1251 et seq.), 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 plutonium—Plutonium manufactured for weapons application. Weapons-grade plutonium contains no more than 7 percent plutonium-240, as defined in the DOE Factsheet, "Additional Information Concerning Underground Nuclear Weapon Test of Reactor-Grade Plutonium." A different range is used in the *Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation*: a ratio of plutonium-240 to plutonium-239 no greater than 0.10; approximately equal to 9 percent plutonium-240.

weapons-usable fissile material—Plutonium or highly enriched uranium in forms (e.g., 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.

wetlands—Those areas that are inundated by surface or groundwater with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas (e.g., sloughs, potholes, wet meadows, river overflow areas, mudflats, natural ponds).

CHAPTER 7
REFERENCES

7.0 REFERENCES

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CHAPTER 8
LIST OF PREPARERS

8.0 LIST OF PREPARERS

This *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement* was prepared by the U.S. Department of Energy and the Tennessee Valley Authority, a cooperating agency. These organizations and the individuals listed below contributed to the overall effort in the preparation of this document.

U.S. DEPARTMENT OF ENERGY

SACHIKO MCALHANY, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION

SEIS RESPONSIBILITIES: DOCUMENT MANAGER, PREPARED INPUTS AND REVIEWER

Education: B.S., Mechanical Engineering, University of South Carolina

Experience/Technical Specialty:
Twenty-six years. Nuclear materials program management.

VIRGINIA KAY, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION

SEIS RESPONSIBILITIES: PREPARED INPUTS AND REVIEWER

Education: B.S., Chemical Engineering, University of South Carolina

Experience/Technical Specialty:
Twenty-one years. Program and project management.

ANDREW GRAINGER, U.S. DEPARTMENT OF ENERGY, SAVANNAH RIVER OPERATIONS OFFICE

SEIS RESPONSIBILITIES: REVIEWER

Education: M.S., Wildlife Ecology, Utah State University
B.S., Natural Resources, Cornell University

Experience/Technical Specialty:
Thirty-three years. National Environmental Policy Act (NEPA) and environmental compliance.

ALLEN GUNTER, U.S. DEPARTMENT OF ENERGY, SAVANNAH RIVER OPERATIONS OFFICE

SEIS RESPONSIBILITIES: REVIEWER

Education: B.S., Ceramic Engineering, Clemson University

Experience/Technical Specialty:
Twenty-nine years. Nuclear materials program management.

RANDALL KALTREIDER, U.S. DEPARTMENT OF ENERGY, OFFICE OF ENVIRONMENTAL MANAGEMENT

SEIS RESPONSIBILITIES: REVIEWER

Education: M.S., Environmental Engineering, Pennsylvania State University
B.S., Wood Products Engineering, State University of New York, College of Environmental Science and Forestry

Experience/Technical Specialty:
Thirty-two years. Environmental engineering and program management.

TENNESSEE VALLEY AUTHORITY

CHRISTOPHER CAREY, TENNESSEE VALLEY AUTHORITY
SEIS RESPONSIBILITIES: PREPARED INPUTS AND REVIEWER

Education: M.S., Electrical Engineering, University of Tennessee
M.E., Nuclear Engineering, University of Florida
B.S., Nuclear Engineering, University of Florida

Experience/Technical Specialty:
Twenty-seven years. Nuclear safety analysis.

PREDRAG MICK MASTILOVIC, TENNESSEE VALLEY AUTHORITY
SEIS RESPONSIBILITIES: REVIEWER

Education: M.B.A., Cornell University
M.S., Mechanical Engineering, Carnegie Mellon University
B.S., Mechanical Engineering, University of Virginia

Experience/Technical Specialty:
Twenty years. Project management.

BRUCE YEAGER, TENNESSEE VALLEY AUTHORITY
SEIS RESPONSIBILITIES: TENNESSEE VALLEY AUTHORITY NEPA POLICY COMPLIANCE, PREPARED INPUTS, REVIEWER

Education: M.S., Zoology, University of Tennessee
B.S., Zoology, Ohio State University

Experience/Technical Specialty:
Thirty-seven years. Environmental compliance and policy and program management.

SAVANNAH RIVER NATIONAL LABORATORY

MICHAEL CHANDLER, SAVANNAH RIVER NATIONAL LABORATORY
SEIS RESPONSIBILITIES: PREPARED INPUTS AND REVIEWER

Education: M.S., Nuclear Engineering, Georgia Institute of Technology
B.S., Nuclear Engineering, Georgia Institute of Technology

Experience/Technical Specialty:
Twenty-eight years. Nuclear process management/technical.

LOS ALAMOS NATIONAL LABORATORY

STEVEN BOOTH, LOS ALAMOS NATIONAL LABORATORY; LOS ALAMOS NATIONAL SECURITY, LLC
SEIS RESPONSIBILITIES: LANL DATA CALL RESPONSE PROJECT LEADER

Education: Ph.D., Economics, Cornell University
M.A., Economics, Cornell University
B.A., Economics, California State University

Experience/Technical Specialty:
Twenty-eight years. Engineering economics evaluation tools such as cost-effectiveness analysis, decision analysis, and business case computations of competing options and policies.

JOHN ISAACSON, LOS ALAMOS NATIONAL LABORATORY; LOS ALAMOS NATIONAL SECURITY, LLC
SEIS RESPONSIBILITIES: ENVIRONMENTAL IMPACTS ANALYSIS.

Education: Ph.D., Anthropology, University of Illinois
M.A., Anthropology, University of Illinois
B.A., English, San Francisco State University

Experience/Technical Specialty:
Twenty-five years. Environmental impact and stewardship and heritage resource protection.

DREW KORNREICH, LOS ALAMOS NATIONAL LABORATORY; LOS ALAMOS NATIONAL SECURITY, LLC
SEIS RESPONSIBILITIES: DATA ANALYST/SYSTEMS ENGINEER

Education: Ph.D., Nuclear Engineering, University of Arizona
M.S., Nuclear Engineering, University of Arizona
B.S., Nuclear Engineering, University of Arizona

Experience/Technical Specialty:
Sixteen years. Nuclear transport theory, criticality safety/analysis, dose modeling analysis, process modeling, and systems engineering and analysis.

STEVEN MCKEE, LOS ALAMOS NATIONAL LABORATORY; LOS ALAMOS NATIONAL SECURITY, LLC
SEIS RESPONSIBILITIES: SUPPORT FOR PROJECT EMISSIONS, UTILITIES AND OTHER RESOURCES, PROCESSING TECHNOLOGY, STAFFING

Education: Ph.D., Chemistry, The Ohio State University
M.S., Chemistry, Bucknell University
B.S., Chemistry and Physics, Elizabethtown College

Experience/Technical Specialty:
Twenty-two years. Project management, plutonium processing technology, and facility equipment installation and operations.

JENNIE RICHARDSON, LOS ALAMOS NATIONAL LABORATORY; LOS ALAMOS NATIONAL SECURITY, LLC

SEIS RESPONSIBILITIES: SUPPORT FOR SAFETY BASIS CALCULATIONS

Education: M.S., Nuclear Engineering, University of New Mexico
M.S., Biology/Biochemistry, University of New Mexico
B.S., Biology, University of New Mexico

Experience/Technical Specialty:

Twenty-five years. Nuclear and industrial safety, with focus on the Chemistry and Metallurgy Research Building and Technical Area 55 facilities at Los Alamos National Laboratory.

SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC

ROBERT BAYER, SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC

SEIS RESPONSIBILITIES: DATA CALL INPUTS AND REVIEWER

Education: B.S., Chemical Engineering, Villanova University

Experience/Technical Specialty:

Twenty years. Process engineering role at SRS directly supporting plutonium processing facilities and design authority roles supporting various projects and studies to construct new plutonium processing facilities. Plutonium processing subject matter expert.

KEITH W. DYER, SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC

SEIS RESPONSIBILITIES: SUBJECT MATTER EXPERT

Education: M.S., Ecology, University of Tennessee
B.S., Natural Science, Shorter College

Experience/Technical Specialty:

Thirty years. Natural resource management, regulatory compliance programs, and NEPA compliance.

F. LEE FOX, SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC

SEIS RESPONSIBILITIES: DATA CALL INPUTS AND REVIEWER

Education: M.S., Electrical Engineering, Purdue University

Experience/Technical Specialty:

Thirty-four years. Process and program (solid waste) management.

KENNETH S. FULLER, SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC

SEIS RESPONSIBILITIES: DATA CALL INPUTS INVOLVING H-CANYON/HB-LINE DISPOSITION OPTIONS AND REVIEWER

Education: M.B.A., Augusta State University
B.S., Chemical Engineering, Clarkson University

Experience/Technical Specialty:

Thirty-one years. Savannah River Site programs, projects, operations, and maintenance management. H-Canyon engineering support.

ELOY SALDIVAR, JR., SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC
SEIS RESPONSIBILITIES: DATA CALL INPUTS AND REVIEWER

Education: B.S., Mechanical Engineering, Texas A&M University

Experience/Technical Specialty:
Thirty years. Nuclear and nonnuclear design authority and regulatory/environmental engineering management.

BETSY L. WESTOVER, SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC
SEIS RESPONSIBILITIES: DATA CALL INPUTS AND REVIEWER

Education: M.B.A., Nova Southeastern University
B.S., Industrial and Operations Engineering, University of Michigan

Experience/Technical Specialty:
Twenty-four years. Reactor operation, environmental compliance, and waste management.

CYNTHIA WILLIAMS, SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC
SEIS RESPONSIBILITIES: DATA CALL INPUTS AND REVIEWER

Education: B.S., Chemistry and Biology, Troy University

Experience/Technical Specialty:
Twenty-two years. Environmental safety, health, and quality, and project management.

RANDALL L. YOURCHAK, SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC
SEIS RESPONSIBILITIES: REVIEWER

Education: B.S., Chemical Engineering, University of Akron

Experience/Technical Specialty:
Thirty years. Nuclear materials processing and process chemistry.

SHAW AREVA MOX SERVICES, LLC

RICHARD CLARK, SHAW AREVA MOX SERVICES, LLC
SEIS RESPONSIBILITIES: DATA CALL INPUTS AND REVIEWER

Education: M.E., Nuclear Engineering, University of Virginia
B.S., Nuclear Engineering, University of Virginia

Experience/Technical Specialty:
Forty years. Reactor physics, core design, reload analyses, project management, fuel packaging and transportation.

FRANCOIS DELCROIX, SHAW AREVA MOX SERVICES, LLC

SEIS RESPONSIBILITIES: *DATA CALL INPUTS*

Education: M.S., Chemical Engineering, Ecole Superieure de Physique et de Chimie Industrielle
B.S., Engineering, Ecole Superieure de Physique et de Chimie Industrielle
(Paris School of Chemistry and Physics)

Experience/Technical Specialty:

Seven years. Nuclear fuel reprocessing, reprocessing plant operation and design.

CARL MAZZOLA, SHAW AREVA MOX SERVICES, LLC

SEIS RESPONSIBILITIES: *DATA CALL INPUTS AND REVIEWER*

Education: M.S., Meteorology, Pennsylvania State University
B.S., Meteorology, City College of New York

Experience/Technical Specialty:

Forty-two years. Environmental impact assessments, environmental compliance, environmental management systems, emergency preparedness and response, chemical commodity management, atmospheric transport and diffusion, consequence assessment, and risk assessment.

PACIFIC NORTHWEST NATIONAL LABORATORY

STEVEN J. MAHERAS, PACIFIC NORTHWEST NATIONAL LABORATORY

SEIS RESPONSIBILITIES: *DATA CALL INPUTS AND REVIEWER*

Education: Ph.D., Health Physics, Colorado State University
M.S., Health Physics, Colorado State University
B.A., Zoology, University of New Hampshire

Experience/Technical Specialty:

Twenty-four years. Transportation, waste management, health physics, safety analysis, and risk assessment.

BATTELLE MEMORIAL INSTITUTE

MICHAEL RECTANUS, BATTELLE MEMORIAL INSTITUTE

SEIS RESPONSIBILITIES: *AIR QUALITY REVIEWER*

Education: B.S., Chemical Engineering, Ohio University

Experience/Technical Specialty:

Fifteen years. Environmental compliance, air quality impact assessments, emissions characterization, and regulatory reviews.

RANDALL REDDICK, BATTELLE MEMORIAL INSTITUTE

SEIS RESPONSIBILITIES: *DATA CALL INPUTS AND REVIEWER*

Education: M.S., Environmental Health Engineering, Kansas University
B.S., Civil Engineering, Kansas University

Experience/Technical Specialty:

Twenty-eight years. Environmental compliance, NEPA compliance, and regulatory reviews.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

JOHN DIMARZIO, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: PROJECT MANAGER, CHAPTER 1 AND APPENDIX A MANAGER, GEOLOGY AND SOILS LEAD

Education: M.S., Geology, George Washington University
B.S., Geology, University of Maryland

Experience/Technical Specialty:
Twenty-six years. Project management, NEPA compliance, geology, water resources, waste management, and cumulative impacts.

JOHN EICHNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: DEPUTY PROJECT MANAGER, EXECUTIVE SUMMARY, CHAPTER 5 AND APPENDIX J MANAGER, INFRASTRUCTURE LEAD

Education: B.S., Accounting, Syracuse University
B.S., Finance, Syracuse University

Experience/Technical Specialty:
Twenty-eight years. Project management, impact analysis, socioeconomics, and cost-benefit analyses.

HANA BINDER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: TECHNICAL EDITOR, CHAPTER 6 MANAGER

Education: B.A., Journalism, University of Oregon

Experience/Technical Specialty:
Four years. Technical writing and editing.

SYDEL CAVANAUGH, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: PUBLIC OUTREACH MANAGER, CHAPTER 9 MANAGER

Education: B.A., Interdisciplinary Studies-Personnel and Sociology, University of Maryland Baltimore County

Experience/Technical Specialty:
Sixteen years. Managing and coordinating activities associated with implementing a public outreach program, including meeting logistics and stakeholder databases.

SUZANNE CREDE, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: CHAPTER 3 MANAGER

Education: M.A., Guidance and Counseling, West Virginia University
B.S., Chemistry, General Science, and Safety Education, West Virginia University

Experience/Technical Specialty:
Twenty years. NEPA analysis and compliance and project management.

MILTON GORDEN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: WASTE MANAGEMENT AND TRANSPORTATION LEAD, APPENDIX E MANAGER

Education: B.S., Nuclear Engineering, North Carolina State University

Experience/Technical Specialty:
Twenty years. Waste management, transportation, human health impacts, socioeconomics, and environmental remediation technologies.

AARON GREENE, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: ECOLOGICAL RESOURCES LEAD AND GIS SUPPORT

Education: M.S., Environmental Science, Indiana University
B.S., Environmental Science, Mansfield University

Experience/Technical Specialty:
Five years. Ecological field assessments, NEPA documentation, and GIS [geographic information system] support.

CHADI D. GROOME, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: CHAPTER 3 MANAGER

Education: M.S., Environmental Engineering Sciences, University of Florida
B.S., Zoology, Clemson University

Experience/Technical Specialty:
Twenty-eight years. Environmental, NEPA, and nuclear regulatory compliance, permitting, and licensing; National Pollutant Discharge Elimination System permitting; and radioactive and hazardous waste management.

SCOTT HEISER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: WASTE MANAGEMENT LEAD

Education: M.S., Environmental Management, University Maryland University College
B.S., Mechanical Engineering, Virginia Polytechnic Institute and State University

Experience/Technical Specialty:
Twenty years. Project management, environmental and NEPA compliance, and impact analysis.

ROY KARIMI, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: TRANSPORTATION

Education: Sc.D., Nuclear Engineering, Massachusetts Institute of Technology
N.E., Nuclear Engineering, Massachusetts Institute of Technology
M.S., Nuclear Engineering, Massachusetts Institute of Technology
B.S., Chemical Engineering, Abadan Institute of Technology

Experience/Technical Specialty:
Thirty years. Nuclear power plant safety, risk and reliability analysis, design analysis, criticality analysis, accident analysis, consequence analysis, spent fuel dry storage safety analysis, and probabilistic risk assessment.

STEVEN MIRSKY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: HUMAN HEALTH IMPACTS – INTENTIONAL DESTRUCTIVE ACTS

Education: M.S., Nuclear Engineering, The Pennsylvania State University
B.S., Mechanical Engineering, Cooper Union

Experience/Technical Specialty:
Thirty-four years. Professional Engineer (Mechanical) Maryland. Safety analysis, nuclear power plant design, operations, foreign nuclear power plant system analysis, accident analysis, thermal hydraulics, shielding and dose assessment, nuclear licensing, and spent nuclear fuel dry storage safety analysis.

DOUGLAS OUTLAW, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: HUMAN HEALTH IMPACTS – FACILITY ACCIDENTS LEAD, APPENDIX D MANAGER

Education: Ph.D., Nuclear Physics, North Carolina State University
M.S., Nuclear Physics, North Carolina State University
B.S., Nuclear Physics, North Carolina State University

Experience/Technical Specialty:
Thirty-two years. Nuclear physics, safety analysis, and risk assessment.

KIRK OWENS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: HUMAN HEALTH IMPACTS MANAGER

Education: B.S., Environmental Resource Management, The Pennsylvania State University

Experience/Technical Specialty:
Thirty-three years. Radioactive waste management, regulatory analysis, environmental compliance and assessment, and radiological impacts assessment.

LAUREN OWENS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: PUBLIC OUTREACH SUPPORT

Education: B.A., Architectural Studies, University of Pittsburgh

Experience/Technical Specialty:
One year. Assisting in meeting logistics and document preparation and distribution.

SHARON M. PIETZYK, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: CULTURAL RESOURCES LEAD AND ADMINISTRATIVE RECORD MANAGER

Education: M.S., Systems Management, University of Southern California
B.S., Biology, James Madison University

Experience/Technical Specialty:
Twenty-three years. NEPA compliance, ecological resources, cultural resources, comment response, public outreach, technical writing, administrative record, and quality assurance.

MICHAEL RAINER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: WATER RESOURCES LEAD

Education: B.S., Agronomy (Soils), Louisiana Tech University

Experience/Technical Specialty:
Twenty years. Soils, erosion, rural roads and crossings, natural resource management, and NEPA.

LINDA ROBINSON, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: PROJECT QUALITY ASSURANCE LEAD

Education: M.B.A., Loyola University
B.S. Ed., Earth Sciences, Texas Christian University

Experience/Technical Specialty:
Thirty years. Nuclear and hazardous waste environmental project management, environmental regulatory compliance, public outreach, and quality assurance.

GARY ROLES, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: CHAPTER 4, APPENDICES F, G, H, AND I MANAGER; IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES, DEACTIVATION, DECONTAMINATION AND DECOMMISSIONING, AND MITIGATION LEAD

Education: M.S., Nuclear Engineering, University of Arizona
B.S., Mechanical Engineering, Arizona State University

Experience/Technical Specialty:
Thirty-two years. Radioactive waste management, regulatory and compliance analysis, and NEPA analysis.

SEAN SCHATZEL, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE LEAD

Education: B.A., Political Economics/Public Administration, Bloomsburg University

Experience/Technical Specialty:
Four years. Socioeconomics and environmental justice.

JAMES SCHINNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: LAND USE, VISUAL RESOURCES, AND CUMULATIVE IMPACTS LEAD

Education: Ph.D., Wildlife Management, Michigan State University
M.S., Zoology, University of Cincinnati
B.S., Zoology, University of Cincinnati

Experience/Technical Specialty:
Thirty-eight years. Ecological field assessments, NEPA documentation, and regulatory reviews.

ROBERT SCHLEGEL, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: HUMAN HEALTH IMPACTS – AFFECTED ENVIRONMENT LEAD

Education: M.S., Nuclear Engineering, Columbia University
B.S., Chemical Engineering, Massachusetts Institute of Technology

Experience/Technical Specialty:
Forty-eight years. NEPA document preparation, Safety Analyses Report preparation, and assessment of radiological doses/associated adverse health impacts.

WALTER SOVEROW, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: ADMINISTRATIVE RECORD AND PUBLIC OUTREACH SUPPORT

Education: B.S., Business Administration, Rochester Institute of Technology

Experience/Technical Specialty:
Eighteen years. Assisting in meeting logistics and document preparation and distribution.

ELLEN TAYLOR, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: CHAPTER 2 AND APPENDIX B MANAGER

Education: Ph.D., Biology, University of Pennsylvania
B.A., Zoology, University of Vermont

Experience/Technical Specialty:
Twenty-seven years. Environmental compliance and NEPA assessments.

AL TOBLIN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: HUMAN HEALTH IMPACTS – ACCIDENT ANALYSIS

Education: M.S., Chemical Engineering, University of Maryland
B.E., Chemical Engineering, Cooper Union

Experience/Technical Specialty:
Thirty-eight years. Contaminant transport through air, groundwater, and surface water and accident risk analysis.

GILBERT H. WALDMAN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: HUMAN HEALTH IMPACTS – NORMAL OPERATIONS LEAD, APPENDIX C MANAGER

Education: M.S., Engineering Management, Johns Hopkins University
B.S., Nuclear Engineering, University of Florida

Experience/Technical Specialty:
Nineteen years. Radiological impacts analysis, radiological dose modeling, and radiological risk assessments.

ROBERT WERTH, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SEIS RESPONSIBILITIES: AIR QUALITY AND NOISE LEAD

Education: B.A., Physics, Gordon College

Experience/Technical Specialty:
Thirty-three years. Acoustics and air quality analysis, regulatory reviews, and NEPA documentation.

CHAPTER 9
DISTRIBUTION LIST

9.0 DISTRIBUTION LIST

The U.S. Department of Energy provided copies of this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* to members of Congress; Federal, state, and local elected and appointed government officials and agencies; American Indian representatives; and organizations and individuals as listed. Approximately 100 copies of the complete *Draft SPD Supplemental EIS,* 400 copies of this *Draft SPD Supplemental EIS Summary*, and 80 compact discs containing the complete *Draft SPD Supplemental EIS* were sent to interested parties. Copies will be provided to others upon request.

United States Congress

U.S. Senate

Alabama

The Honorable Jeff Sessions
The Honorable Richard Shelby

Georgia

The Honorable Saxby Chambliss
The Honorable Johnny Isakson

New Mexico

The Honorable Jeff Bingaman
The Honorable Tom Udall

South Carolina

The Honorable Jim DeMint
The Honorable Lindsey Graham

Tennessee

The Honorable Lamar Alexander
The Honorable Bob Corker

U.S. Senate Committees

Committee on Appropriations
The Honorable Daniel Inouye, Chairman
The Honorable Thad Cochran, Vice Chairman

Committee on Appropriations, Subcommittee on Energy and Water Development
The Honorable Dianne Feinstein, Chairman
The Honorable Lamar Alexander, Ranking Member

Committee on Armed Services
The Honorable Carl Levin, Chairman
The Honorable John McCain, Ranking Member

Committee on Energy and Natural Resources
The Honorable Jeff Bingaman, Chairman
The Honorable Lisa Murkowski, Ranking Member

Committee on Energy and Natural Resources, Subcommittee on Energy
The Honorable Maria Cantwell, Chairman
The Honorable James E. Risch, Ranking Member

Committee on Environment and Public Works
The Honorable Barbara Boxer, Chairman
The Honorable James M. Inhofe, Ranking Member

Committee on Environment and Public Works, Subcommittee on Clean Air and Nuclear Safety
The Honorable Thomas R. Carper, Chairman

The Honorable John Barrasso, Ranking Member

U.S. House of Representatives

Alabama

The Honorable Robert Aderholt, District 4
The Honorable Mo Brooks, District 5

Georgia

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The Honorable Paul C. Broun, M.D., District 10
The Honorable John Barrow, District 12

New Mexico

The Honorable Martin T. Heinrich, District 1
The Honorable Stevan Pearce, District 2
The Honorable Ben R. Lujan, District 3

South Carolina

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The Honorable Jeff Duncan, District 3
The Honorable Mick Mulvaney, District 5
The Honorable James E. Clyburn, District 6

Tennessee

The Honorable John J. Duncan, Jr., District 2
The Honorable Charles Fleischmann, District 3
The Honorable Scott DesJarlais, District 4

U.S. House of Representatives Committees

Committee on Appropriations
The Honorable Harold Rogers, Chairman
The Honorable Norman Dicks, Ranking Member

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The Honorable Peter J. Visclosky, Ranking Member

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The Honorable Bobby L. Rush, Ranking Member

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The Honorable Gene Green, Ranking Member

Committee on Science, Space, and Technology
The Honorable Ralph Hall, Chairman
The Honorable Eddie Bernice Johnson, Ranking Member

Committee on Science, Space, and Technology, Subcommittee on Energy and Environment
The Honorable Andy Harris, Chairman
The Honorable Brad Miller, Ranking Member

Federal Agencies

Advisory Council on Historic Preservation
Defense Nuclear Facilities Safety Board
National Park Service
U.S. Department of Agriculture
U.S. Department of the Interior
U.S. Department of Transportation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Government Accountability Office
U.S. Nuclear Regulatory Commission

State Government

Alabama

Governor
Robert J. Bentley

Senators
Bill Holtzclaw, District 2
Arthur Orr, District 3

Representatives
Micky Hammon, District 4
Dan Williams, District 5

Georgia

Governor
Nathan Deal

Senators
Hardie Davis, District 22
Jesse Stone, District 23
Bill Jackson, District 24

Representatives
Harry Geisinger, District 48
Lee Anderson, District 117
Ben L. Harbin, District 118
Barbara Sims, District 119
Quincy Murphy, District 120
Henry Howard, District 121
Earnest Smith, District 122
Gloria Frazier, District 123

New Mexico

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Susana Martinez

Senators
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Richard C. Martinez, District 5
Linda Lopez, District 11
Dede Feldman, District 13
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Timothy M. Keller, District 17
Lynda M. Lovejoy, District 22
Sander Rue, District 23
Nancy Rodriquez, District 24
Peter Wirth, District 25
Stuart Ingle, District 27
David Ulibarri, District 30
Timothy Jennings, District 32
Rod Adair, District 33
Vernon D. Asbill, District 34
Carroll H. Leavell, District 41
Gay Kernan, District 42

Representatives
Patricia A. Lundstrom, District 9
Miguel P. Garcia, District 14
James P. White, District 20
Conrad D. James, District 24
Al Park, District 26
Nick L. Salazar, District 40
Debbie A. Rodella, District 41
Jim Hall, District 43
Jim Trujillo, District 45
Ben Lujan, District 46
Brian Egolf, District 47
Luciano Varela, District 48
Rhonda S. King, District 50
William J. Gray, District 54
Cathrynn Brown, District 55
Dennis Kintigh, District 57
Candy Spence Ezzell, District 58
Nora Espinoza, District 59
Shirley Tyler, District 61
Donald Bratton, District 62
Bob Wooley, District 66

South Carolina

Governor

Nikki Haley

Senators

W. Greg Ryberg, District 24
A. Shane Massey, District 25
Nikki Setzler, District 26
John Matthews, Jr., District 39
C. Bradley Hutto, District 40
Clementa Pinckney, District 45

Representatives

Gilda Cobb-Hunter, District 66
Thomas Young, Jr., District 81
William Clyburn, District 82
Bill Hixon, District 83
J. Roland Smith, District 84
Bill Taylor, District 86
Bakari Sellers, District 90
Lonnie Hosey, District 91
Jerry Govan, Jr., District 95

Tennessee

Governor

Bill Haslam

Senators

Mike Bell, District 9
Bo Watson, District 11
Ken Yager, District 12

Representatives

Eric Watson, District 22
Gerald McCormick, District 26
Richard Floyd, District 27
Tommie Brown, District 28
JoAnne Favors, District 29
Vince Dean, District 30
Jim Cobb, District 31

State NEPA Points of Contact

James Hardeman, Georgia Department of Natural Resources
F. David Martin, New Mexico Environment Department
Clearinghouse Coordinator, State Clearinghouse, Office of State Budget, South Carolina
Shelley Wilson, South Carolina Department of Health & Environmental Control
Mary Parkman, Tennessee Department of Environment and Conservation
Chudi Nwangwa, Tennessee Department of Environment and Conservation

State Agencies

Alabama Department of Conservation and Natural Resources
N. Gunter Guy, Jr., Commissioner of Conservation

Alabama Department of Economic and Community Affairs
Jim Byard, Jr., Director

Alabama Department of Environmental Management
Lance R. LeFleur, Director

Alabama Department of Transportation
John R. Cooper, Director

Georgia Department of Natural Resources
Mark Williams, Commissioner
Judson H. Turner, Director, Environmental Protection Division
Jim Sommerville, Branch Chief, Program Coordination Branch

Alabama Historical Commission
Elizabeth Ann Brown, Director, Deputy State Historic Preservation Officer

New Mexico Economic Development Department
Jon Barela, Cabinet Secretary

New Mexico Department of Public Safety
Gorden Eden, Jr., Secretary

New Mexico Department of Homeland Security and Emergency Management
Gregory A. Myers, Acting Cabinet Secretary

New Mexico Department of Transportation
Todd Wilson, WIPP Route Safety Coordinator, Risk Management Division

New Mexico Energy, Minerals and Natural Resources Department
John H. Bemis, Cabinet Secretary
Anne deLain Clark, Coordinator, New Mexico Radioactive Waste Consultation Task Force

New Mexico Environment Department
Butch Tongate, Deputy Secretary
John Kieling, Bureau Chief, Hazardous Waste Bureau
Julie Roybal, Environmental Impact Review Coordinator
Thomas Skibitski, Chief, DOE Oversight Bureau
Steve Yanicak, Staff Manager, DOE Oversight Bureau

South Carolina Department of Archives & History
W. Eric Emerson, State Historic Preservation Officer

South Carolina Department of Health and Environmental Control
C. Earl Hunter, Commissioner
Robert King, Jr., PE, Deputy Commissioner, Environmental Quality Control
Jennifer Hughes, Director (Region 5), Environmental Quality Control, Bureau of Environmental Services
Daphne Neel, Bureau Chief, Bureau of Land and Waste Management
Myra Reece, Bureau Chief, Bureau of Air Quality
Renee Shealy, Bureau Chief, Bureau of Environmental Services
David Wilson, PE, Bureau Chief, Bureau of Water

South Carolina Department of Natural Resources
Bob Perry, Director, Office of Environmental Programs
Brian Long, Cultural Preserve Manager
Greg Mixon, Environmental Review Program Manager, Land, Water and Conservation Division

South Carolina Department of Transportation
Robert J. St. Onge, Jr., Secretary

South Carolina Energy Office
Ashlie Lancaster, Director

South Carolina Governor's Nuclear Advisory Council
Karen Patterson, Chair
Ben Rusche

South Carolina Wildlife and Marine Resources Department
Robert Duncan, Environmental Coordinator, Department of Health and Environmental Control

Tennessee Department of Economic and Community Development
Michael Atchison, Special Projects Director, NEPA Contact

Tennessee Department of Environment and Conservation
Robert Martineau, Commissioner
Sandra Dudley, Director, Water Pollution Control
Britton Dotson, Director, Division of Groundwater Protection
Anne Marshall, Director, Resource Management Division
Debra Shults, Director, Division of Radiological Health
Barry Stephens, Director, Division of Air Pollution Control
Jennifer Barnett, Federal Programs Archaeologist, Division of Archaeology

Tennessee Department of Transportation
John Schroer, Commissioner
Toks Omishakin, Chief, Environment and Planning Bureau

Tennessee Historical Commission
E. Patrick McIntyre, Jr., Executive Director, State Historic Preservation Officer

Tennessee Wildlife Resources Agency
Ed Carter, Executive Director
Robert Todd, Environmental Services Division

Local Government

Alabama

Mayors
William Marks, Athens
Don Stanford, Decatur

County Officials
Stanley Menefee, Chairman, County Commission, Limestone County
Rita White, Director, Emergency Management Agency, Limestone County
Ray Long, Chairman, County Commission, Morgan County

Georgia

Mayors
Deke Copenhaver, Augusta
Pauline Jenkins, Waynesboro

City Officials
Frederick Russell, City Administrator, Augusta
Jerry Coalson, City Manager, Waynesboro

County Officials
Jerry Brigham, Commissioner, Augusta-Richmond County Commission
Wayne Crockett, Chairman, Burke County Board of Commissioners
Merv Waldrop, County Administrator, Burke County
Ron C. Cross, Chairman, Columbia County Board of Commissioners

New Mexico

Mayors
Richard J. Berry, Albuquerque
Phillip Burch, Artesia
Dale W. Janway, Carlsbad
Alice Lucero, Española
Gary Don Reagan, Hobbs
Del Jurney, Roswell
David Coss, Santa Fe
Darren Cordova, Taos
Pete Estrada, Village of Loving

City/Town Officials
Trudy Jones, President, City Council, Albuquerque
Jon Tully, Acting City Administrator, Carlsbad
Robert Romero, City Manager, Santa Fe
Joe Mike Duran, Chairman, Board of County Commissioners, Taos

County Officials

Roxanne Lara, Chair, County Commissioners, Eddy County
Allen Sartin, County Manager, Eddy County
Harry Burgess, County Administrator, Los Alamos County
Martha Perkins, Senior Planner, Los Alamos County
Gene Schmidt, Superintendent, Los Alamos County Public Schools
Sharon Stover, Chair, County Council, Los Alamos County
Tierra Amarilla, County Manager, Rio Arriba County
Katherine Miller, County Manager, Santa Fe County
Virginia Vigil, Chair, County Commissioners, Santa Fe County

South Carolina

Mayors

Frederick B. Cavanaugh, Aiken
Ronnie Jackson, Allendale
Edward Lemon, Barnwell
Charles H. Williams, Burnettown
Frank Mizell, Windsor
Clyde Smith, Monetta
Lark W. Jones, North Augusta
Thomas Williams, Perry
N. Salley, Sr., Salley
Anthony Shaw, New Ellenton
Mike Miller, Wagener

City/Town Officials

Don Wells, City Council, Aiken
Richard Pearce, City Manager, Aiken
Charles Barranco, Director of Public Safety, Aiken
DeWayne Ennis, Town Administrator, Allendale
John Zawacki, City Administrator, Barnwell
B. Todd Glover, City Administrator, North Augusta
John C. Thomas, Director of Public Safety, North Augusta

County Officials

J. Clay Killian, County Administrator, Aiken County
Ronnie Young, Chairman, Aiken County Council
Charles Barton, Aiken County Council
Gary Bunker, Aiken County Council
Sandy Haskell, Aiken County Council
Willar Hightower, Aiken County Council
LaWana McKenzie, Aiken County Council
Kathy Rawls, Aiken County Council
Chuck Smith, Aiken County Council
Scott Singer, Aiken County Council
David Ruth, Coordinator, Aiken County Emergency Management Division
Vacant, County Administrator, Allendale County
H. Carl Gooding, Chairman, Allendale County Council
Pickens Williams, Jr., County Administrator, Barnwell County
Travis Black, Chairman, Barnwell County Council

Tennessee

Mayors
Bob Vincent, Dayton
Bill James, Decatur
Ted Doss, Graysville
Jim Coppinger, Hamilton County
Garland Lankford, Meigs County
George Thacker, Rhea County
Jim Adams, Soddy-Daisy
Mary Sue Garrison, Spring City

City Officials
Hardy Stulce, City Manager, Soddy-Daisy
Vicki Doster, City Manager, Spring City

County Officials
Tony Reavley, Director of Emergency Services, Hamilton County
Bill Tittle, Chief of Emergency Management, Hamilton County
Tony Finnell, Director, Emergency Management Agency, Meigs County
Jacky Reavley, Director, Emergency Management Agency, Rhea County

Advisory Boards

Menice Santistevan, Executive Director, Northern New Mexico Citizens Advisory Board
Donald Bridges, Chairman, Savannah River Site Citizens Advisory Board

Native American Representatives

Alabama

Buford Rolin, Chairman, Poarch Band of Creek Indians
Robert Thrower, Tribal Historic Preservation Officer, Poarch Band of Creek Indians

Florida

Paul N. Backhouse, Tribal Historic Preservation Officer, Seminole Tribe of Florida
Mitchell Cyprus, Chief, Seminole Tribe of Florida

Louisiana

Dana Masters, Jena Band of Choctaw Indians
Christine Norris, Chief, Jena Band of Choctaw Indians

Missouri

Robin DuShane, Cultural Preservation Director, Eastern Shawnee Tribe of Oklahoma
Glenna Wallace, Chief, Eastern Shawnee Tribe of Oklahoma

New Mexico

Rob Corabi, Director, Eight Northern Indian Pueblo Council
Mark Chino, President, Mescalero Apache Tribe
Ron Lovato, Governor, Ohkay Owingeh
Randall Vicente, Governor, Pueblo of Acoma
Phillip Quintana, Governor, Pueblo of Cochiti
Greg Kaufman, Director, Department of Natural Resources, Pueblo of Jemez
Joshua Madalena, Governor, Pueblo of Jemez
Phillip A. Perez, Governor, Pueblo of Nambe
George Rivera, Governor, Pueblo of Pojoaque
Terry Aguliar, Governor, Pueblo of San Ildefonso
Steve Rydeen, Interim Director, Department of Environmental and Cultural Preservation, Pueblo of San Ildefonso
Ernest J. Lujan, Governor, Pueblo of Sandia
Joseph M. Chavarria, Director, Office of Environmental Affairs, Pueblo of Santa Clara
Walter Dasheno, Governor, Pueblo of Santa Clara
Ramos Romero, Governor, Pueblo of Tesuque

North Carolina

Michell Hicks, Principal Chief, Eastern Band of Cherokee Indians
Russ Townsend, Tribal Historic Preservation Officer, Eastern Band of Cherokee Indians

Oklahoma

George Blanchard, Governor, Absentee Shawnee Tribe of Oklahoma
Henrietta Ellis, Tribal Historic Preservation Officer, Absentee Shawnee Tribe of Oklahoma
Augustine Asbury, Cultural Preservation Coordinator, Alabama Quassarte Tribal Town
Richard Allen, Policy Analyst, Cherokee Nation
Chad "Corntassel" Smith, Chief, Cherokee Nation
Bill Anoatubby, Governor, Chicksaw Nation
Kirk Perry, Administrator, Chicksaw Nation
Henry Harjo, Environmental Director, Kialegee Tribal Town
Tiger Hobia, Chief, Kialegee Tribal Town
Alfred Berryhill, Cultural Preservation Department, Muscogee (Creek) Nation of Oklahoma
George Tiger, Principal Chief, Muscogee (Creek) Nation of Oklahoma
Natalie Deere, Tribal Historic Preservation Officer, Seminole Nation of Oklahoma
Leonard Harjo, Chief, Seminole Nation of Oklahoma
Kim Jumper, Tribal Historic Preservation Officer, Shawnee Tribe
Ron Sparkman, Chairman, Shawnee Tribe
Charles Coleman, NAGPRA Representative, Thiopthlocco Tribal Town
Lisa LaRue-Baker, Acting Tribal Historic Preservation Officer, United Keetoowah Band of Cherokee Indians
George Wickliffe, Chief, United Keetoowah Band of Cherokee Indians

South Carolina

Bill Harris, Chief, Catawba Indian Nation

Texas

Bryant Celestine, Tribal Historic Preservation Officer, Alabama-Coushatta Tribe of Texas
Oscola Clayton Sylestine, Chief, Alabama-Coushatta Tribe of Texas

Public Reading Rooms and Libraries

A complete copy of the *SPD Supplemental EIS* and references may be reviewed at any of the reading rooms and libraries listed below.

Alabama

Athens-Limestone Public Library
405 East South Street
Athens, AL 35611
(256) 232-1233

Georgia

Asa H. Gordon Library
Savannah State University
2200 Tompkins Road
Savannah, GA 31404
(912) 358-4324

Reese Library
Augusta State University
2500 Walton Way
Augusta, GA 30904
(706) 737-1745

New Mexico

Carlsbad Field Office
U.S. Department of Energy
WIPP Information Center
4021 National Parks Highway
Carlsbad, NM 88220
(575) 234-7348

DOE Public Reading Room
Government Information Department
Zimmerman Library
University of New Mexico
1 University of New Mexico
Albuquerque, NM 87131
(505) 277-7180

Española Public Library
313 N. Paseo de Oñate
Española, NM 87532
(505) 747-6087

Los Alamos National Laboratory
Reading Room
Pojoaque, NM 87501
(505) 667-0216

Mesa Public Library
2400 Central Avenue
Los Alamos, NM 87544
(505) 662-8240

New Mexico State Library
1209 Camino Carlos Rey
Santa Fe, NM 87507
(505) 476-9700

Santa Fe Public Library
145 Washington Avenue
Santa Fe, NM 87501
(505) 955-6780

Santa Fe Public Library
Oliver La Farge Branch
1730 Llano Street
Santa Fe, NM 87505
(505) 955-4860

South Carolina

Gregg-Graniteville Library
University of South Carolina-Aiken
471 University Parkway
Aiken, SC 29801
(803) 641-3320

South Carolina State Library
1500 Senate Street
Columbia, SC 29201
(803) 734-8026

Tennessee

Chattanooga Public Library
1001 Broad Street
Chattanooga, TN 37402
(423) 757-5310

Lawson McGhee Public Library
500 W. Church Avenue
Knoxville, TN 37902
(865) 215-8750

Washington, DC

U.S. Department of Energy
Freedom of Information Act Reading Room
1000 Independence Avenue, SW, 1G-033
Washington, DC 20585
(202) 586-5955

Organizations/Public Interest Groups

Dorelen Bunting, Albuquerque Center for Peace and Justice
Tom Clements, Alliance for Nuclear Accountability
Katherine Fuchs, Alliance for Nuclear Accountability
Susan Gordon, Alliance for Nuclear Accountability
Lesley Weinstock, Aquaes Vida Action Team
Marshall L. Martin, Jr., Barnwell County Economic Development Commission
Sandra Kurtz, Bellefonte Efficiency and Sustainability Team
Louis Zeller, Blue Ridge Environmental Defense League
Roy Dawson, Brown Beret
Matt Leroch, Carlsbad Chamber of Commerce
W.T. Martin, Jr., Carlsbad Department of Development
John Waters, Carlsbad Department of Development
George Mulholland, Carlsbad Environmental Monitoring and Research Center
Harry Rogers, Carolina Peace Resource Center
Sara Williams, Carolina Peace Resource Center
Doug Lynn, Center of Excellence for Hazardous Material Management
David McCoy, Citizen Action New Mexico
Janet Greenwald, Citizens for Alternatives to Radioactive Dumping
Mildred McClain, Citizens for Environmental Justice
Clinton Wolfe, Citizens for Nuclear Technology Awareness
Kathleen Ferris, Citizens to END IT
Tammy Shepherd, Columbia County Chamber of Commerce
Joni Arends, Concerned Citizens for Nuclear Safety
Basia Miller, Concerned Citizens for Nuclear Safety
Virginia Miller, Department of Peace Initiative New Mexico
Troy Post, Development Authority of Columbia County
Walter C. Sprouse, Jr., Development Authority of Richmond County
Ernest S. Chaput, Economic Development Partnership
Will Williams, Economic Development Partnership
Robert Hatch, Engineered Resources LLC
David Hiland, Engineered Resources LLC
Bansi Patel, Engineered Resources LLC
Barbara O’Neal, Erwin Citizens Awareness Network
Ruth Thomas, Environmentalists, Inc.
Chris Monetta, GE Energy
Bobbie Paul, Georgia Women’s Action for New Directions
Louis Clark, Government Accountability Project
J. David Jameson, Greater Aiken Chamber of Commerce
Hugh Ball, Greater Limestone County Chamber of Commerce
Rod Young, Green Party of Tennessee
Arjun Makhijani, Institute for Energy and Environmental Research
Mervn L. Tano, International Institute for Indigenous Resource Management
Penelope McMullen, Loretto Community
John Severance, Los Alamos Monitor
Greg Mello, Los Alamos Study Group
Peter Neils, Los Alamos Study Group
Trish Williams-Mello, Los Alamos Study Group
F. Wayne Rogers, Lower Savannah Council of Governments
Eric Johnson, Metro Spirit
Gregory Moore, MOX-AFS
Brendolyn L. Jenkins, NAACP-Aiken Chapter
Thomas B. Cochran, Natural Resources Defense Council
Geoffrey Fettus, Natural Resources Defense Council
Douglas Meiklejohn, New Mexico Environmental Law Center
Nora McMillican, North-Central Alabama Regional Council of Governments
Paul Friesema, Northwestern University

Julie Keys, Nuclear Energy Institute
Diane D'Arrigo, Nuclear Information and Resource Center
Mary Olson, Nuclear Information and Resource Service-Southeast Office
Jay Coghlan, Nuclear Watch New Mexico
Scott Kovac, Nuclear Watch New Mexico
Glenn Carroll, Nuclear Watch South
Ralph Hutchison, Oak Ridge Environmental Peace Alliance
Peggy Prince, Peace Action New Mexico
Judith Mohling, Rocky Mountain Peace and Justice Center
LeRoy Moore, Rocky Mountain Peace and Justice Center
Roger Snodgrass, Santa Fe New Mexican
Kelly Trice, Shaw AREVA MOX Services, LLC
Nancy Muse, Shoals Environmental Alliance
Jackie Poses, Shoals Environmental Alliance
Kurt Henning, Sierra Club
Judy Gordon, Sierra Club – Savannah River Group
Susan Corbett, Sierra Club – South Carolina Chapter
Brian Paddock, Sierra Club – Tennessee Chapter
Beatrice Brailsford, Snake River Alliance
Otis Rawl, South Carolina Chamber of Commerce
Adam King, South Carolina Institute of Archeology and Anthropology
George Wingard, South Carolina Institute of Archeology and Anthropology
Ben Gregg, South Carolina Wildlife Federation
Beth Jones, Southeast Tennessee Development District
Sara Barczak, Southern Alliance for Clean Energy
Don Hancock, Southwest Research and Information Center
Richard V. McLeod, SRS Community Reuse Organization
Marc Miller, SRS Community Reuse Organization
J. Walt Joseph, SRS Heritage Foundation Board
Don Safer, Tennessee Environmental Council
Kathy Sanchez, Tewa Women United
Beata Tsosie-Pena, Tewa Women United
Robert B. Culver, Top of Alabama Regional Council of Governments
Marylia Kelley, Tri-Valley CAREs
Scott Yundt, Tri-Valley CAREs
J. Gilbert Sanchez, Tribal Environmental Watch Alliance
Edwin S. Lyman, Union of Concerned Scientists
Peter Sederberg, University of South Carolina
Jessica Quinn, Visiones Photography
Susan Shaer, Women's Action for New Directions
Ellen Thomas, Women's International League for Peace and Freedom

Individuals

Barbara Antonoplos
Marcus Atkinson
Floy Barrett
Janice Barrett
Tom and Lorraine Bennett
Adrian Bernal
Ricky Blea
Bonnie Bonneau
Sam Booher
Marcia Borowski
Catherine Bradshaw
William F. Brizes
Ed Burke
Matthew and Lisa Bush
Tom Butler
Joe Carl
Patricia Carter
Kathy Chadwell
Euval Claxton
Ira and Elaine Cooper
Claudine Cremer
Sara Crossfield
Julia Crowley
John Cruickshank
Marci Culley
Kay Cumbow
Donna Cuthbert
Russell D'Arensbourg
Elena Day
Silas DeRoma
Donna Detweiler
Deborah Dix
Spencer Dixon
Mark Donham
Ned Z. Elkins
Mitzi Evans
Robert J. Evers
Tom Ferguson
John D. Fligelman
Sylvia Foster
Elizabeth Frank
Joe Gant
Holly Garrett
Jonathan Golden
Arifa Goodman
Martin Grantham
Judith Greene-McLeod
Pamela Greenlaw
Robert Guild
Henry Gurr
Rose Hayes
Lorena Hildebrandt
Lilli Hoffman
William Holcomb
Jeannine Honicker
Stewart Horn
Sara Hornbacher
Tom Howell
Cyndia Hunnicutt
Eileen Jenkins
Ann Jennings
Robert E. Johannesen
Adrienne Johnson
Elizabeth Johnson
Henry L. Jones
Arnold Karr
Hans J. Kaufmann, Jr.
Michael Keegan
Shelah Killen
Elisabeth King
Joan O. King
Kathryn Kuppers
Adele Kushner
Marvin Lewis
Martha Lightfoot
Ron Livingston
Lorrie Lopez
Nicole Lunsford
Phil Lusk
Joy MacNulty
Mildred Markum
Mary Esther Marques
Susannah Masarie
Scott Maxwell
Ellen McCabe
Yolande McCurdy Gottfried
Bert McDert
Mary Merrill
Susan Michetti
Stephanie Miller
Nancy Mills
L. Shaw Mitchell
Arlan Monderewicz
Donald and Hattie Monson
Garry Morgan
L. Noel Morphis
Hattie Nestel
Dennis Nester
Lille Norstad
Rowena Nylund
Joe Ortaldo
David Ortman
Trevor Owens
Peter Paluch
Judy Parady
Cindy Parker
Lewis Patrie
Larry S. Pollock
Jim Raines
David Reister
N.T. Rempe
William Reynolds
Charles Richardson
Don Richardson
Betty Rivard
H. Schaktman
Mr. and Mrs. Emerson Scott
Damon Sgrignoli
Melanie Sgrignoli
Sally Shaw
C.B. Shedrow
Nathan Smith
Larry Sortor
Gary W. Stueve
Alan W. Swafford
Will J. Swafford, Jr.
Gloria Tatum
Kay Tauches
David M. Trayer
David Trenkle
Herb Underwood
Jesse Van Gerven
Joan Wages
Mike Wahl
Carl Wassilie
Lisa Watson
Dan Webster
Joel Weinbaum
Henry A. White
Barbara Wise
Harriet Woolf
R.D. Young
Jennifer Zorland

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