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ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

AEI	areas of environmental interest
ALARA	as low as is reasonably achievable
ALOHA	Areal Locations of Hazardous Atmospheres
ATR	Advanced Test Reactor
BEIR	Biological Effects of Ionizing Radiation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFA	Central Facilities Area
CFR	*Code of Federal Regulations*
CHEMTREC	Chemical Transportation Emergency Center
CIRRPC	Committee on Interagency Radiation Research and Policy Coordination
CITRC	Critical Infrastructure Test Range Complex (formerly Power Burst Facility)
CPP	Chemical Processing Plant
DARHT	Dual Axis Radiographic Hydrodynamic Test
dB	decibel
dBA	decibels A-weighted
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EBR	Experimental Breeder Reactor
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guideline
ETTP	East Tennessee Technology Park
FDF	Fluorinel Dissolution Facility
FDPF	Fluorinel Dissolution Process and Fuel Storage Facility
FEMA	Federal Emergency Management Agency
FFTF	Fast Flux Test Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FY	Fiscal Year
HEPA	high-efficiency particulate air (filter)
HEU	high enriched uranium
HFIR	High Flux Isotope Reactor
HLW	high level radioactive waste
HVAC	heating, ventilating and air conditioning
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
INEEL	Idaho National Engineering and Environmental Laboratory

INL	Idaho National Laboratory (formerly Idaho National Engineering and Environmental Laboratory)
INTEC	Idaho Nuclear Technology and Engineering Center
ISCORS	Interagency Steering Committee on Radiation Standards
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LLNL	Lawrence Livermore National Laboratory
LOC	level-of-concern
MCL	maximum contaminant level
MEI	maximally exposed individual
MFC	Materials and Fuels Complex (formerly Argonne National Laboratory-West)
MCL	maximum contaminant level
MMI	Modified Mercalli Intensity
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NCRP	National Council on Radiation Protection and Measurements
NEHRP	National Earthquake Hazards Reduction Program
NEPA	National Environmental Policy Act
NI PEIS	*Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*
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
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPH	natural-phenomena hazards
NRC	U.S. Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PEIS	Programmatic Environmental Impact Statement
PIDAS	Perimeter Intrusion and Detection Assessment System
PM_{10}	particulate matter less than or equal to 10 microns in aerodynamic diameter
ppm	parts per million
PSD	prevention of significant deterioration
rad	radiation absorbed dose
RAP	Radiological Assistance Program
RCRA	Resource Conservation and Recovery Act
REDC	Radiochemical Engineering Development Center
rem	roentgen equivalent man

RESRAD	residual radiation
RfC	reference concentration
RHU	radioisotope heater units
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROI	region of influence
RPS	radioisotope power system
RTC	Reactor Technology Complex (formerly Test Reactor Area)
RTG	radioisotope thermoelectric generator
RWL	Radiological Welding Laboratory
RWMC	Radioactive Waste Management Complex
SFM	special fissionable material
SM	source material
SMC	Specific Manufacturing Complex
SNL	Sandia National Laboratories
SNM	special nuclear material(s)
SPERT	Special Power Excursion Reactor Test
SRS	Savannah River Site
SSPSF	Space and Security Power Systems Facility
SST/SGTs	Safe, Secure Trailer/Safeguards Transports
TA	technical area
TAN	Test Area North
TDEC	Tennessee Department of Environment and Conservation
TEDE	total effective dose equivalent
TEEL	Temporary Emergency Exposure Limits
TRA	Test Reactor Area
TRAGIS	Transportation Routing Analysis Geographic Information System
TRANSCOM	Transportation Tracking and Communications System
TRU	transuranic waste
TVA	Tennessee Valley Authority
U.S.C.	*United States Code*
UFSF	Unirradiated Fuel Storage Facility
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAG	waste area group
WERF	Waste Experimental Reduction Facility
WROC	Waste Reduction Operations Complex
WIPP	Waste Isolation Pilot Plant
Y-12	Y-12 Plant
ZPPR	Zero Power Physics Reactor

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	16,025.6	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
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	3.78533	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 FOR AGENCY ACTION

1.0 INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

Chapter 1 of this environmental impact statement (EIS) provides an overview of the U.S. Department of Energy (DOE) proposal for consolidation of nuclear operations supporting production of radioisotope power systems (RPSs). It includes background information, the purpose and need for agency action, and the scope of the *Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (*Consolidation EIS*) (DOE/EIS-0373D). This chapter also explains the decisions to be supported by this EIS, and describes other National Environmental Policy Act (NEPA) documents related to the consolidation proposal, as well as the public scoping process used to obtain public input on the issues addressed in this *Consolidation EIS*.

1.1 Purpose and Need for Agency Action

The purpose and need for agency action is to consolidate RPS production at a single site to reduce the security threat in a cost-effective manner, improve program flexibility, and to reduce interstate transportation of special nuclear material (SNM)[1] and other radioactive material. The infrastructure required to produce RPSs currently exists, or is planned to exist, at three geographically separate and distant DOE sites: Oak Ridge National Laboratory (ORNL), Tennessee; Los Alamos National Laboratory (LANL), New Mexico; and Idaho National Laboratory (INL), Idaho; (formerly known as Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory-West, Idaho), (see **Figure 1–1**). After the events of September 11, 2001, DOE re-evaluated security requirements for the storage and transport of SNM. Since the nuclear material required to produce RPSs is SNM (plutonium-238), DOE has determined that consolidating plutonium-238 nuclear production operations at a single, highly-secure site would better protect these materials, eliminate the need for interstate transportation, and avoid the unnecessary costs of implementing security upgrades at multiple sites.

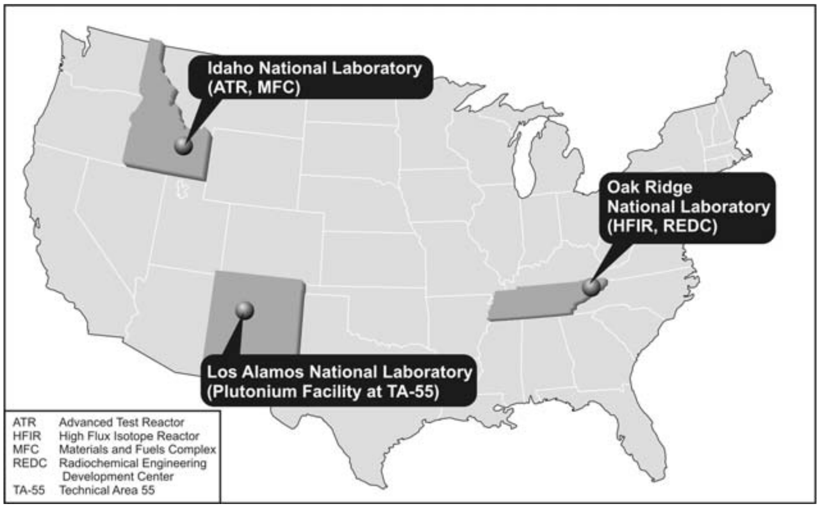

Figure 1–1 Current Locations of U.S. Department of Energy Nuclear Operations Supporting Radioisotope Power System Production

1.2 Background

DOE and its predecessor agencies have been producing RPSs for over 35 years. The RPS is a unique technology used in situations that require a long-term, unattended source of heat and/or supply of electrical power in harsh and remote environments. These systems are reliable, maintenance free, and capable of producing heat and/or electricity for decades. The unique characteristics of these systems make them especially well suited for applications where large solar arrays (panels of photoelectric cells that convert sunlight directly into

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[1] *Plutonium-238 is classified as SNM by DOE. Neptunium-237 requires the same safeguards and protection as SNM (DOE 2003a). Discussed in greater detail in Appendix E of this Consolidation EIS.*

electricity) or batteries are not practical. As a heat source, an RPS can be used to warm critical components.

RPSs provide electrical power through the conversion of heat (thermal energy) generated by the decay of plutonium-238 to electricity. These systems currently utilize plutonium-238 fuel with static electrical converter systems that use thermoelectric elements to convert the heat directly into electricity (see cross-section schematics in **Figure 1–2**).[2] The major advantages of this process are its simplicity and reliability.

Under the authority of the Atomic Energy Act of 1954, the DOE mission includes "meeting the nuclear material needs of other Federal agencies." For the past 4 decades, DOE has supplied RPSs, including plutonium-238-fueled radioisotope thermoelectric generators (RTGs) and plutonium-238-fueled light-weight radioisotope heater units, as the source of electric power and heat for National Aeronautics and Space Administration (NASA) and national security missions. These RPSs are an irreplaceable enabling technology for space exploration and national security missions. NASA used RPSs in the Apollo lunar surface scientific packages and spacecraft like the Pioneer, Viking, Voyager, Galileo, Ulysses, Cassini, and the Mars Exploration Rovers. NASA's next mission that would use RPSs is called New Horizon and would survey the planet Pluto.[3] DOE's role in these missions reflects established ongoing cooperation between DOE and NASA to ensure that RPS production capabilities are maintained and coordinated to meet NASA mission requirements. The DOE RPS production infrastructure represents the sole national capability to produce RPSs. Without these power systems, NASA missions could not explore deep space and the surfaces of neighboring planets. For this reason, NASA is participating as a cooperating agency in the preparation of this *Consolidation EIS* (40 *Code of Federal Regulations* [CFR] 1501.6).

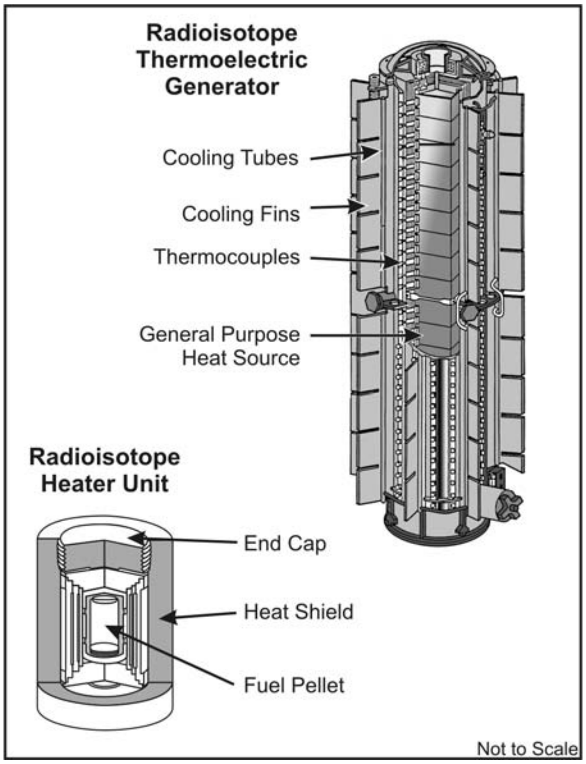

Figure 1–2 Radioisotope Power Systems: Radioisotope Thermoelectric Generator and Radioisotope Heater Unit

Along with NASA deep space satellite applications, plutonium-238, in radioisotope heater units and RTGs, is needed to support national security missions. By international agreement, no imported Russian plutonium-238 can be used for national security. Due to its classified nature, a national security application can be characterized by what it is not, as delineated below.

- It is not used in any nuclear weapons.
- It is not used in any nonnuclear weapons.

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[2] *Next-generation RPSs may use Stirling Cycle engines. The Stirling Cycle is a thermal cycle that uses heat to generate electricity mechanically with moving parts.*
[3] *NASA issued a Notice of Availability for a Draft EIS for the mission on February 25, 2005 (70 Federal Register [FR] 9387).*

- It is not used in any military satellites or in space.
- It is not used in any missile defense systems.

After the events of September 11, 2001, the national security requirements for plutonium-238 RPSs have increased.

The nuclear infrastructure required to produce an RPS comprises three major components: (1) the production of plutonium-238; (2) the purification, pelletization, and encapsulation of plutonium-238 (heat source), as plutonium dioxide, into a usable fuel form; and (3) the assembly, testing, and delivery of RPSs to Federal users. Currently, DOE RPS production operations exist or are planned to exist at three separate sites: ORNL, Tennessee; LANL, New Mexico; and INL, Idaho. Safety, security, transportation issues, and economic considerations drive the proposed consolidation of the three major operational components of this mission to one DOE site. The first infrastructure component, plutonium-238 production, must be reestablished to meet future mission needs. The other two infrastructure components are operating to meet current mission needs. The three major components of the existing infrastructure, and the current status of each, are briefly described below.

Production of Plutonium-238—The plutonium-238 production process consists of the fabrication of neptunium-237 targets, irradiation of the targets in a nuclear reactor, and recovery of plutonium-238 from the irradiated targets through chemical extraction. In the past, plutonium-238 was produced at DOE's Savannah River Site (SRS) in South Carolina, using reactors that are no longer operating. The last operating reactor was shut down in 1996. After SRS stopped producing plutonium-238, DOE made use of existing plutonium-238 inventory stored at LANL. Beginning in 1992, this inventory was augmented by plutonium-238 purchased from Russia for peaceful applications to fuel power sources that provide heat and electricity for space missions.[4] DOE analyzed the need for reestablishment of plutonium-238 production capability in the *Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* (*NI PEIS*) (DOE/EIS-0310) (DOE 2000f), issued in December 2000. Based on the analysis in the *NI PEIS*, DOE issued a Record of Decision (ROD) on January 26, 2001 (66 FR 7877), to reestablish plutonium-238 production capability at ORNL using the Radiochemical Engineering Development Center (REDC) for the fabrication of targets and extraction of plutonium-238 from the irradiated targets, and the Advanced Test Reactor (ATR), located at INL, supplemented by the High Flux Isotope Reactor (HFIR), located at ORNL, for the irradiation of targets. This decision, however, has not been implemented, and DOE has expended no resources to establish plutonium-238 production at ORNL. The events of September 11, 2001, caused DOE to reconsider plutonium-238 production at ORNL due to increased security requirements.

Neptunium-237, the material incorporated in targets and irradiated to produce plutonium-238, had been stored at SRS, where plutonium-238 was historically produced. In the *NI PEIS* ROD, DOE decided to transfer this material to ORNL, as the plutonium-238 production capability was to be established there. DOE has determined that storage of neptunium-237 requires the same security and safeguards as SNM[5] (DOE 2003a). Because REDC at ORNL cannot meet the security requirements for storage of SNM without costly security upgrades, DOE amended the *NI PEIS* ROD on August 13, 2004, to change the storage location for neptunium-237 from ORNL to Argonne National Laboratory-West (now known as the Materials and Fuels Complex [MFC]) at INL, which has the required level of security (69 FR 50180).

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[4] *DOE declared its intention to continue purchasing plutonium-238 in a May 8, 2002, Joint Announcement by DOE and the Russian Federation Ministry for Atomic Energy.*

[5] *This determination was made in DOE's Manual for Control and Accountability of Nuclear Materials, DOE M 474.1-1B, June 13, 2003.*

Neptunium-237, in the form of an oxide, is currently being shipped from SRS to INL (shipments began in December 2004 and will end in 2006) for storage until needed for the fabrication of plutonium-238 production targets.

Purification, Pelletization, and Encapsulation of Plutonium-238—Plutonium-238 is purified and fabricated into plutonium dioxide pellets (or shards), then encapsulated in a metal capsule that is welded closed at the Plutonium Facility at Technical Area 55 (TA-55) at LANL. Lower purity plutonium-238 may be purified and blended with higher purity plutonium-238 prior to pelletization. Blending has always been an integral part of the purification, pelletization, and encapsulation process to meet the DOE specifications for chemical purity. These fuel capsules are used as a heat source in the RPS. The finished plutonium-238 fuel capsules are shipped from LANL to INL for assembly of the RPSs. Small amounts of transuranic waste generated during purification would be shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico under the alternatives analyzed in this *Consolidation EIS*.

RPS Assembly and Test Operations—From the early 1980s until August 2002, assembly and testing of RPSs was conducted at DOE's Mound Site in Miamisburg, Ohio. The events of September 11, 2001 resulted in increased security requirements and concerns at the Mound Site. In response, DOE transferred these operations to INL (a highly secure DOE site) to provide enhanced security in a cost-effective manner.

The environmental impacts of the transfer from the Mound Site to INL were assessed in the *Final Environmental Assessment for the Future Location of the Heat Source/Radioisotope Power System Assembly and Test Operations Currently Located at the Mound Site (Mound EA)* (DOE/EA-1438). Based on the *Mound EA*, DOE signed a Finding of No Significant Impact (FONSI) on August 30, 2002, and the transfer of the assembly and testing capability was initiated. The first RPS assembled and tested at INL will be in support of the proposed NASA New Horizon mission to survey the planet Pluto.

The current and planned configuration of RPS production operations capability and infrastructure is as follows:

- Neptunium-237, used in preparation of targets as feed material for the production of plutonium-238, being transferred and stored at INL (Amendment to the *NI PEIS* ROD).
- Plutonium-238 production capability is planned for ORNL, where the targets would be fabricated in REDC, irradiated in ATR at INL (supplemented by HFIR at ORNL if needed), and then processed in REDC to recover plutonium-238. Extracted plutonium-238 would be transported from ORNL to LANL (*NI PEIS* ROD).
- Plutonium-238 fuel is purified, pelletized, and encapsulated in fuel capsules within the Plutonium Facility at TA-55 at LANL and then transported to INL (*Mound EA* and FONSI).
- RPS assembly and test operations to be conducted at INL (*Mound EA* and FONSI).

1.3 The Proposed Action and Scope of the Environmental Impact Statement

DOE's Proposed Action is to consolidate all nuclear operations related to RPS production at a single, highly secure site within its complex. These operations include plutonium-238 production, purification, pelletization, encapsulation, and RPS assembly and testing.

The *Consolidation EIS* evaluates the environmental impacts of two action alternatives (Consolidation and Consolidation with Bridge Alternatives) and a No Action Alternative. Under the No Action Alternative, plutonium-238 would be produced in accordance with the *NI PEIS* ROD and Amendment at existing DOE facilities. Under the Consolidation and Consolidation with Bridge Alternatives, RPS nuclear operations currently assigned to facilities at ORNL and LANL would be consolidated at INL. However, should new production of plutonium-238 be required prior to completion of the proposed new facilities at INL, DOE would utilize existing facilities on an interim basis for the production of plutonium-238, until the new facilities at INL are operational, which is the Consolidation with Bridge Alternative. The principal difference between the alternatives is the amount of radioactive material transported between DOE sites. The No Action and Consolidation with Bridge Alternatives involve interstate transportation greater than 12,900 kilometers (8,000 miles) for each shipment of neptunium-237 and plutonium-238, while consolidation of RPS nuclear production operations at INL would require no interstate transport for new plutonium-238 production. However, the Consolidation and Consolidation with Bridge Alternatives would require the one-time transportation of existing plutonium-238 from LANL and Pantex to INL.

Other consolidation alternatives were also considered, but were dismissed from detailed analysis. Chapter 2 of this EIS describes these alternatives and discusses the reasons why they were not analyzed in detail.

1.4 Decisions to Be Supported by the *Consolidation EIS*

The *Consolidation EIS* will provide DOE's decisionmaker with important environmental information for use in the overall decisionmaking process. Based on the analytical results presented in the EIS as well as cost, schedule, safeguards and security issues, and other programmatic considerations, which are not part of the EIS, DOE intends to make the following decisions concerning the consolidation of nuclear operations related to RPS production:

- Whether to consolidate nuclear operations related to RPS production at INL or continue with the ongoing and planned nuclear operations at INL, ORNL, and LANL. Consistent with the *NI PEIS* and its ROD, plutonium-238 production would be established at ORNL.

- Should the decision be made to consolidate nuclear operations related to RPS production at INL, whether to use REDC and HFIR at ORNL (covered under the No Action Alternative) on an interim basis, if plutonium-238 production becomes necessary prior to the completion of new consolidation facilities at INL.

- Whether to consolidate existing, usable, and available plutonium-238 inventory, including the milliwatt RTG heat sources at LANL and Pantex, at INL (a one-time relocation of material) and blend this material gradually into the plutonium-238 purification process.

- Should the decision be made to consolidate nuclear operations related to RPS production at INL, which route to select to construct a new road for the safe secure transfer of targets between the MFC and ATR.

However, DOE is not revisiting any decision as to the need for RPS production at this time. For the past four decades, DOE has supplied plutonium-238 fueled power systems and plutonium-238 heat sources as the source of electric power and heat for NASA and national security missions. These RPSs are an irreplaceable enabling technology for space exploration and national security missions. DOE proposes to consolidate plutonium-238 operations and reestablish plutonium-238 production capability in order to produce these power systems in a secure and efficient manner. No other radioisotope is available, qualified, or economically and technically practical to fulfill the unique requirements as a long-term, unattended source of heat and/or supply of electrical power in harsh and remote environments. RPSs provide electrical power by the conversion of heat (thermal energy) generated by the decay of plutonium-238 to electricity. The unique characteristics of these systems make them especially suited for applications where large solar arrays (panels of photoelectric cells that convert sunlight directly into electricity) or batteries are not practical.

The United States does not currently have the domestic capability to produce plutonium-238. Historically, the reactors and chemical processing facilities at SRS were used to produce plutonium-238. Downsizing of the DOE nuclear weapons complex resulted in the shutdown of the last remaining SRS operating reactor, K-Reactor, in early 1996 and a decision to phase out operations at the two chemical processing facilities (F-Canyon and H-Canyon) at SRS. Hence, DOE does not have a long-term supply of plutonium-238. Currently, plutonium-238 is being supplied by depleting the limited U.S. inventory of domestically produced plutonium-238 and by purchase of plutonium-238 from Russia. However, the plutonium-238 from Russia cannot be used for national security missions. Currently identified national security applications may consume almost all of the DOE's domestic plutonium-238 inventory by the end of the decade. The 2001 ROD for the *NI PEIS* authorized the reestablishment of the DOE's plutonium-238 production capability and the mission need was approved in February of 2004. As decided in the ROD for the *NI PEIS*, a production rate of 5 kilograms (11 pounds) per year of plutonium-238 is expected to be sufficient to meet estimated long-term requirements and will not be revisited. The *Consolidation EIS* does not analyze alternative annual production rates.

1.5 Related National Environmental Policy Act Reviews

This section explains the relationship between the *Consolidation EIS* and other relevant NEPA compliance impact analysis documents and the DOE Office of Nuclear Energy, Science and Technology[6] programs. Other NEPA actions not directly relevant to the proposed consolidation of RPS nuclear operations, but relevant to cumulative impacts at INL, are identified and discussed in the analysis of cumulative impacts at INL, in Chapter 4 of this EIS.

1.5.1 *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement* (DOE/EIS-0287)

The *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement* (DOE 2002e) was issued in September 2002. It evaluated alternatives for managing the high-level radioactive waste and associated radioactive waste and facilities at INL. Under the terms of the 1995 Settlement Agreement and Consent Order with the state of Idaho, DOE agreed to treat high-level radioactive waste currently stored at INL and to prepare the waste in a form ready to be shipped out of Idaho by 2035. The purpose of this EIS is to assist DOE in making decisions concerning the management of this radioactive waste to ensure compliance with applicable laws and regulations and to protect the environment and health and safety of workers and the public in a cost-effective manner.

In this EIS, DOE evaluated reasonable alternatives and options for treatment of high-level radioactive waste, sodium-bearing, and newly generated waste and for disposition of facilities associated with high-level radioactive waste generation, treatment, and storage at INL. In addition, this EIS is integrated with the ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Program at the Idaho Nuclear Technology and Engineering Center. The Proposed Action under this EIS would contribute to the cumulative impacts at INL discussed in this *Consolidation EIS*. DOE has not issued a ROD from this EIS.

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[6] *The DOE Office of Nuclear Energy, Science and Technology is responsible for RPS production.*

1.5.2 *Finding of No Significant Impact and Final Environmental Assessment for the Future Location of the Heat Source/Radioisotope Power System Assembly and Test Operations Currently Located at the Mound Site* (DOE/EA-1438)

The *Finding of No Significant Impact and Final Environmental Assessment for the Future Location of the Heat Source/Radioisotope Power System Assembly and Test Operations Currently Located at the Mound Site* (DOE 2002c) were completed in August 2002. DOE has assembled and tested heat sources and RPSs, which included RTGs, at the Mound Site in Miamisburg, Ohio, for the past 35 years. After the events of September 11, 2001, a DOE-wide review of security identified the need for enhanced security measures at the Mound Site to safeguard the materials associated with DOE's heat source/RPS assembly and test operations. DOE analyzed a range of options to provide for the extra safeguards and security measures. These included either upgrading the safeguards and security infrastructure at the Mound Site to enable the program to remain at that location, or transferring the operations to a more secure building at the Mound Site itself. In addition, DOE considered two alternative locations, the Pantex Plant in Texas and the Argonne National Laboratory-West (now called MFC) at INL in Idaho, both of which have enhanced security and safeguards measures in place because of other ongoing programs. DOE prepared this environmental assessment to consider the potential environmental impacts associated with actions that might be taken with regard to the future location of heat source/RPS operations. Based on the analysis in the environmental assessment, DOE determined that the Proposed Action, the relocation of the heat source/RPS, would not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of NEPA. The No Action Alternative assessed in this *Consolidation EIS* is consistent with the Proposed Action analyzed in this environmental assessment.

1.5.3 *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* (DOE/EIS-0310)

The *Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS)* (DOE 2000f) was issued in December 2000. Under authority of the Atomic Energy Act of 1954, as amended, DOE is responsible for ensuring the availability of isotopes for medical, industrial, and research applications; meeting the nuclear material needs of other Federal agencies; and undertaking research and development activities related to development of nuclear power for civilian use. To meet these responsibilities, DOE maintains nuclear infrastructure capabilities that support various missions. Estimates of the future needs for medical and industrial isotopes, plutonium-238, and research requirements indicated that the current infrastructure would be insufficient to meet the projected demands. In the *NI PEIS*, DOE proposed to enhance these capabilities to provide for: (1) production of isotopes for medical and industrial uses, (2) production of plutonium-238 for use in advanced RPSs for future NASA space exploration missions, and (3) the nation's nuclear research and development needs for civilian application.

The *NI PEIS* evaluated the environmental impacts of a No Action Alternative (maintaining status quo), four alternative strategies to accomplish isotope production, and an alternative to permanently deactivate the Fast Flux Test Facility (FFTF) (located at the Hanford Site near Richland, Washington) with no new missions. Alternatives 2, 3, 4, and 5 also included permanent deactivation of FFTF. The alternatives considered were the No Action Alternative, (1) Restart FFTF at Hanford, Washington, (2) Use Only Existing Operational Facilities, (3) Construct One or Two New Accelerators, (4) Construct a New Research Reactor, and (5) Permanently Deactivate FFTF (with no new missions).

In the ROD, which was published in the *Federal Register* on January 26, 2001 (66 FR 7877), DOE selected the Preferred Alternative (Alternative 2, Option 7, Use Only Existing Operational Facilities).

DOE decided to reestablish domestic production of plutonium-238, as needed, using the ATR at INL and the HFIR at ORNL. DOE also decided to transport neptunium-237 (in oxide form) from SRS to the REDC at ORNL in Tennessee, which would also fabricate and process irradiated plutonium-238 targets. In the ROD, DOE also decided to permanently deactivate FFTF.

In an amended ROD, published in the *Federal Register* on August 13, 2004 (69 FR 50180), DOE decided to amend its decision on the storage location for neptunium-237 oxide from ORNL to Argonne National Laboratory-West (now the MFC) at INL. The impacts of this and other actions presented in the *NI PEIS* are factored into the assessment of impacts in this *Consolidation EIS*. The No Action Alternative assessed in this *Consolidation EIS* is consistent with the *NI PEIS* ROD and Amendment.

1.5.4 *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE/EIS-0306)

In July 2000, DOE issued the *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000c). This document evaluated strategies to remove or stabilize the reactive sodium contained in a portion of DOE's spent nuclear fuel inventory to prepare the spent nuclear fuel for disposal in a geologic repository. Under the Proposed Action, the EIS analyzed six alternatives that employ one or more of the following technology options at nuclear fuel management facilities at SRS or INL: electrometallurgical treatment, the plutonium-uranium extraction process, packaging in high-integrity cans, and the melt and dilute treatment process. In the ROD published in the *Federal Register* on September 19, 2000 (65 FR 56565), DOE decided to implement the Preferred Alternative of electrometallurgically treating the Experimental Breeder Reactor-II spent nuclear fuel and miscellaneous small lots of sodium-bonded spent nuclear fuel at Argonne National Laboratory-West (now the MFC at INL). Because of the different physical characteristics of the Fermi-1 sodium-bonded blanket spent nuclear fuel also analyzed in the EIS, DOE decided to continue to store this material while alternative treatments are evaluated. The Proposed Action under this EIS contributed to the cumulative impacts at the site discussed in this *Consolidation EIS*.

1.5.5 *Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* (DOE/EIS-0290)

The *Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* (DOE 1999b) was issued in January 1999 and assessed the potential environmental impacts associated with four alternatives related to the construction and operation of the Advanced Mixed Waste Treatment Facility at INL. The alternatives analyzed were: (1) a No Action Alternative, under which existing waste management operations, facilities, and projects would continue; (2) the Proposed Action/Preferred Alternative, under which BNFL, Inc., would build and operate an Advanced Mixed Waste Treatment Project Facility using proposed thermal and nonthermal treatment technologies for certification and shipment to WIPP in New Mexico or to another acceptable disposal facility; (3) a nonthermal treatment alternative, under which some treatment of transuranic, alpha, and mixed low-level radioactive waste would occur at an advanced mixed waste treatment project facility at the same location as the Proposed Action, and waste requiring thermal treatment would be repackaged for storage; and (4) a treatment and storage alternative that would include the same processes as the Proposed Action/Preferred Alternative, except the treated waste would be placed in permitted storage units at the onsite Radioactive Waste Management Complex at INL for long-term storage. The ROD was published in the *Federal Register* on April 7, 1999 (64 FR 16948). The impacts of the action DOE decided to implement are factored into the assessment of potential cumulative impacts at INL discussed in the *Consolidation EIS*.

1.5.6 *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EIS-0238)

In January 1999, DOE issued the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico (LANL SWEIS)* (DOE 1999a). The *LANL SWEIS* assessed four alternatives for the operation of LANL: (1) No Action, (2) Expanded Operations, (3) Reduced Operations, and (4) a Greener Alternative. The ROD for the *LANL SWEIS* was published in the Federal Register on September 20, 1999 (64 FR 50797). In the ROD, DOE selected the Expanded Operations Alternative with a lower level of certain weapons-related work. The Expanded Operations Alternative described in the *LANL SWEIS* analyzed the impacts from the continuation of all present activities at LANL, at the highest level of activity.

In mid-2004, the National Nuclear Security Administration (NNSA) undertook the preparation of a Supplement Analysis of the *LANL SWEIS* pursuant to DOE's regulatory requirement to evaluate site-wide NEPA documents at least every 5 years (10 CFR 1021.330) and determine whether the existing EIS remains adequate, to prepare a new Site-wide EIS (SWEIS), or to prepare a supplement to the existing SWEIS. On January 5, 2005, NNSA announced its intent to proceed immediately with the preparation of a supplemental SWEIS to update the analyses presented in the 1999 *LANL SWEIS* (70 FR 807) and the process for participation in public scoping of the document's impact analysis. After carefully considering scoping comments, NNSA determined that it would be necessary to prepare a new SWEIS to provide appropriate NEPA compliance for the possibility of enhancement of LANL's stockpile stewardship interim pit production capability. The No Action Alternative for the new SWEIS is the continued implementation of the 1999 SWEIS ROD, together with other actions described and analyzed in subsequent NEPA reviews. The new SWEIS will analyze an expanded operations alternative that includes the enhancement of pit production capability, as well as a reduced operations alternative.

The No Action Alternative assessed in the *Consolidation EIS* is consistent with the Expanded Operations Alternative identified in the 1999 *LANL SWEIS* and its associated ROD. The effects of the Expanded Operations Alternative level of activity at LANL are discussed in Chapter 4, "Environmental Consequences," of the 1999 *LANL SWEIS*, and have been included in the description of the Affected Environment at LANL.

1.5.7 *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Wastes* (DOE/EIS-0200)

In May 1997, DOE issued the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Wastes* (DOE 1997b). This programmatic environmental impact statement (PEIS) examined the potential environmental and cost impacts of strategic management alternatives for managing five types of radioactive and hazardous wastes resulting from nuclear defense and research activities at sites around the United States. The five waste types are mixed low-level radioactive waste, low-level radioactive waste, transuranic waste, high-level radioactive waste, and hazardous waste. This PEIS provided information on the impacts of various siting alternatives to assist DOE in deciding at which sites to locate additional treatment, storage, and disposal capacity for each waste type. This information included the cumulative impacts of combining future siting configurations for the five waste types and the collective impacts of other past, present, and reasonably foreseeable future capabilities.

The selective waste management facilities considered for the five waste types were treatment and disposal facilities for mixed low-level radioactive waste, treatment and disposal facilities for low-level radioactive waste, treatment and storage facilities for transuranic waste (in the event that treatment is required before disposal), storage facilities for canisters of treated (vitrified) high-level radioactive waste, and treatment of nonwastewater hazardous waste by DOE and commercial vendors. In addition to the No Action Alternative, which included only existing or approved waste management facilities, the alternatives for each of the five waste type configurations included decentralized, regionalized, and centralized alternatives for using existing and operating new waste management facilities. However, the siting, construction, and operation of any new facility at a selected site would not be decided until completion of a site-wide or project-specific environmental review.

DOE published four decisions from this PEIS. In its "ROD for the Treatment and Management of Transuranic Waste," published in the *Federal Register* (63 FR 3629) and subsequent revisions to this ROD (65 FR 82985, 66 FR 38646, and 67 FR 56989), DOE decided (with one exception) that each DOE site that currently has or will generate transuranic waste would prepare its transuranic waste for disposal and store the waste onsite until it could be shipped to WIPP near Carlsbad, New Mexico, for disposal.

In the second ROD (63 FR 41810), DOE decided to continue using offsite facilities for treatment of major portions of the nonwastewater hazardous waste generated at DOE sites. This decision did not involve any transfer of nonwastewater hazardous waste among DOE sites.

In the third ROD, published on August 26, 1999 (64 FR 46661), DOE decided to store immobilized high-level radioactive waste in a final form at the site of generation (Hanford Site, INL, SRS, and the West Valley Demonstration Project, in New York) until transfer to a geologic repository for ultimate disposal.

DOE addressed the management and disposal of low-level radioactive waste and mixed low-level radioactive waste in a fourth ROD, published on February 25, 2000 (65 FR 10061). In this ROD, DOE decided to perform minimal treatment of low-level radioactive waste at all sites and continue, to the extent practicable, disposal of onsite low-level radioactive waste at INL, LANL, the Oak Ridge Reservation, and SRS. DOE decided to treat mixed low-level radioactive waste at the Hanford Site, INL, the Oak Ridge Reservation, and SRS, with disposal at the Hanford Site and the Nevada Test Site.

Radioactive and hazardous wastes generated by current and future nuclear operations related to production of RPSs would continue to be managed in accordance with these and amended RODs.

1.6 Public Participation and Scoping

During the NEPA process, there are opportunities for public involvement (see **Figure 1–3**). As a preliminary step in development of an EIS, regulations established by the Council on Environmental Quality (CEQ) (40 CFR 1501.7) and DOE require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a Proposed Action." The purpose of this scoping process is to inform the public about a Proposed Action and the alternatives being considered and to identify and clarify issues that are relevant to the EIS by soliciting public comments. This process is initiated by publication of the Notice of Intent (NOI) in the *Federal Register*. As part of the scoping process (40 CFR 1501.7[a]), CEQ requires the agency preparing an EIS to:

- Invite the participation of affected Federal, state, and local agencies, American Indian tribes, and other interested persons;
- Determine the scope and significant issues to be analyzed in the EIS;
- Identify and eliminate from detailed study the issues that are not significant or have been covered under other environmental reviews;
- Allocate assignments for EIS preparation among lead and cooperating agencies;

- Indicate any other NEPA documents that are being or will be prepared that are related to the EIS but not part of the scope;
- Identify other environmental review and consultation requirements so that other necessary analyses and studies can be prepared concurrently and integrated with the EIS; and
- Indicate the relationship between the timing of the preparation of environmental analyses and the agency's tentative planning and decisionmaking schedule.

On November 16, 2004, DOE published an NOI in the *Federal Register* (69 FR 67139) to prepare the *Consolidation EIS*. In this NOI, DOE invited public comment on the proposed scope of the *Consolidation EIS*. The NOI listed the issues initially identified by DOE for evaluation in the EIS. Public citizens, civic leaders, American Indian tribal representatives, and other interested parties were invited to comment on these issues and to suggest additional issues that should be considered in the EIS. The NOI informed the public that comments on the scope of issues to be addressed and for identifying the significant issues related to the Proposed Action could be communicated via the U.S. mail, a special DOE Website on the Internet, a toll-free phone line, a toll-free fax line, and in person at public meetings (40 CFR 1501.7).

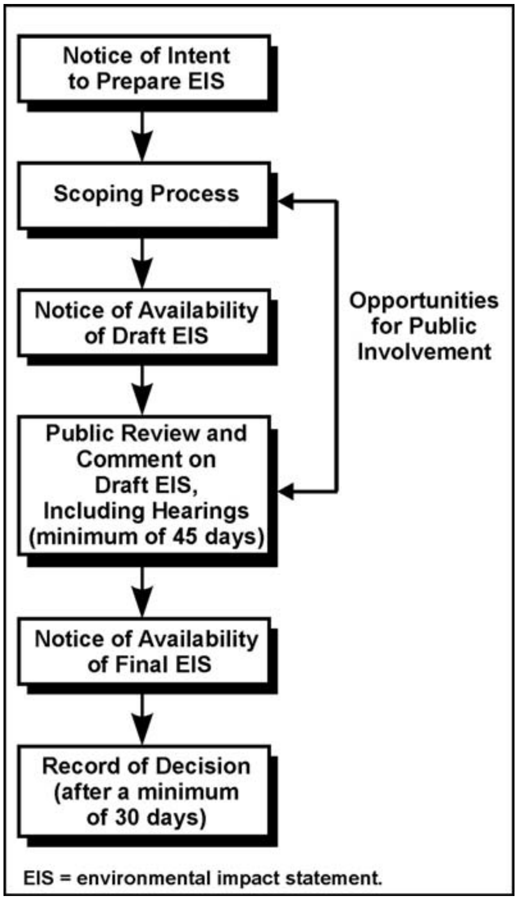

Figure 1–3 National Environmental Policy Act Process for the *Consolidation EIS*

During the public scoping period from November 16, 2004 to January 31, 2005, DOE conducted seven public scoping meetings. A total of approximately 120 attendees were present at these meetings. The locations and dates of these public meetings were as follows:

- December 6, 2004, in Idaho Falls, Idaho
- December 7, 2004, in Jackson, Wyoming
- December 8, 2004, in Fort Hall, Idaho
- December 9, 2004, in Twin Falls, Idaho
- December 13, 2004, in Los Alamos, New Mexico
- December 15, 2004, in Oak Ridge, Tennessee
- December 17, 2004, in Washington, DC

As a result of previous experience and positive responses from attendees of other DOE NEPA public meetings and hearings, DOE chose an interactive format for the scoping meetings. Each meeting began with a presentation by DOE representatives who explained the proposed RPS consolidation and the NEPA process. Afterward, the floor was opened to questions, comments, and concerns from the audience. DOE representatives were available to respond to questions and comments. The proceedings and formal comments presented at each meeting were recorded verbatim, and a transcript of each meeting was produced. The public was also encouraged to submit written or oral comments during the meetings or to submit comments via letters, the DOE *Consolidation EIS* Website (http://consolidationeis.doe.gov/), toll-free phone line, and toll-free fax line until the end of the scoping period. DOE reviewed all comments received during the public scoping period for consideration in preparing the Draft *Consolidation EIS*.

Summary of Major Scoping Comments and U.S. Department of Energy Responses

Many comments were received from individuals, interest groups, agencies, American Indian tribal representatives, and local officials during the public scoping period. A number of comments asked DOE to consider using the FFTF, a nuclear reactor in Hanford, Washington, for the production of plutonium-238. Commentors expressed their belief that circumstances had changed since the publication of the *NI PEIS*.

Many commentors expressed concern regarding the introduction of plutonium operations at INL. They considered plutonium to be dangerous and the Proposed Action as a precursor to the introduction of nuclear weapons to INL. The attractiveness of plutonium to terrorists was also expressed as a negative factor regarding the consolidation of RPS nuclear production at INL. Several commentors stated concern for worker safety in handling plutonium and questioned the effectiveness of filtration systems in new facilities to prevent or minimize plutonium releases to the environment.

Numerous comments were received expressing opposition to the use of plutonium-238 in RTGs and in deep space missions. NASA's safety record, especially in light of the Challenger accident, was cited as a reason that plutonium should not be used in space. General opposition to the production, use, handling, and management of plutonium was frequently discussed in comments.

Specific environmental impact concerns expressed by commentors included the use of water resources, air pollution, and impacts on American Indian sacred lands. The generation, handling, management, and ultimate disposition of radioactive waste was an issue of concern for some commentors.

The following major issues identified during the scoping process are addressed in this *Consolidation EIS*:

- Consolidation alternatives at other DOE sites,
- National security and the transportation and storage of plutonium-238,
- Plutonium-238 from Russia,
- Waste management and pollution prevention,
- Emergency response capability, training, and planning for plutonium-238 transportation within the United States,
- Plutonium-238 transportation/shipping container design safety,
- Use of plutonium-238 in nuclear weapons, "dirty bombs," and its attractiveness to terrorists,
- American Indian cultural resources,

- Continuity between the *NI PEIS* and this *Consolidation EIS* to avoid segmentation,
- Cost of each alternative, and
- Displacement of isotope production by plutonium-238 production.

Specifically, as a result of commentors asking DOE to consider additional consolidation alternatives, a new alternative, the Consolidation with Bridge Alternative, has been added to the alternatives identified in the NOI. In addition, detailed discussions have been provided for alternatives considered and dismissed, especially for the use of FFTF in the production of plutonium-238. Chapter 2 of this EIS also provides information in response to scoping comments concerning additional RPS consolidation alternatives at other DOE sites and the need for plutonium-238 from Russia. Waste management, emergency response capability, training, and planning for plutonium-238 transportation within the United States, and American Indian cultural resources are discussed in detail in Chapter 3 of this EIS. Appendix D of this EIS addresses plutonium-238 transportation/shipping container design safety and security concerns regarding transportation and storage of plutonium-238. Concerns regarding the use of plutonium-238 use in nuclear weapons, "dirty bombs," and its attractiveness to terrorists resulted in the development of an appendix, Appendix E, to address these concerns. Continuity between the *NI PEIS* and this *Consolidation EIS* to avoid NEPA segmentation is addressed in Chapter 2 of this EIS. The estimated cost of each alternative has been included in the description of alternatives.

1.7 Organization of this Environmental Impact Statement

This EIS is presented in one volume with a Summary available separately. This EIS contains the main analyses and supporting technical appendices, along with additional project and public participation information. It contains 10 chapters that include the following information:

Chapter 1 – Introduction and Purpose and Need for Agency Action

> Chapter 1 describes the RPS program; purpose and need for agency action; Proposed Action, EIS scope, and alternatives; relationship of the *Consolidation EIS* to other DOE NEPA actions and programs; and issues identified during the scoping process.

Chapter 2 – Project Description and Alternatives

> Chapter 2 provides a description of the mission and project; description of the alternatives and facilities; summary comparison of potential environmental impacts of the EIS alternatives; and the Preferred Alternative.

Chapter 3 – Affected Environment

> Chapter 3 describes the aspects of the environment that could be affected by the EIS alternatives.

Chapter 4 – Environmental Consequences

> Chapter 4 provides a discussion of the potential environmental impacts of the EIS alternatives, as well as the projected environmental impacts from no action.

Chapter 5 – Applicable Laws, Regulations, and Other Requirements

> Chapter 5 describes the environmental, safety, and health laws, regulations, and standards applicable to the Proposed Action. The requirements and status of the consultation process are also provided in this chapter.

Chapters 6 – 10

> Chapters 6 through 10 contain a list of references; a glossary; an index; a list of preparers; and a distribution list of agencies, organizations, and persons to whom copies of the *Consolidation EIS* were sent.

The EIS contains eight appendices, which provide technical information in support of the environmental analyses presented in the chapters. The appendices contain the following information: overview of the public participation process, environmental impact methodologies, human health effects of normal operations and facility accidents, human health effects of overland transportation, relationship to nuclear weapons and the DOE NNSA nuclear weapons complex, preliminary floodplain assessment, *Federal Register* notices, and a contractor disclosure statement.

CHAPTER 2
PROJECT DESCRIPTION AND ALTERNATIVES

2.0 PROJECT DESCRIPTION AND ALTERNATIVES

This chapter provides a description of the radioisotope power system (RPS) production process and existing infrastructure that supports it. It defines the alternatives evaluated in this environmental impact statement (EIS), as well as alternatives that were considered but dismissed from detailed evaluation. It provides descriptions of the existing and planned facilities under the No Action Alternative, the Consolidation Alternative, and the Consolidation with Bridge Alternative, and concludes with a comparison of environmental consequences of each alternative.

2.1 Nuclear Operations Related to Production of Radioisotope Power Systems

In the past, the power source of RPSs, plutonium-238, was produced at the U.S. Department of Energy (DOE) Savannah River Site (SRS) in South Carolina, using reactors that are no longer operating. After SRS stopped producing plutonium-238 (the last operating reactor was shut down in 1996), DOE satisfied its plutonium-238 requirement by using DOE's inventory in storage at the Los Alamos National Laboratory (LANL) in New Mexico. The inventory was augmented by plutonium-238 purchased from Russia for use in space missions beginning in 1992. DOE analyzed the need for reestablishment of plutonium-238 production capability in the *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS)* (DOE 2000f), issued in December 2000. On the basis of the analysis in the *NI PEIS*, DOE issued a Record of Decision (ROD) on January 26, 2001 (66 *Federal Register* [FR] 7877), to reestablish plutonium-238 production capability at the Oak Ridge National Laboratory (ORNL) in Tennessee using the Radiochemical Engineering Development Center (REDC) for the fabrication of neptunium-237 targets and extraction of plutonium-238 from the irradiated targets. The ROD also specified that the Advanced Test Reactor (ATR), located at the Idaho National Engineering and Environmental Laboratory (now referred to as the "Idaho National Laboratory" [INL]), supplemented by the High Flux Isotope Reactor (HFIR), located at ORNL, would be used for the irradiation of targets.

The nuclear infrastructure required to produce an RPS comprises the following components: (1) storage of the target material, neptunium-237, (2) target fabrication, (3) target irradiation, (4) post-irradiation extraction of plutonium-238 from the irradiated targets, (5) purification, pelletization, and encapsulation of the plutonium-238 dioxide into a usable fuel form, and (6) assembly and testing of the RPS. Production of an RPS includes transportation of materials between the locations where the operations take place. Available plutonium-238 in storage could also be used after its purification and pelletization into fuel form. The nuclear infrastructure components required to produce an RPS are shown in **Figure 2–1**. Transportation of the finished product to the end users was analyzed in the *Final Environmental Assessment for the Future Location of the Heat Source/ Radioisotope Power System Assembly and Test Operations Currently Located at the Mound Site* (DOE/EA-1438) (*Mound EA*) (DOE 2002c), that evaluated transfer of the assembly and testing capability from the Mound Site, in Ohio to the Space and Security Power Systems Facility, hereafter referred to as the "Assembly and Testing Facility," at the INL Materials and Fuels Complex (MFC) (formerly known as Argonne National Laboratory-West).

Storage of Target Material—The feed material for fabrication of targets for plutonium-238 production has been neptunium-237. Neptunium-237 has been stored at SRS, where plutonium-238 was historically produced. In the *NI PEIS* ROD, DOE decided to transfer this material to ORNL, as the plutonium-238 capability was previously planned to be reestablished there. DOE has determined that neptunium-237 should be managed with the same level of security as special nuclear materials (SNM) (DOE 2003a). Therefore, DOE amended the *NI PEIS* ROD on August 13, 2004, to change the storage location for neptunium-237 from ORNL

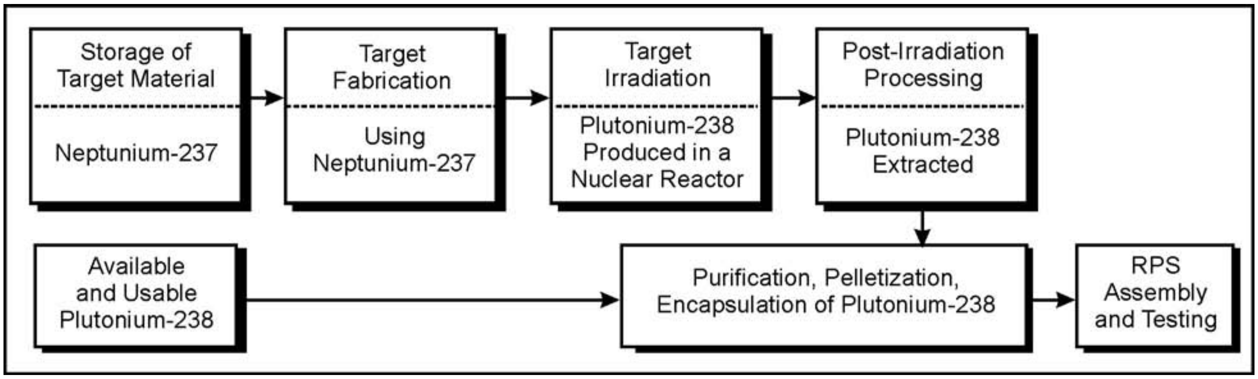

Figure 2–1 Nuclear Infrastructure to Produce Radioisotope Power Systems

to INL (69 FR 50180). Neptunium-237, in the form of an oxide, is being shipped from SRS to INL (beginning in December 2004 and ending in 2006) for storage in the Fuel Manufacturing Facility (FMF) at MFC until needed for the fabrication of plutonium-238 production targets.

Target Fabrication—To manufacture targets for the production of plutonium-238, neptunium-237 oxide is dissolved in an acid solution prior to removal of protactinium-233, a decay daughter of neptunium-237. Protactinium-233 reaches 90 percent of its equilibrium activity approximately 90 days after purification, and contributes significantly to radiation doses in the target fabrication line. The best approach for removal of the protactinium-233, and possibly the easiest to implement, is to pass the neptunium solution through a column containing silica gel adsorbent. After protactinium-233 removal, the purified neptunium solution is transferred to a target-fabrication glovebox line, and reconversion of the neptunium to the oxide form is initiated. The desired form of the oxide (microspheres) is obtained by loading the neptunium on a cation-exchange resin of the selected particle-size range, washing the loaded resin, and using heated air to oxidize the resin and form the neptunium dioxide microspheres.

Current target designs for ATR and HFIR consist of neptunium dioxide blended with aluminum powder, pressed into a target core, and clad with aluminum. This type of target has been used in nearly all DOE production and research reactors to produce isotopes in general and plutonium-238 specifically.

Neptunium-237 Targets

Plutonium-238 production requires fabrication and irradiation of neptunium-237 targets, which are typically made of purified, concentrated neptunium-237 dioxide with an aluminum binder, canned or clad in aluminum. Production of plutonium-238 requires:

- Production of neptunium-237 dioxide from solution followed by target fabrication,
- Target irradiation to produce plutonium-238 via neutron capture and beta decay,
- Solvent extraction and ion-exchange processing to separate and purify plutonium-238, and
- Repeat cycle to produce more plutonium-238.

Each cycle reduces the inventory of isotope available for plutonium-238 production, as the isotope is converted to plutonium-238 in the process. During the production cycle, neptunium-237 is in different solid (e.g., oxide powders and pressed solid matrices) and liquid forms (e.g., nitrate solutions).

Table 2–1 provides current DOE inventory distribution and program requirements for neptunium-237 and plutonium-238.

In the *NI PEIS* ROD, DOE decided to use REDC at ORNL for target fabrication.

Target Irradiation —Irradiation of neptunium-237 targets in neutron flux produces plutonium-238 according to the following equations:

$$_{93}\mathrm{Np}^{237} + {}_{0}\mathrm{n}^{1} \rightarrow {}_{93}\mathrm{Np}^{238}$$

$$_{93}\mathrm{Np}^{238} \rightarrow {}_{-1}\beta^{0} + {}_{94}\mathrm{Pu}^{238}$$

The neptunium-237 target nuclide absorbs a neutron to become neptunium-238 (first equation), which in turn decays with a half-life of 2.1 days and emits a beta particle (or electron) to form plutonium-238 (second equation).

Irradiation of the neptunium-237 targets generates fission products in the targets. The irradiated targets are cooled for 120 to 160 days to allow time for the decay of short-lived fission products (e.g., iodine-131). Following the cooldown period, the irradiated targets are loaded into a shielded cask for transport to the chemical extraction facility. They are then ready for chemical extraction to separate the plutonium-238 content and unconverted target isotopes from radioactive waste products, mainly transuranic and low-level radioactive waste.

Post-irradiation Processing—Processing of the irradiated targets is conducted inside heavily shielded hot cells to protect workers from high radiation doses. Hot cells are specially designed shielded vaults or areas used for the remote handling and manipulation of some radioactive materials. Certain chemical extraction steps are required to recover the plutonium-238 as product and to recover the target isotopes for recycle. This process is accomplished in two steps:

- Caustic-nitrate solution is used to dissolve the cladding, thereby separating the bulk of the aluminum and caustic-soluble fission products from the actinide products, including the neptunium and plutonium.

- Next, acid is used to dissolve the actinide products and remaining fission products to prepare the feed for the mainline separation process. The feed is then filtered prior to pH (acidity/alkalinity) adjustment to remove any solids that could complicate the solvent extraction process.

Subsequent to target dissolution, a tributyl-phosphate-based solvent extraction process is used for three cycles of purification. The first cycle decontaminates the neptunium and plutonium products removing fission product wastes, the second-cycle solvent extraction process separates the neptunium from the plutonium, and the third-cycle process removes trace plutonium from the neptunium product. The plutonium product undergoes further purification using anion exchange if the product does not meet specification.

Chemical conversion of the plutonium to an oxide starts with its precipitation from solution as an oxalate. The precipitate is filtered and calcined (heated in an oven at a high temperature) to an oxide product.

Plutonium-238

Plutonium-238 is SNM because it is a fissile isotope of plutonium. However, isotopically concentrated plutonium-238 (above 80 percent) does not constitute a nuclear proliferation threat because it cannot be used in a nuclear weapon Physics Package. This material is rigorously protected against loss, theft, and sabotage (through physical protection and accounting) and is strictly contained (to prevent accidental release) as a result of the health and safety risks presented by the material. Under DOE safeguards, plutonium-238 is reportable in 0.1-gram (0.004-ounce) quantities.

Production of plutonium-238 requires production of purified neptunium-237 dioxide from neptunium-237 solution, followed by target fabrication; irradiation to build in plutonium-238 via neutron capture and beta decay; solvent extraction and ion exchange processing to separate and purify neptunium-237 and plutonium-238 from fission and other waste products; and a repeat of the cycle to produce further plutonium-238. During the production cycle, plutonium-238 is in different solid (e.g., oxide powders and pressed solid matrices) and liquid forms (e.g., nitrate solutions). During the process of building plutonium-238 into neptunium-237 targets, a small amount of plutonium-239 is also produced by some neutron captures in plutonium-238. Because the desired product is relatively pure plutonium-238, the secondary production of plutonium-239 is intentionally limited. This limits the production of plutonium-238 to about 10 to 15 percent of the neptunium-237 content of the fresh target.

Table 2–1 provides current DOE inventory and program requirements for plutonium-238 and neptunium-237.

The purified neptunium nitrate from the third-cycle solvent extraction process is stored as a solution. A small quantity of neptunium oxide (6 to 8 kilograms [13 to 17 pounds]) is removed from storage, dissolved, and purified to replace the neptunium-237 that was converted to plutonium-238. This material is added to the neptunium solution recovered during post-irradiation target processing, loaded onto a cation-exchange resin, and then calcined to produce oxide microspheres for reuse in target assemblies for irradiation. Waste-handling equipment is used to minimize the activity in low-level radioactive liquid waste and to stabilize solid wastes into an acceptable waste form.

In the *NI PEIS* ROD, DOE decided to use REDC at ORNL for the extraction of plutonium-238 from the irradiated targets.

Purification, Pelletization, and Encapsulation—The purification of plutonium-238 is a multistep aqueous process in which non-actinide impurities in the plutonium are chemically removed. This process does not remove any isotopes of plutonium that may be present, but does remove a high percentage of all other elements present. The end product of purification is plutonium dioxide, that meets DOE specifications.

The plutonium-238 oxide powder is ground in a ball mill (a device used to produce a desired range of particle sizes) to reduce the differences in surface activity among feedstock lots, cold compressed and granulated to produce properly sized granules for the hot-pressing operation, and then sintered and hot pressed into pellet form. Lower purity plutonium-238 may be purified and blended with higher purity plutonium-238 prior to pelletization. Blending has always been an integral part of the purification, pelletization, and encapsulation process to meet the DOE specifications for chemical purity.

Encapsulation is the process by which purified plutonium-238 oxide, in the form of high-density sintered (ceramic) cylindrical pellets, is placed and sealed inside a vented cladding shell composed of iridium metal. Iridium is used because it has a very high melting point (2,466 degrees Celsius, or 4,471 degrees Fahrenheit), and is a very strong metal. Iridium is also the most corrosion resistant of all elements.

The purification, pelletization, and encapsulation work is currently conducted in the Plutonium Facility within Technical Area 55 (TA-55) at LANL.

RPS Assembly and Testing—A plutonium-238 heat source consists of plutonium-238 dioxide, pressed into pellets,[1] encapsulated in iridium, and assembled with graphite components. An RPS uses thermoelectric components to convert the heat from the heat sources to electricity[2]. Together, the heat source and the RPS form a heat source/RPS assembly. Thermoelectric converters with electric heat source are purchased commercially; and, in assembling the heat source/RPS, the electric heater that simulates the heat source is removed and the plutonium-238 heat source is inserted using special tools and fixtures. The heat source/RPSs are assembled in gloveboxes. The process takes place in a large inert-atmosphere chamber. Each heat source/RPS unit is put through a series of acceptance and characterization tests. Environmental testing of the units includes dynamic (vibration and shock) tests in both the horizontal and vertical positions and thermal vacuum testing. Other acceptance tests performed on these units include radiation survey, magnetic mapping, and mass-properties determination. The tests require sophisticated instrumentation and unique fixtures. Acceptance and characterization testing is complicated by the high thermal output and radiation fields generated by an RPS. The test cells in which these tests are performed are shielded; most of the tests are remotely controlled.

From the early 1980s until August 2002, DOE conducted its assembly and test operations for the RPS at the Mound Site in Miamisburg, Ohio. The events of September 11, 2001 resulted in increased security requirements and concerns at the Mound Site. In response, DOE transferred these operations to INL (a highly secure DOE site) to provide enhanced security in a cost-effective manner. The environmental impacts of the transfer from the Mound Site to INL were assessed in the *Mound EA* (DOE 2002c). DOE signed a Finding of No Significant Impact (FONSI) on August 30, 2002, and the transfer of the assembly and testing capability

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[1] *National Aeronautics and Space Administration (NASA) RPS production uses plutonium-238 pellets, but national security applications may use plutonium-238 shards.*

[2] *Next-generation RPSs may use Stirling Cycle engines. The Stirling Cycle is a thermal cycle that uses heat to generate electricity mechanically with moving parts.*

from the Mound Site to the Assembly and Testing Facility at MFC at INL was initiated. The Assembly and Testing Facility has been commissioned and is now operational.

Inventory of Available and Usable Plutonium-238—DOE will utilize existing available and usable plutonium-238 inventory to meet Federal agency requirements for RPSs in space and national security applications. "Available" inventory means it is not being used for other applications and is readily accessible by DOE during the time period assumed in this EIS for each alternative. "Usable" plutonium-238 means that it has a form and purity level that allows it to be used by DOE. In most cases, RPSs require a minimum of 80 percent plutonium-238 (80 percent of the total plutonium present is plutonium-238). When produced from neptunium-237 by irradiation in a nuclear reactor, plutonium-238 purity is above 80 percent. If the plutonium-238 is below 80-percent pure, it can be blended with higher purity plutonium-238 to reach the desired 80 percent. Blending is limited by the amount of available higher-purity plutonium-238. For example, 60 percent pure plutonium-238 can be blended to 80 percent, whereas 20 percent plutonium-238 would require more higher purity plutonium-238 than would be available to reach the purity specification. Blending has always been an integral part of the purification, pelletization, and encapsulation process to meet the DOE specifications for chemical purity.

Table 2–1 presents the current locations and quantities of available and usable plutonium-238 and neptunium-237 inventory and program requirements. This inventory includes plutonium-238 purchased from Russia. It is important to note that the Russian plutonium-238 is only available for NASA space missions. The plutonium-238 inventory considered in the *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)* is located at four DOE sites: INL, LANL, ORNL, and the Pantex Plant (Pantex), in Texas. The INL inventory is in existing heat sources. The small inventory at ORNL comes from experimental tests with neptunium-237 targets that were irradiated in the ATR at INL. The LANL inventory includes the remaining plutonium-238 produced by the SRS nuclear reactors before they were shut down; Russian plutonium-238; plutonium-238 recovered from the purification, pelletization, and encapsulation process; and plutonium-238 recovered from small RPSs that have been recovered and returned to LANL.

Another source of available plutonium-238 is milliwatt radioisotope thermoelectric generator (RTG) heat sources removed from nuclear weapons as part of the ongoing weapons dismantlement program. A milliwatt generator is a very small RPS designed to produce a fraction of a watt of electricity, and it has been incorporated in nuclear weapons design since the 1960s. As the weapons are dismantled, a total of about 3,200 heat sources are projected to become available between Fiscal Years 2009 and 2022. These heat sources are located at Pantex and LANL. Due to the long decay time, these heat sources have an estimated purity level of between 50 and 65 percent plutonium-238, thereby requiring blending to reach the 80 percent purity specification level. Although it is below the 80 percent purity specification level, the plutonium in the heat sources is still considered usable after 2010 because it can be blended with a reasonable mass of higher purity plutonium-238 to reach the desired purity specification at that time. The milliwatt RTG heat source plutonium-238 will be usable when the new production of higher purity plutonium-238 at INL commences in 2011.

DOE will use available and usable plutonium-238 inventory to meet the space mission and national security needs of Federal agencies. This inventory would be augmented by plutonium-238 produced from neptunium-237 targets.

Table 2–1 Current Locations and Quantities of Plutonium-238 and Neptunium-237 Available and Usable Inventory and Program Requirements

DOE Site	*Plutonium-238 Inventory [a] (kilograms)*	*Neptunium-237 Inventory (kilograms)*
Idaho National Laboratory	11.2	6 [b]
Los Alamos National Laboratory	28.3	0
Sandia National Laboratories	0	0
Oak Ridge National Laboratory	0.01	0
Savannah River Site	0	294 [b]
Hanford Site	0	0
Lawrence Livermore National Laboratory	0	0
Brookhaven National Laboratory	0	0
Kansas City Plant	0	0
Total current DOE inventory	39.51	300
National security requirements to 2010	< 25	Not applicable [c]
NASA minimum requirements to 2010 [d]	8	Not applicable [c]
Total plutonium-238 requirements to 2010	< 33	Not applicable [c]
Remaining plutonium-238 inventory in 2010	≥ 6.51 [e]	Not applicable [c]
Pantex	≤ 20 [f]	0

NASA = National Aeronautics and Space Administration.

[a] Since 1993, 16.5 kilograms of plutonium-238 have been purchased from Russia and is at LANL. An additional 5 kilograms of plutonium-238 has been ordered from Russia. Russian plutonium-238 is precluded from use in national security missions.

[b] The SRS neptunium-237 is being transported to INL based on the amended *NI PEIS* ROD (69 FR 5018).

[c] Not applicable, as neptunium-237 is the material used to produce plutonium-238, but not directly usable in RPSs.

[d] Assumes RPS use only for the New Horizons Pluto mission. If NASA schedules the Mars Science Laboratory mission during this time period, an additional 11 kilograms will be required for RPSs based on the number of RPSs and their electric power requirements for this mission.

[e] Of this remaining inventory, only 0.2 kilograms is domestically produced and is available for national security missions beyond 2010 because 0.81 kilograms is used in calibration instruments and 5.5 kilograms was obtained from Russia.

[f] This inventory is in old heat sources from dismantled nuclear weapons' RTGs. Its purity level is too low for direct reuse, but suitable for blending with higher purity plutonium-238. Some of these heat sources are located at LANL. The 20 kilograms is the total inventory for all the heat sources, both at LANL and Pantex. Transportation of this inventory from LANL and Pantex to INL is analyzed in this EIS. This inventory will be available and usable by 2011.

Note: To convert from kilograms to pounds, multiply by 2.2046.

Sources: AEC 1969, INL 2005c, and Monsanto 1978.

2.2 Alternatives to Be Evaluated

Consistent with the National Environmental Policy Act (NEPA) implementation requirements, this EIS assesses the range of reasonable alternatives regarding DOE's proposal to consolidate RPS nuclear production operations. DOE has identified three alternatives to be evaluated for the proposed consolidation:

1) the No Action Alternative (REDC, ATR, and HFIR);

2) the proposed consolidation of RPS nuclear production operations at INL (new MFC Plutonium-238 Facility and ATR) (Consolidation Alternative), which is also the Preferred Alternative; and

3) the interim use of existing facilities (REDC, ATR, and HFIR) until new facilities at INL are completed (new MFC Plutonium-238 Facility and ATR) (Consolidation with Bridge Alternative).

Should DOE decide to consolidate RPS nuclear production operations at INL, the Consolidation with Bridge Alternative would allow DOE to produce plutonium-238, if needed, prior to completion of facilities at INL under the Preferred Alternative. The activities to be evaluated in this EIS and the facilities to be used under each alternative are described below and summarized in **Table 2–2**. **Figures 2–2, 2–3,** and **2–4** illustrate the differences between the No Action, Consolidation, and Consolidation with Bridge Alternatives in terms of transportation requirements. Descriptions of the existing or proposed facilities for implementation of the alternatives are provided in Section 2.3.

Table 2–2 Infrastructure Comparison Among Alternatives

RPS Production Component	***No Action Alternative***	***Consolidation Alternative***	***Consolidation with Bridge Alternative***
Storage of target material	FMF at MFC, INL	FMF at MFC, INL	FMF at MFC, INL
Transportation of target material for fabrication	Neptunium-237 from INL to ORNL Buildings 7920 and 7930 (2007 to 2042)	Intrasite at INL (after 2011)	Neptunium-237 from INL to ORNL Building 7920 (2007 to 2011), Intrasite at INL (after 2011)
Target fabrication	REDC Buildings 7920 and 7930 at ORNL	Plutonium-238 Facility at the MFC at INL (new) (after 2011)	REDC Building 7920 at ORNL (2007 to 2011), Plutonium-238 Facility at the MFC at INL (after 2011)
Transportation of fabricated targets for irradiation	From ORNL Buildings 7920 and 7930 to INL (with ATR), From REDC Buildings 7920 and 7930 to HFIR (within ORNL)	Intrasite at INL (after 2011)	From REDC Building 7920 to HFIR (Intrasite at ORNL) (2007 to 2011), From MFC to ATR (Intrasite at INL) (after 2011)
Target irradiation	ATR at INL and HFIR at ORNL	ATR at INL (after 2011)	HFIR at ORNL (2007 to 2011), ATR at INL (after 2011)
Transportation of irradiated targets	From INL to ORNL Buildings 7920 and 7930 (with ATR), Intrasite (with HFIR)	Intrasite at INL (after 2011)	From HFIR to REDC Building 7920 (Intrasite at ORNL) (2007 to 2011), From ATR to MFC (Intrasite at INL) (after 2011)
Post-irradiation processing	REDC Buildings 7920 and 7930 at ORNL	Plutonium-238 Facility at the MFC at INL (after 2011) [a]	REDC Building 7920 at ORNL (2007 to 2011), Plutonium-238 Facility at the MFC at INL (after 2011) [a]
Transportation of processed plutonium-238 for purification, pelletization, and encapsulation	From ORNL Buildings 7920 and 7930 to LANL	Intrasite at the MFC at INL (after 2011)	From ORNL Building 7920 to LANL (2007 to 2011), Intrasite at the MFC at INL (after 2011)
Purification, pelletization, and encapsulation	Plutonium Facility at LANL	Plutonium Facility at LANL (2007 to 2011), Plutonium-238 Facility and RWL at MFC at INL (after 2011)	Plutonium Facility at LANL (2007 to 2011), Plutonium-238 Facility and RWL at MFC at INL (after 2011)
Transportation of encapsulated plutonium-238	From LANL to INL	From LANL to INL (2007 to 2011), Intrasite at the MFC at INL (after 2011)	From LANL to INL (2007 to 2011), Intrasite at the MFC at INL (after 2011)
RPS assembly and testing	Assembly and Testing Facility at the MFC at INL	Assembly and Testing Facility at the MFC at INL	Assembly and Testing Facility at the MFC at INL
Available existing and usable plutonium-238 inventory	Remains where it is currently stored at INL, LANL, and Pantex	From LANL and Pantex to the MFC at INL (2009 to 2022)	From LANL and Pantex to the MFC at INL (2009 to 2022)

RPS = radioisotope power system, FMF = Fuel Manufacturing Facility, MFC = Materials and Fuels Complex, INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory, REDC = Radiochemical Engineering Development Center, ATR = Advanced Test Reactor, HFIR = High Flux Isotope Reactor, LANL = Los Alamos National Laboratory, RWL = Radiological Welding Laboratory.

[a] In conjunction with the Plutonium-238 Facility, there would also be a new Support Building.

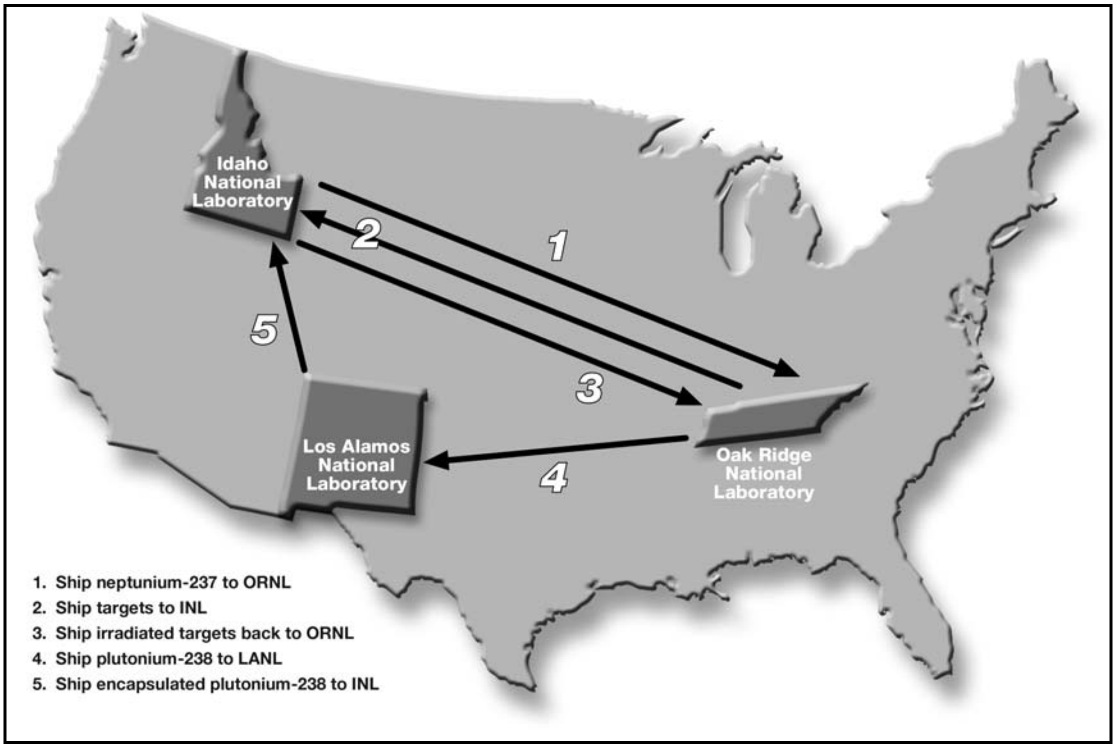


Figure 2–2 No Action Alternative Intersite Transportation

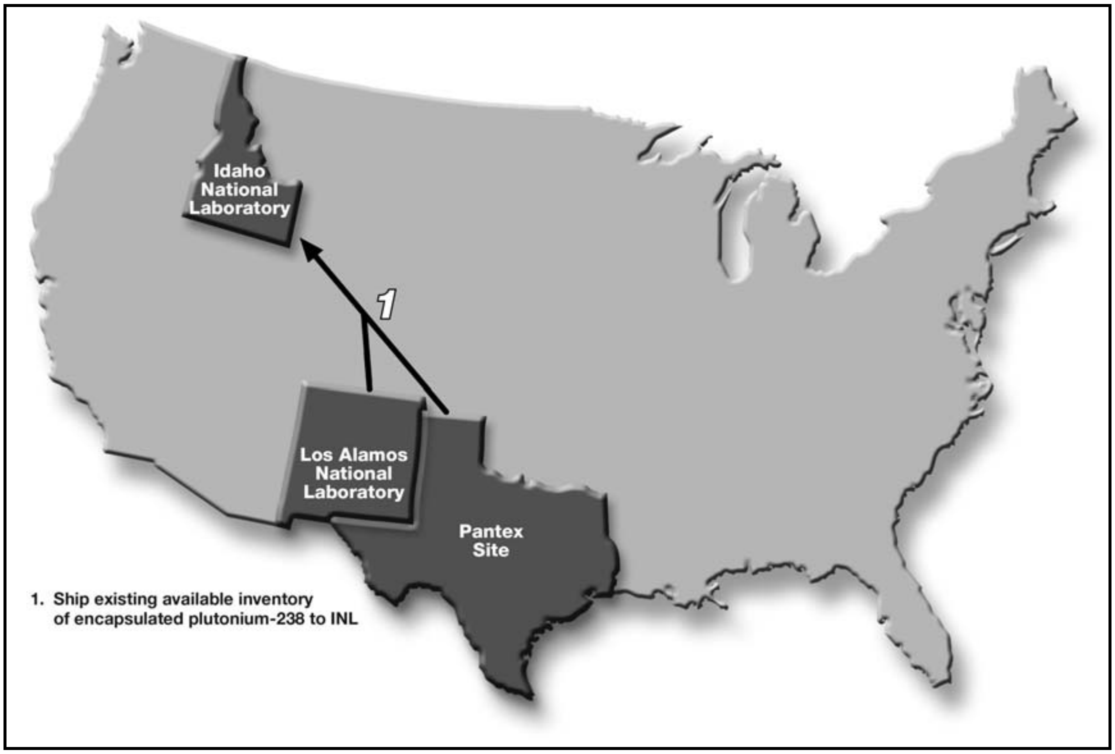


Figure 2–3 Consolidation Alternative and Consolidation Period of the Consolidation with Bridge Alternative Intersite Transportation

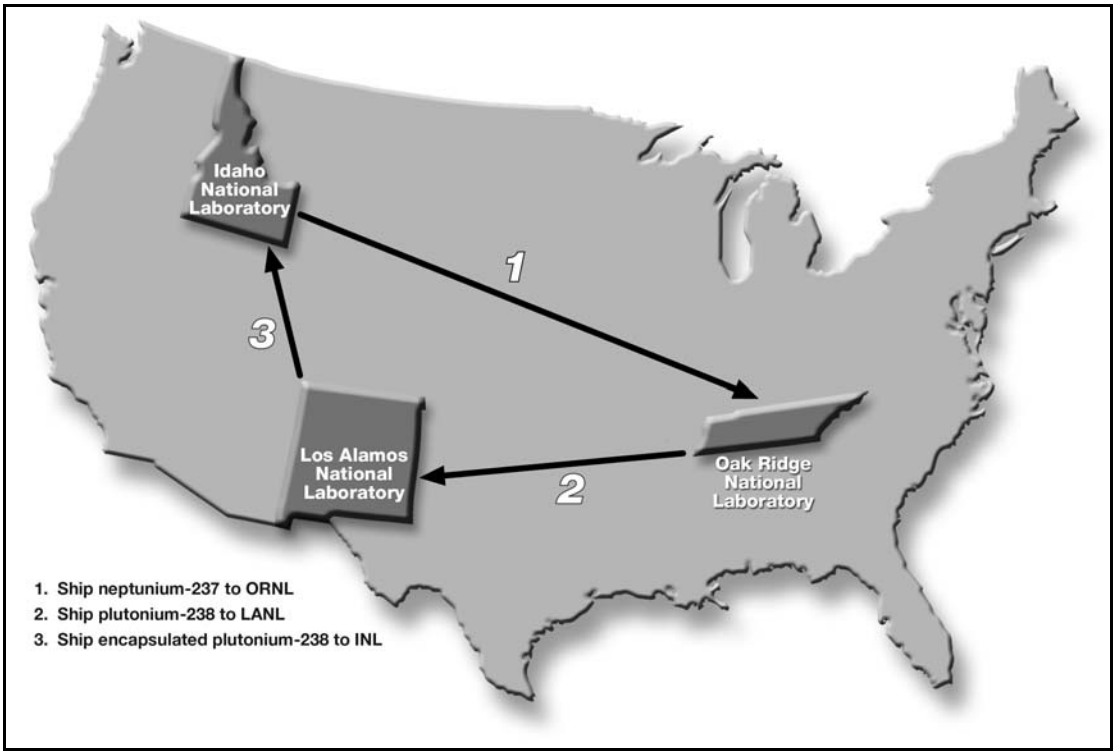


Figure 2–4 Bridge Period of the Consolidation with Bridge Alternative Intersite Transportation

2.2.1 No Action Alternative

Under the No Action Alternative, DOE would continue existing and planned RPS production under current management practices. No new facilities would be constructed. However, as described in the *NI PEIS*, the REDC at ORNL would require some internal modifications. The operational period evaluated in this EIS under the No Action Alternative is assumed to be 35 years, consistent with the *NI PEIS* assumption. The current estimated capital cost for implementing the No Action Alternative is $80 to $90 million. The nuclear infrastructure components required to produce the RPS, under the No Action Alternative would be implemented as follows:

Storage of Target Material—The FMF at INL would be used for neptunium-237 storage, in accordance with the *NI PEIS* amended ROD (69 FR 5018). The FMF is located within the secure area of the MFC at INL. Neptunium-237 would be transported from INL to ORNL for target fabrication.

Target Fabrication—REDC at ORNL would be used for target fabrication and post-irradiation processing. REDC consists of two hot cell facilities, both constructed during the period from 1964 to 1967. One of the hot cell facilities, designated Building 7920, was built to produce transuranium isotopes for research. The second hot cell, designated Building 7930, was built to develop and demonstrate the remote fabrication of uranium-233/thorium fuel materials for recycle into power reactors. Following fabrication, the neptunium-237 targets, would be transported to ATR at INL or HFIR at ORNL for irradiation, if needed.

Target Irradiation—Irradiation of the targets would take place in ATR at INL, supplemented by HFIR at ORNL. It is expected that the combined production from the two reactors would result in approximately 5 kilograms (11 pounds) of plutonium-238 per year and would satisfy anticipated program needs.

ATR is a DOE-owned light-water-cooled and -moderated reactor with a design thermal power of 250 megawatts that is owned by DOE and is located in the Reactor Technology Complex (RTC) (formerly the Test Reactor Area) in the southwest portion of INL. ATR would continue to operate and meet its current mission requirements, including naval reactor research and development, medical and industrial isotope production, and civilian nuclear energy research and development activities, at its current operating levels.

HFIR is a beryllium-reflected, light-water-cooled and -moderated reactor operating at a thermal power level of 85 megawatts. HFIR is owned by DOE and is located at ORNL in the southern portion of the Oak Ridge Reservation (ORR). HFIR would continue to be operated to meet its primary mission of neutron-science-based research for the DOE Office of Science. In addition, medical and industrial isotope production and civilian nuclear energy research and development activities would be performed on a not-to-interfere basis at its current operating level. When supporting its plutonium-238 production mission, HFIR would fully support its primary mission, and would support the medical and industrial isotope production and civilian nuclear energy research and development activities to the extent possible within current reactor operating levels.

Following irradiation, the irradiated targets would be transported back to REDC at ORNL for post-irradiation processing.

Post-irradiation Target Processing—Post-irradiation processing would take place at REDC at ORNL. Five kilograms (11 pounds) of plutonium-238 post-irradiation processing would require some modifications to the facility and additional equipment installation in three main areas of the second floor of REDC Buildings 7920 and 7930, as stated in the *NI PEIS*. Following post-irradiation processing at REDC, processed plutonium-238 would be transported to LANL for purification, pelletization, and encapsulation.

Purification, Pelletization, and Encapsulation—Purification, pelletization, and encapsulation of plutonium-238 would continue at the Plutonium Facility at LANL's TA-55. Encapsulated plutonium-238 would then be transported to INL for RPS assembly and test operations.

RPS Assembly and Testing—The existing Assembly and Testing Facility at MFC at INL would be used for assembly and testing operations.

Storage of Plutonium-238 Available Inventory—The available and usable inventory of plutonium-238 identified in Table 2–1 would remain at its current locations (i.e., INL, LANL, and Pantex).

2.2.2 Consolidation Alternative (Preferred Alternative)

Under the Consolidation Alternative, DOE would consolidate all RPS nuclear production operations within the secure area at MFC at INL. New construction to house plutonium-238 production, purification, pelletization, and encapsulation would be required due to the very limited capability of existing facilities in the secure area at the MFC. Construction of a new road between ATR and MFC at INL would be required under this alternative to provide appropriate security measures for the transfer of unirradiated and irradiated targets and preclude shipment on public roads. The new road is an essential part of this alternative for security purposes and to preclude use of public roads. It is expected that new construction would be completed by 2009, and operations would start in 2011. Current plutonium-238 operations at the Plutonium Facility at LANL would continue until new facility operations at MFC commence in 2011. ATR would not begin production of plutonium-238 until 2011. No operations at REDC or HFIR would occur under the Consolidation Alternative. The operational period evaluated under this alternative is 35 years. The current estimated capital cost that would be required for implementing the Consolidation Alternative is $250 to $300 million. The nuclear infrastructure components required to produce the RPS under the Consolidation Alternative would be implemented as follows.

Storage of Target Material—As in the case of the No Action Alternative, FMF at the MFC at INL would be used for neptunium-237 storage.

Target Fabrication—Target fabrication would take place in the production wing of a new facility proposed for construction at MFC at INL, called the Plutonium-238 Facility. It would be located within the special secure area at MFC. The same facility would be used for post-irradiation processing.

Target Irradiation—Target irradiation would take place at ATR at the RTC at INL. It is expected that ATR alone would be sufficient to produce up to approximately 5 kilograms (11 pounds) of plutonium-238 per year to satisfy program needs.

Post-irradiation Target Processing—Post-irradiation processing would take place in the production wing of the proposed new Plutonium-238 Facility at the MFC at INL.

Purification, Pelletization, and Encapsulation—Purification, pelletization, and encapsulation would also take place at the proposed new Plutonium-238 Facility and new Radiological Welding Laboratory. The proposed new Radiological Welding Laboratory would be used for weld research and development in support of RPS nuclear production operations. The Radiological Welding Laboratory would be an addition built onto existing Building 772, north of the Zero Power Physics Reactor (ZPPR) complex at the MFC at INL. Until 2011, the Plutonium Facility at LANL would continue to operate as described in the No Action Alternative.

RPS Assembly and Testing—The existing Assembly and Testing Facility at the MFC at INL would be used for assembly and testing operations.

Storage of Available Plutonium-238 Inventory—The available and usable inventory of plutonium-238 identified in Table 2–1 would be transported from LANL and Pantex to the MFC at INL from 2009 to 2022 for storage until used. This inventory could be used as early as 2011.

2.2.3 Consolidation with Bridge Alternative

The Consolidation with Bridge Alternative was developed in response to comments raised during the scoping period. It was pointed out that, should national security needs exceed the available inventory of plutonium-238 prior to the completion of new facilities at INL under the proposed Consolidation Alternative, ORNL would be able to produce up to 2 kilograms (4.4 pounds) of plutonium-238 per year using only Building 7920 at REDC and HFIR. The Plutonium Facility at LANL and Assembly and Test Facility at INL would continue to operate as described in the No Action Alternative.

Under the Consolidation with Bridge Alternative, DOE would use existing facilities for the production of plutonium-238 during the time period required for the new facilities at INL to become operational. This period between 2007 and 2011 is referred to in this EIS as the “bridge” period. HFIR would be the only reactor used for target irradiation during this period. Therefore, production would be limited by the irradiation capability of HFIR of approximately 2 kilograms (4.4 pounds) of plutonium-238 per year. Under this alternative, RPS nuclear production operations at INL would start in 2011, when the new facilities under the Consolidation Alternative would become operational. The operational period under this alternative includes the bridge period of 5 years (2007 through 2011) plus the consolidation period of 35 years (2012 to 2047). The bridge period is similar to the No Action Alternative except only HFIR would be used whereas the No Action Alternative would use both ATR and HFIR. Also, the bridge period would produce up to 2 kilograms (4.4 pounds) of plutonium-238 per year while the No Action Alternative would produce up to 5 kilograms (11 pounds) of plutonium-238 per year. After the bridge period, this alternative is identical to the Consolidation Alternative.

Under this alternative, ATR would not be used during the bridge period because of the additional risk associated with interstate transportation. With REDC and HFIR, there is no interstate transportation of unirradiated or irradiated targets. In addition, the lower production rate of plutonium-238 in HFIR is estimated to be acceptable for the 5-year bridge period until production of 5 kilograms (11 pounds) per year of plutonium-238 is available at INL. The current estimated capital cost for implementing the Consolidation with Bridge Alternative is $265 to $325 million consisting of $250 to $300 million for consolidation of nuclear operations at INL and $15 to $25 million for upgrade modifications to REDC and HFIR for the bridge period (ORNL 2005). Under the Consolidation with Bridge Alternative, DOE would fully implement RPS nuclear production operation at INL after completion and testing of the new facilities in 2011, as described in Section 2.2.2.

2.2.4 Alternatives Considered and Dismissed

2.2.4.1 Consolidation of Radioisotope Power Systems Nuclear Production Operations at Sites Other than Idaho National Laboratory

DOE considered whether consolidation at another site would be reasonable and could meet programmatic needs. In order to consolidate all nuclear-related RPS production activities at one site, a site must have an appropriate level of Perimeter Intrusion and Detection Assessment System (PIDAS) security and an operating nuclear reactor capable of producing 5 kilograms (11 pounds) of plutonium-238 per year by 2011. The design and construction of a new nuclear reactor as opposed to using an existing nuclear reactor was considered and dismissed from detailed evaluation in the *Consolidation EIS* because its estimated capital cost, including support facilities, would be greater than the cost of utilizing an existing operating nuclear reactor. Consolidation at the Hanford Site, LANL, ORNL, and SRS is discussed below.

Hanford Site

DOE considered whether consolidation at Hanford, using the Fast Flux Test Facility (FFTF) reactor and other existing facilities, would be a reasonable alternative. FFTF is a DOE-owned, 400 megawatt (thermal) liquid-metal (sodium) cooled nuclear test reactor located in the DOE Hanford Site's 400 Area near Richland, Washington. FFTF full-scale operations were conducted between 1982 and 1992. DOE operated the reactor as a science test bed for the U.S. Liquid Metal Fast Reactor Program testing advanced nuclear fuels, materials, components, and demonstrated reactor safety designs. DOE also conducted ancillary experimental activities including cooperative international research and irradiation to produce tritium and a variety of medical and industrial isotopes.

In December 1993, DOE ordered the FFTF to be shutdown (i.e., deactivated) because of a lack of economically viable missions at that time. Thereafter, project planning was undertaken to shutdown the facility, which included preparation of a NEPA *Environmental Assessment, Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington* (*FFTF Shutdown EA),* DOE/EA-0993. In May 1995, the EA and its FONSI were published. Following issuance of the FONSI, FFTF deactivation activities involving fuel offload, sodium drain preparations, and systems lay-up were initiated.

In January 1997, DOE formally halted deactivation activities at FFTF and placed the facility in standby while an evaluation was conducted to determine if FFTF could have a future role in DOE's national tritium-producing strategy. In December 1998, DOE decided that FFTF would not play a role in tritium production. In December 2000, DOE issued the *NI PEIS*. The *NI PEIS* reviewed the environmental impacts associated with enhancing the existing DOE nuclear facility infrastructure to provide for the following missions: (1) production of isotopes for medical, research, and industrial uses; (2) production of plutonium-238 for use in advanced radioactive isotope power systems for future NASA space exploration missions; and (3) to support the nation's civilian nuclear energy research and development needs. In the *NI PEIS*, FFTF was evaluated as an alternative irradiation services facility for the aforementioned missions.

Although DOE stated in the *NI PEIS* that the "FFTF would provide the greatest flexibility for both isotope production and nuclear-based research and development among the baseline configurations for all of the proposed alternatives," DOE chose not to make the 35-year commitment that would be required by FFTF restart because it felt long-term financial support for such an operational regime was too uncertain, that in the short term, existing operating facilities could handle mission growth, and that in the long term, other means could be pursued to meet rising research and development and isotope needs.

In January 2001, DOE published the *NI PEIS* ROD, which included a decision to resume the permanent deactivation of the FFTF. In April 2001, DOE suspended the FFTF decision in the ROD and evaluated expressions of interest submitted by private and Government groups in the use of FFTF for research and isotope production. Based on these reviews, DOE decided in December 2001 that restart of the FFTF was impracticable and that its permanent deactivation would resume. In July 2002, the DOE Office of Environmental Management was directed to take the necessary actions to transfer management and budget responsibility of FFTF from the DOE Office of Nuclear Energy, Science and Technology to the DOE Office of Environmental Management by the end of Fiscal Year 2002 (September 2002).

In late 2002, FFTF deactivation activities were temporarily stopped due to legal challenges on NEPA grounds by Benton County, Washington State, alleging that it was not acceptable to address only deactivation activities in the May 1995 EA. On February 28, 2003, the U.S. District Court of Eastern Washington upheld the May 1995 EA. Benton County did not pursue an appeal of the decision. In May 2003, the Tri-Party agencies (i.e., DOE, State of Washington Department of Ecology and the U.S. Environmental Protection Agency), signed the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) M-81-00 milestones and schedule for implementing the FFTF deactivation activities currently underway. DOE is planning to achieve the final closure of the FFTF (e.g., the FFTF Closure Project) by completing ongoing deactivation and future decommissioning of the FFTF and designated support facilities on the Hanford Site by September 2012. On May 19, 2005 as part of deactivation activities, a hole was drilled in the FFTF reactor vessel core support structure to allow access for removal of the liquid sodium coolant. This effectively rendered FFTF inoperable and foreclosed the option of restart. Currently, DOE is preparing an *FFTF Decommissioning EIS* (DOE/EIS-0364) to determine the final end state of the deactivated FFTF and its support facilities on the Hanford Site. Alternatives being evaluated in the EIS include No Action, entombment, and removal. Since FFTF is the only reactor that could be used to produce plutonium-238 at the Hanford Site and since FFTF is not a viable reactor for the mission of producing plutonium-238 within economic and schedule requirements, the Hanford Site was considered and dismissed from detailed evaluation in the *Consolidation EIS.*

Los Alamos National Laboratory

Although LANL currently has the capability of purifying, pelletizing, and encapsulating plutonium-238, it does not have any operating nuclear reactors. Its last reactor, Omega West, was been decommissioned and decontaminated, and is now a greenfield. Because LANL has no available onsite nuclear reactor, it was considered and dismissed from detailed evaluation in this EIS.

Oak Ridge National Laboratory

Consolidation of RPS nuclear production operations at ORNL would not allow DOE to meet its programmatic needs. Because the reactor at ORNL, HFIR, is a dedicated DOE Office of Science facility for projects related to basic energy sciences and isotope production, use of this reactor for the RPS program would be only on an "as-available" basis and could not be guaranteed for 35 years of plutonium-238 production at 5 kilograms (11 pounds) per year. Even if HFIR were to be dedicated solely to plutonium-238 production, its core design precludes it from producing 5 kilograms (11 pounds) per year of plutonium-238. Consolidation at ORNL, therefore, could only partially meet the programmatic objective, and was dismissed from detailed evaluation in this EIS.

Savannah River Site

The last U.S. production of plutonium-238 in a nuclear reactor occurred at SRS using the K-reactor in the 1980s. In the 1980s and early 1990s, plutonium-238 was extracted from targets in the HB Line with H-Canyon at SRS. The last operating nuclear reactor, the K-reactor, was shut down in 1996. Since the 1996 shutdown of the K-reactor, all the nuclear fuel and heavy water used as moderator in the reactor have been removed. The heavy water is currently in storage at SRS and the nuclear fuel has all been reprocessed in the H-line at SRS. Numerous other reactor components have been removed from the K-reactor including two 54-ton structural shield doors, the top 21-meters (69-feet) of the reactor building exhaust stack, and approximately 108 tons of contaminated steel from the reactor building. The K-reactor spent fuel storage basin contains no spent nuclear fuel and has also been subject to deactivation activities such as the removal of some systems and equipment (WSRC 2000, WSRC 2002).

In July 1998, DOE decided to use the SRS K-reactor Building 105-K, which encloses the reactor, along with a new facility to be constructed for the storage of plutonium from the Rocky Flats Environmental Technology Site and other DOE facilities for 10-years. Building 105-K was later designated the K Area Material Storage to be used for the storage of non-pit surplus plutonium. In January 2001, DOE decided to cancel the new plutonium storage facility and only use the K Area Material Storage for all storage of Rocky Flats Environmental Technology Site’s non-pit surplus plutonium, which may last longer than 10 years. A supplement environmental analysis to the Weapons-Usable Fissile Materials Storage and Disposition EIS (DOE/EIS-0229, December 1996) was issued in February 2002 to support the decision for plutonium storage at K Area Material Storage for more than 10-years (DOE/EIS-0229-SA-2). Plutonium residue, in appropriate containers, is currently in storage in the K-reactor Building 105-K (DOE 1996d, DOE 2002a).

In 1997, the U.S. and Russia signed a Plutonium Production Reactor Agreement, later amended in 2003, which requires that plutonium production reactors shut down in both countries do not resume operation. This agreement covers 24-shutdown plutonium production reactors in both countries including all plutonium production reactors at the Hanford and SRS sites, including the K-reactor. This agreement is for reactors designed to produce plutonium-239 for nuclear weapons. In accordance with the U.S.-Russia agreement on plutonium production reactors all five plutonium production reactors at SRS, including the K-reactor, are closed with special safeguards seals and are subject to annual visits by inspectors from Russia to ensure that these reactors will not restart (DOE 2005e). Because SRS has no available onsite nuclear reactor, it was considered and dismissed from detailed evaluation in the *Consolidation EIS*.

2.2.4.2 Consolidation of Radioisotope Power Systems Nuclear Production Operations Using Existing Facilities at Idaho National Laboratory

One of the alternatives evaluated in the *NI PEIS* (Alternative 2, Option 2) was to use the Fluorinel Dissolution Process and Fuel Storage Facility (FDPF) at INL for storing neptunium-237, fabricating targets, and processing irradiated targets at ATR. The existing Unirradiated Fuel Storage Facility (UFSF) was also proposed for storage under the same alternative. These facilities were considered and dismissed from detailed evaluation in this EIS because of the following major issues associated with their use: (1) The cost for modifications to these facilities to meet the design and safety requirements for RPS nuclear production operations is much greater than that of constructing new facilities; (2) these modifications will incur additional radiological risk to facility modification construction workers because of the contamination present in existing facilities; (3) security does not meet requirements for the protection of SNM; (4) both buildings are contaminated; (5) it is questionable as to whether these buildings were constructed according to the latest building codes and standards; and (6) currently, these facilities are slated for decontamination and decommissioning as early as 2012 (INL 2005c). The FDPF and UFSF are described below along with the status of each facility.

FDPF—The FDPF is located on the INL reservation at the Idaho Nuclear Technology and Engineering Center, northeast of the Central Facilities Area, approximately 3.2 kilometers (2 miles) southeast of ATR. The FDPF building is divided into two parts, a spent nuclear fuel storage area and the Fluorinel Dissolution Facility (FDF) and became operational in 1983. The storage area consists of six storage pools for storing spent nuclear fuel. Radioactive spent fuel is stored under about 11 million liters (3 million gallons) of water, which provides protective shielding and cooling. An engineered leak detection system and other technologies provide safe underwater storage (INL 2005c).

FDF is a shielded hot cell, supported by remote manipulators, an overhead crane, shielded viewing windows, and a remote-control sampling cell. In 1986, FDF was started up in the Chemical Processing Plant to process zirconium-clad fuel. FDF had three large dissolvers that dissolved fuel in a mixture of hydrofluoric acid/aluminum nitrate that had both boron and cadmium present as nuclear poisons.

In 1988, the plant was temporarily shut down to bring the underground piping into compliance with U.S. Environmental Protection Agency regulations (40 CFR 280). This entailed significant modifications throughout the processing facilities and laboratories. In 1991, the custom processing operation was shut down. In April 1992, a decision by the Secretary of Energy halted all nuclear fuel reprocessing. The plant was, however, allowed to run the second- and third-cycle/denigration operation to completely remove all fissile material from the process tanks in 1996. That material and the material from the two Fluorinel campaigns are still stored in the Chemical Processing Plant vault (INL 2005c).

Under an agreement with the state of Idaho, INL is committed to moving all spent nuclear fuel into dry storage by 2023, with an accelerated cleanup plan goal to have this work completed by 2012. As the fuel is removed from underwater storage facilities, the decontamination and decommissioning process will take place. All of the spent nuclear fuel located at INL will be consolidated in dry storage until it is repackaged and readied for shipment to a Federal repository outside of Idaho. The Idaho Completion Project is focused on completing the majority of cleanup work from past INL missions by 2012 (INL 2005c).

Unirradiated Fuel Storage Facility—The UFSF is located within 100 meters (328 feet) of FDPF. It was built in 1984 as a vault storage area and consists of 100 inground, concrete-shielded storage well positions. About 2,000 kilograms (4,409 pounds) of fissile material is currently stored at UFSF. It is a Hazard Category 2 facility. There is no loose contamination; however, fissile material contains uranium-232 and emits alpha radiation. UFSF is not normally occupied. It is essentially a complete building enclosed by, and interacting with, another complete building surrounded on three sides by an earthen berm (INL 2005c).

As an interim disposition step, UFSF will be emptied of all SNM inventory by September 30, 2005. Upon removal of the SNM, the facility must be basically cleaned to the point where a lower hazard category can be achieved. The facility will then be decontaminated and decommissioned by 2012 (INL 2005c).

Other INL Facilities

Due to security requirements, especially the need for an existing PIDAS to encompass all involved structures, all other facilities at INL were considered but dismissed for further evaluation because they lack sufficient security protection and the cost to establish such protection would be excessive. In addition, no existing facility at INL was designed for neptunium-237 target fabrication; plutonium-238 extraction from irradiated targets; plutonium-238 purification, pelletization or encapsulation; or RPS assembly and testing. Modifications of existing INL facilities to fulfill these functions would cost much more than constructing new facilities at the MFC.

Because the cost and radiological risk to construction workers to decontaminate and modify existing facilities at INL would be greater than that of constructing new facilities, the use of existing facilities was considered and dismissed from detailed evaluation in the *Consolidation EIS*.

2.2.4.3 Proposed New Road

Under the Consolidation and Consolidation with Bridge Alternatives, a new road is required at INL to connect the proposed new Plutonium-238 Facility at the MFC with the ATR at the RTC to provide appropriate security measures for the transfer of unirradiated and irradiated targets, while eliminating transportation over any public road. DOE initially considered these alternative routes: the T-3 Road, T-24 Road, and the East Power Line Road. These routes are further described in Section 2.3.2.4 and throughout this Draft EIS. The northernmost route (T-3 Road), while more direct, would require that a new bridge be constructed across the Big Lost River. A new bridge would impact the floodplain and associated wetlands of the Big Lost River. As it is DOE policy to avoid direct and indirect support of development in a floodplain or new construction in a wetland wherever there is a practicable alternative as stated in 10 CFR 1022, this route is infeasible and is dismissed from further evaluation.

2.3 Description of Facilities

2.3.1 Existing Facilities

2.3.1.1 Radiochemical Engineering Development Center

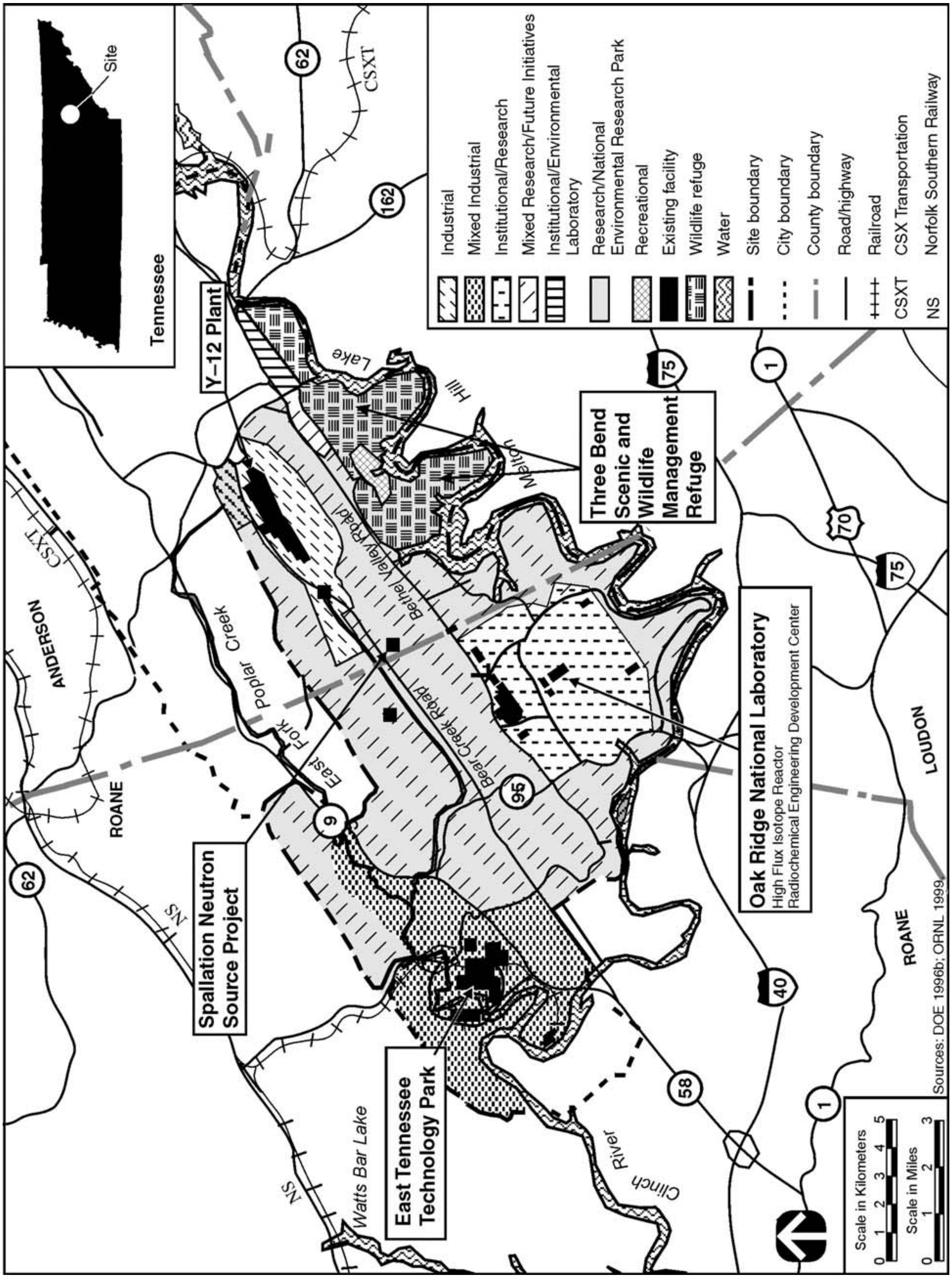
The REDC at ORNL would be used for target fabrication and post-irradiation processing under the No Action Alternative, and during the bridge period under the Consolidation with Bridge Alternative. REDC consists of two hot cell facilities.

REDC Building 7930 was constructed from 1964 to 1967 to develop and demonstrate the remote fabrication of uranium-233/thorium fuel materials for recycle into power reactors. However, the program was cancelled prior to the installation of any processing equipment. REDC Building 7930 houses heavily shielded hot cells and analytical laboratories used for remote fabrication of rods and targets (for irradiation in HFIR) and processing of irradiated rods and targets for separation and purification of transuranium elements, process development, and product purification and packaging. **Figure 2–5** presents a map of ORR that depicts REDC's location. **Figure 2–6** presents the layout of the facility.

REDC Building 7930 is divided into four major areas: (1) a cell complex with seven cells, six shielded and one unshielded; (2) maintenance and service areas surrounding the cell complex; (3) an operating control area; and (4) an office area adjacent to, but isolated from, the operating areas. Utility services and ventilating, crane and manipulator, and liquid waste systems also are included. Plutonium-238 post-irradiation processing under the No Action Alternative would require some modifications to the facility and additional equipment installation in three main areas of the second floor of REDC Building 7930. The activities required for target fabrication would take place in shielded gloveboxes. Cell E would contain processing equipment to purify the separated plutonium-238 product, prepare the plutonium oxide, and transfer the oxide into shipping containers. Cell D activities would include receipt of irradiated targets, as well as target dissolution, chemical separation of neptunium and plutonium from fission products, and partitioning and purification of neptunium. Cell D also contains process equipment for removing transuranic elements from the aqueous waste streams and vitrifying the waste (DOE 2000f).

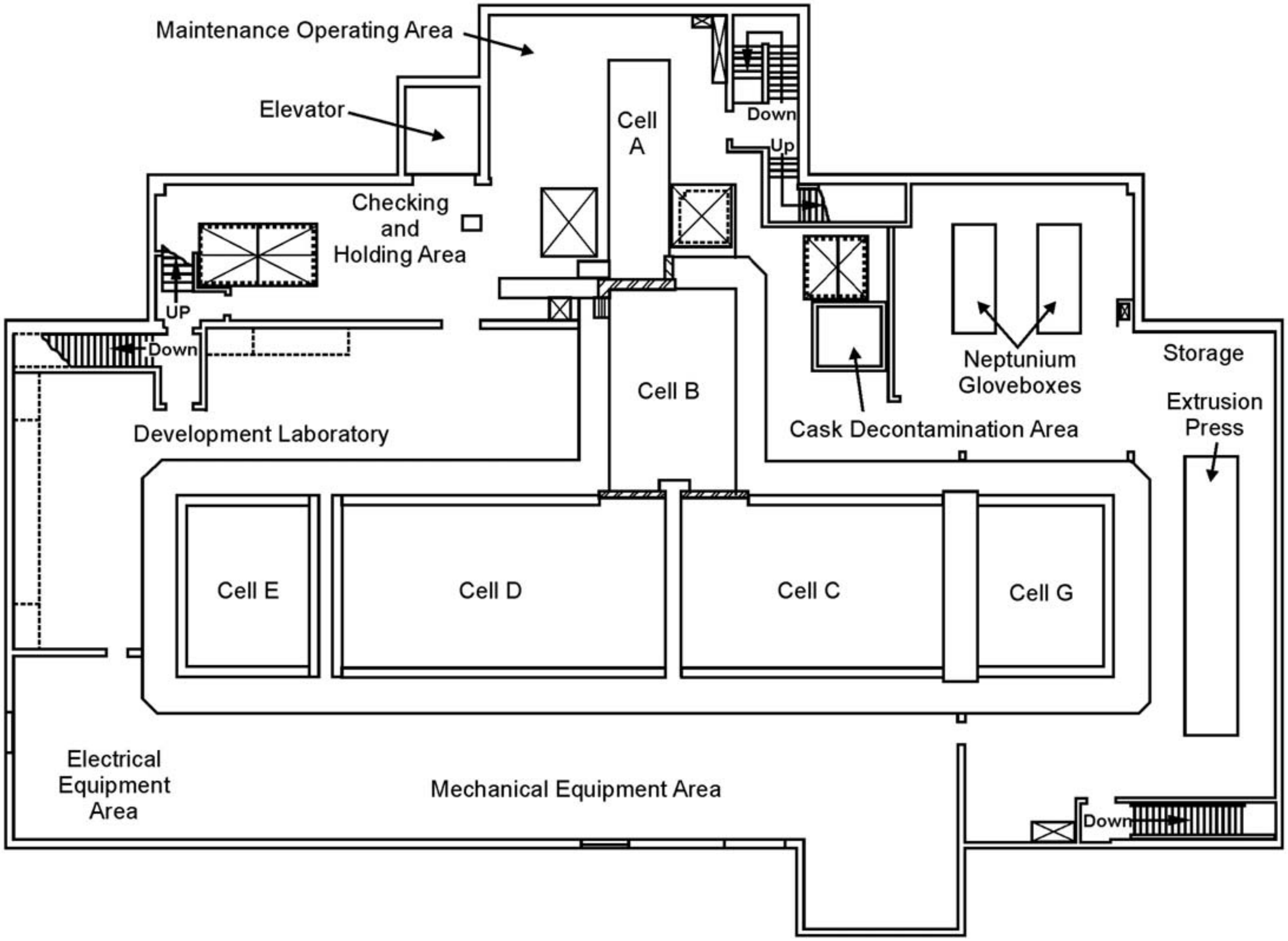
Use of REDC under the No Action Alternative and during the bridge period of the Consolidation with Bridge Alternative would require the following:

- Existing glovebox laboratories in Building 7920 would be modified to fabricate targets containing neptunium.



Sources: DOE 1996b; ORNL 1999

Figure 2–5 Oak Ridge Reservation Site



Source: Wham et al. 1998.

Figure 2–6 Radiochemical Engineering Development Center Facility Layout

- Existing operational hot cells in Building 7920 would be used for chemical extraction. These cells are currently used for curium, americium, and plutonium processing similar to that required for plutonium-238 production, and are contaminated. Equipment in the hot cells and in waste processing operations would be modified for plutonium-238 separations. These cells would be used for target dissolution, initial separation of plutonium/neptunium from the fission products, and separation of the plutonium from the neptunium. Separated plutonium-238 would be purified and converted to an oxide. The oxide would be placed in a container, transferred to an appropriate shipping container and placed into a shipping package (ORNL 2005).

In addition to using REDC Building 7920 under the No Action Alternative, REDC Building 7930 would be used in order to meet the plutonium-238 production goal of 5 kilograms (11 pounds) per year.

2.3.1.2 Advanced Test Reactor

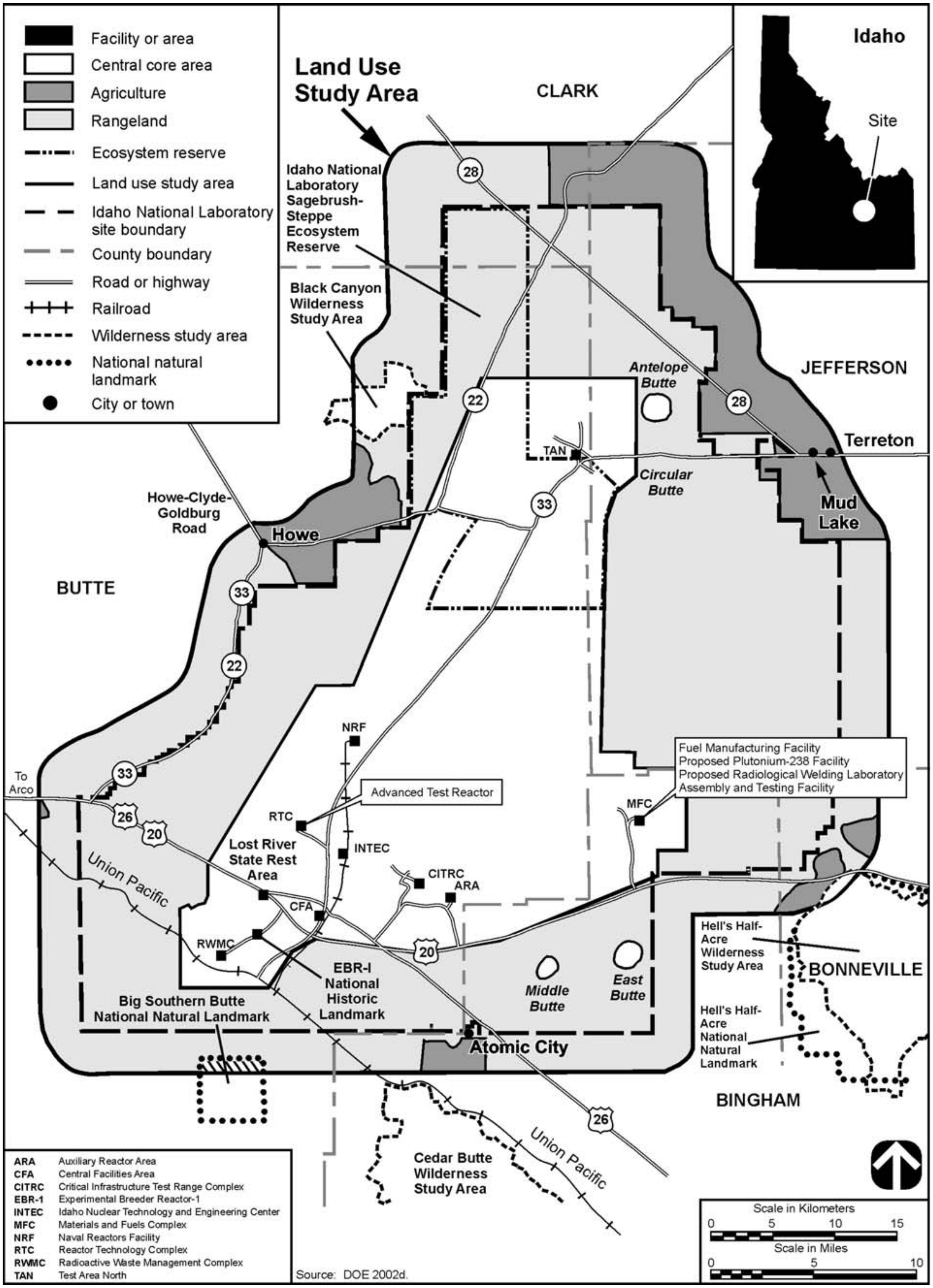
ATR at INL is the reactor to be used for the irradiation of neptunium-237 targets under the Consolidation Alternative and under the Consolidation with Bridge Alternative after 2011. It is one of the reactors to be used for target irradiation, along with HFIR, under the No Action Alternative.

ATR is a DOE-owned light-water-cooled and -moderated reactor with a design thermal power of 250 megawatts, and is located within the RTC at INL. **Figure 2–7** presents a map of INL that depicts the location of ATR at the RTC.

Under all three alternatives, ATR would continue to operate and meet its current mission requirements, including naval reactor research and development, medical and industrial isotope production, and civilian nuclear energy research and development activities, at its current operating capacities. The production planning assumption for ATR is from 3 kilograms (6.6 pounds) of plutonium-238 per year (No Action Alternative) to 5 kilograms (11 pounds) of plutonium-238 per year (if ATR were used alone).

Special features of ATR include high neutron flux levels (ranging from 1×10^{15} neutrons per square centimeter per second in the flux traps to 1×10^{13} neutrons per square centimeter per second in the outer reflector positions) and the ability to vary power to fit different experiment needs in different test positions. The primary user of ATR is the U.S. Naval Nuclear Propulsion Program. A variety of other users include other foreign and domestic Government programs, a commercial isotope production company, industrial customers, and research and development interests (DOE 2000f).

ATR is currently operating at approximately 140 megawatts or less. The power level of ATR would not change under any alternative for producing plutonium-238. ATR operates with highly enriched uranium fuel. Typical operating cycles are 42 days or 49 days at power followed by a 7-day outage for refueling and changeout of experiments and isotope production targets. The core is 1.2 meters (4 feet) high and is surrounded by a 1.3-meter-diameter (4.25-foot-diameter) beryllium reflector. Beryllium is an excellent neutron reflector and is used to enhance the neutron flux essential to a test reactor. ATR has nine flux traps in its core and achieves a close integration of flux traps and fuel by means of a serpentine fuel arrangement. When viewed from above, the ATR fuel region resembles a four-leaf clover. The flux traps positioned within the four lobes of the reactor core are almost entirely surrounded by fuel, as is the center position. The other flux trap positions between the lobes of the core have fuel on three sides. ATR's unique control device design permits large power shifts among the flux traps. Testing can be performed in test loops installed in some flux traps with individual flow and temperature control, or in reflector irradiation positions with primary fluid as coolant. The curved fuel arrangement brings the fuel closer on all sides of the test loops than is possible in a rectangular grid (DOE 2000f).



Source: DOE 2002d.

Figure 2–7 Idaho National Laboratory Site

Five of the nine flux traps are configured with pressurized-water loops that allow for individual temperature, pressure, flow, and chemistry controls. The five test loops are used by the Naval Reactors Program. Of the remaining four flux traps, one is dedicated to the Naval Reactors Program, one is used for isotope production, one is used for low-specific-activity cobalt production, and the fourth has recently had the Irradiation Test Vehicle installed. The Irradiation Test Vehicle can be described as three small pressurized-gas test loops. The use of one of these three test loops was recently purchased by a British corporation; negotiations for use of the other two are currently underway (DOE 2000f).

In addition to the primary flux trap irradiation positions, there are some 70 irradiation positions in the beryllium reflector (and aluminum support structure) that are available for experiment irradiation and isotope production. These position diameters range from 1.6 centimeters (0.625 inches) to 12.7 centimeters (5 inches), with thermal neutron flux levels ranging from 2×10^{14} to 1×10^{13} neutrons per square centimeter per second. Approximately 25 percent of the high-flux test positions (A, B, and H holes) are currently used for iridium-192 production. The majority of the remaining high-flux test positions are used for cobalt-60 production. Occasionally, additional isotopes (e.g., strontium-89, nickel-63) are generated in small quantities. A private company leases the space for production of these isotopes. A small number of positions are used by other companies or Government programs for other materials irradiation projects. For the production of plutonium-238, neptunium-237 targets would be placed in the beryllium reflector positions. The proposed target design consists of neptunium dioxide blended with aluminum powder, pressed into a target core, and clad with aluminum. The ATR target length would be sized for the 1.2-meter (4-foot) active core length of ATR. Production of plutonium-238 at the ATR would not affect other radioisotope production at ATR because sufficient irradiation space in the ATR core exists for both uses.

ATR is equipped with numerous safety features, including extensive plant protective systems, standby power sources, experiment interlocks, computerized surveillance, confinement systems, safety rods, and an emergency firewater injection system. ATR's six safety rods provide fast shutdown of the reactor if potentially damaging conditions develop. A sudden rise in power or coolant temperature, a sudden drop in coolant flow or pressure, or the overheating of a test sample are examples of conditions that would automatically drop the safety rods into the core. The firewater injection system provides emergency core cooling and flooding of the reactor vessel in the event of a loss of primary coolant. ATR is connected by a water canal to the ATR Critical Facility. The ATR Critical Facility is a low-power, full-size nuclear duplicate of ATR used to provide data as needed for experiment loadings prior to irradiation of the actual experiments in ATR (DOE 2000f).

2.3.1.3 High Flux Isotope Reactor

HFIR at ORNL would be used as one of the reactors for irradiating neptunium-237 targets under the No Action Alternative or under the Consolidation with Bridge Alternative during the bridge period on an as-available basis.

HFIR is a beryllium-reflected, light-water-moderated and -cooled reactor operating at a thermal power level of 85 megawatts. HFIR is owned by DOE and is located at ORNL in the southern portion of ORR. Figure 2–5 presents a map of ORR (DOE 2000f).

Under the No Action and Consolidation with Bridge Alternatives, HFIR would continue to be operated to meet its primary mission of neutron-science-based research for the DOE Office of Science. In addition, medical and industrial isotope production and civilian nuclear energy research and development activities would be performed on a not-to-interfere basis at its current operating level.

Consideration must be given to the need to maintain appropriate levels of neutron flux to support HFIR's primary mission. Neutron flux levels can be impacted by the placement of targets (such as neptunium-237 targets for the production of plutonium-238) in the reactor core. Under the planning assumptions for plutonium-238 production, HFIR could produce up to 2 kilograms (4.4 pounds) per year without impacting ongoing missions. Even if HFIR were to be dedicated solely to plutonium-238 production, its core design precludes it from producing 5 kilograms (11 pounds) per year of plutonium-238. As the program goal is to achieve a production rate of 5 kilograms (11 pounds) per year, HFIR alone would not be able to meet this goal, but could in combination with ATR (DOE 2000f).

HFIR was originally designed as both an isotope production and research reactor with a thermal flux of 3 to 5×10^{15} neutrons per square centimeter per second and a full-power level of 100 megawatts-thermal (3.4×10^{8} British thermal units per hour) for economy reasons. It is currently operating at a maximum authorized powerlevel of 85 megawatts-thermal (2.9×10^{8} British thermal units per hour) to extend the useful life of the reactor. The power level of HFIR for producing plutonium-238 would not change under any alternative. Many experiment irradiation facilities were provided for in the original design, and several others have been added (DOE 2000f).

HFIR transfers its primary coolant heat load to secondary coolant through heat exchangers for dissipation to the atmosphere by an induced-draft cooling tower. The reactor uses highly enriched uranium and aluminum-clad plate fuel. The reactor vessel itself is immersed in a pool in a poured-concrete reactor building that also houses the primary coolant pumps and heat exchangers, a spent fuel pool, and experiment areas. The control and water wing of the reactor building contains the reactor control room, relay and amplifier areas, heating and ventilating equipment, pool and fire alarm equipment, instrumentation systems, and office and support rooms. A separate electrical building adjacent to the reactor building contains switchgear, diesel generators, and associated transformers that connect the facility to offsite power. The reactor building is essentially airtight and provides dynamic confinement. A special hot-exhaust system exhausts air from potentially contaminated areas of the building through filters (two high-efficiency particulate air [HEPA] filters and two charcoal filters) before it is released to the atmosphere through a 76-meter (250-foot) stack. The stack serves as the exhaust point for both HFIR and REDC at ORNL (DOE 2000f).

After the reactor completed 17.2 full-power years of its 20-full-power-year design life in November 1986, several measures were taken to extend the useful life of the reactor, including reducing the 100 megawatts-thermal (3.4×10^{8} British thermal units per hour)-rated power level to 85 megawatts-thermal (2.9×10^{8} British thermal units per hour), adjusting the primary coolant temperature and pressure, conducting periodic hydrostatic tests, establishing an irradiation embrittlement surveillance program, and installing an emergency depressurization system. Subsequent life-extension programs could enable HFIR to provide support during the total 35-year evaluation period for operations (DOE 2000f).

The reactor core assembly is contained in a 2.44-meter-diameter (8-foot-diameter) pressure vessel in a pool of water. The top of the pressure vessel is 5.18 meters (17 feet) below the pool surface, and the reactor horizontal midplane is 8.38 meters (27.5 feet) below the pool surface. The control-plate drive mechanisms are in a subpile room beneath the pressure vessel. These features provide the necessary shielding for working above the reactor core and greatly facilitate access to the pressure vessel, core, and reflector regions (DOE 2000f).

The neutron flux within HFIR is primarily a thermal neutron flux ranging from approximately 2×10^{15} neutrons per square centimeter per second in the flux trap to approximately 4×10^{14} neutrons per square centimeter per second in the outer regions of the beryllium reflector. Specially designed neutron-beam tubes provide access to neutrons that supply intense neutron beams to various specialized instruments used for neutron scattering research (DOE 2000f).

2.3.1.4 Plutonium Facility at the Los Alamos National Laboratory

LANL's Plutonium Facility at TA-55 would continue to be used for purification, pelletization, and encapsulation as well as blending of plutonium-238 under the No Action Alternative and until construction is completed and facilities are operational under both the Consolidation and Consolidation with Bridge

Alternatives. Blending has always been an integral part of the purification, pelletization, and encapsulation process to meet the DOE specifications for chemical purity.

The Plutonium Facility at TA-55 was constructed beginning in 1972, and has been operating continuously since 1978 as a state-of-the-art laboratory facility for research and development on plutonium processing. The facility is located within a secure area at TA-55. The Plutonium Facility at TA-55 contains 7,000 square meters (8,372 square yards) of core area floor space for laboratory operations, of which about 790 square meters (945 square yards) are dedicated to plutonium-238 processing operations.

The ventilation system at the facility is designed to provide three levels of containment for contamination control. Direction of airflow, maintained by pressure gradients, is from the outermost areas of the building, where offices are located, to the laboratory areas, and then to the gloveboxes and conveyors that operate using an air atmosphere. All gloveboxes operate at lower pressure than the laboratories. All glovebox atmosphere is exhausted to the environment through an emissions control system that contains four stages of HEPA filters. Within each laboratory module, 10 percent of the air is exhausted to the atmosphere after passing through 2 HEPA filters, and 90 percent is passed through two HEPA filters before being recirculated into the laboratories. Thus, any contamination that might be released is retained within the area of emissions control, and air passes through two or more stages of HEPA filters before being released to the environment (DOE 1991).

All plutonium processing operations at the Plutonium Facility at TA-55 are performed in gloveboxes. For this work, the glovebox atmosphere for pellet fabrication work is inert argon, rather than air. This argon atmosphere is maintained at a pressure lower than that of the laboratory to prevent radioactive particulate material escaping into the laboratory. Each glovebox is equipped with a HEPA filter through which the gas flows before being exhausted into the main emissions control system. Gloveboxes used for welding have an atmosphere of helium, with conditions maintained by recirculating through an atmosphere-purifying system (DOE 1991).

Gloveboxes are interconnected by conveyor enclosure mounted on the facing sides of adjacent gloveboxes such that the plutonium and the inert atmosphere are contained within the enclosed system at all times. Material is introduced into the system through an airlock in the glovebox line and removed from the glovebox line through an airlock fitted with a contained removal (bag-out) system that prevents contaminated material from escaping into the laboratory (DOE 1991).

2.3.1.5 Fuel Manufacturing Facility

FMF at INL would be used for neptunium-237 storage under each alternative. FMF is located adjacent to the ZPPR facility at the MFC area at MFC at INL (see **Figure 2–8**) and is covered with an earthen mound. FMF was used to manufacture fuel for the Experimental Breeder Reactor (EBR)-II. The facility was completed in 1986 and was oversized for the EBR-II mission. The building includes a large SNM vault, an induction furnace, and gloveboxes and hoods, as well as other temporary experimental setups.

2.3.1.6 Assembly and Testing Facility

The Assembly and Testing Facility (also known as the Space and Security Power Systems Facility) would be used for the assembly and testing of RPSs under each alternative. The Assembly and Testing Facility is located in the southeast quadrant of the MFC at INL, south of the ZPPR and Building 784, and comprises Buildings 792 and 792A (see Figure 2–8). Building 792 is used as the administrative and operations support facility for Building 792A process operations, as well as for miscellaneous equipment support. Building 792A is the actual process operations building for assembly and acceptance testing of RPSs.

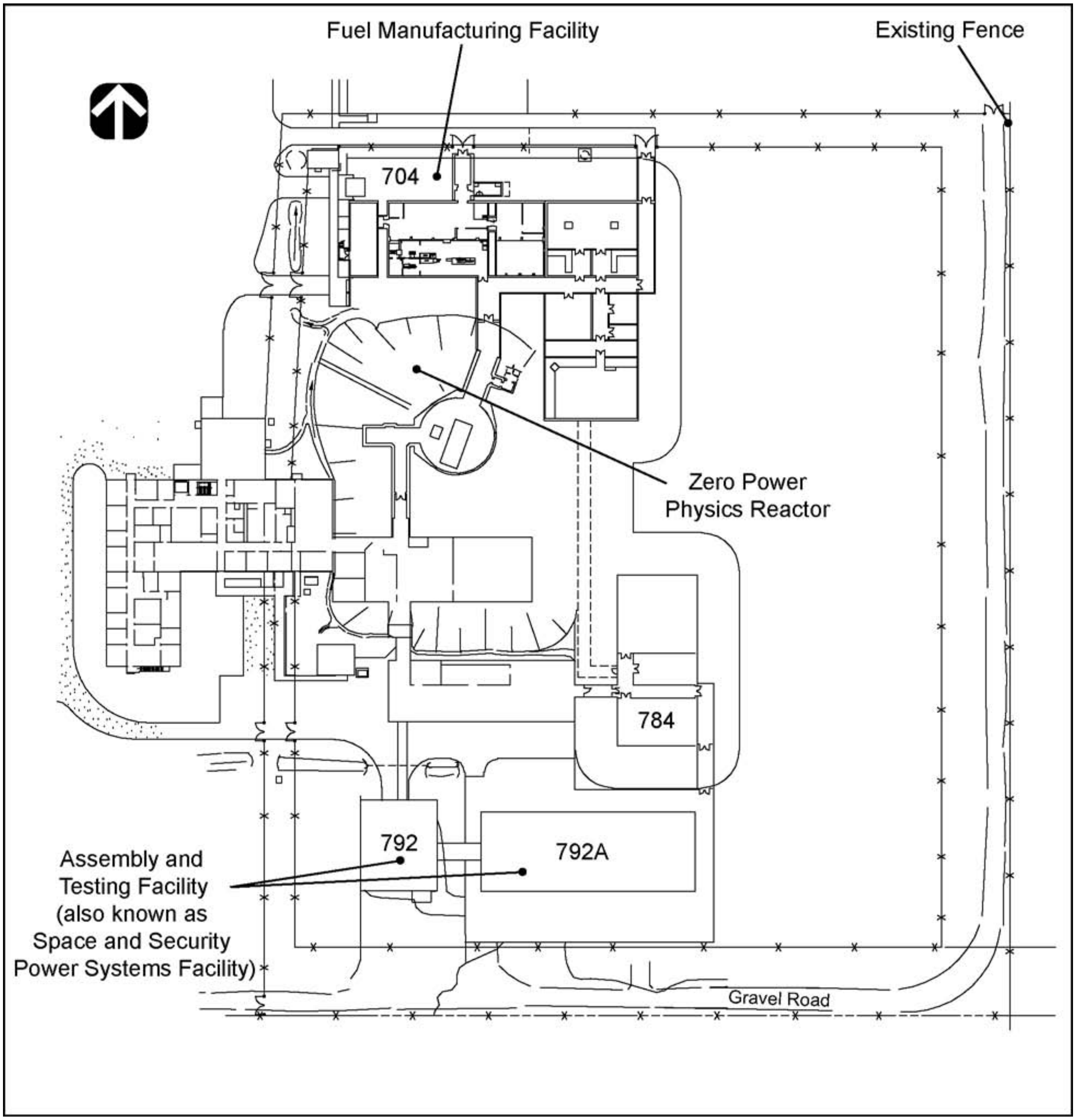


Figure 2–8 Fuel Manufacturing Facility Location within the Zero Power Physics Reactor Complex

Building 792 is approximately 15.2 meters (50 feet) wide, 18.3 meters (60 feet) long, and 7.6 meters (25 feet) tall. The walls are constructed of 30.5-centimeter-thick (12-inch-thick) masonry block and the roof deck is double-tee prestressed concrete. The building is freestanding, single story, and has an open bay area with office, conference room, and restrooms.

The main floor of Building 792A is 18.9 (62 feet) wide by 31 meters (101 feet, 8 inches) long. The second floor is 10.4 meters (34 feet) wide by 31 meters (101 feet, 8 inches) long. The building is approximately 9.1 meters (30 feet) tall. The main structure is constructed of 30.5-centimeter-thick (12-inch-thick) reinforced concrete exterior walls, including most of the interior walls. The second floor and roof are constructed of precast double-tee beams and concrete overlay. Building 792A is located 4 meters (13 feet) due east of

Building 792. The buildings are connected by an enclosed hallway between the east-wall double-door opening in Building 792 and the Building 792A double-door entrance on its west side.

2.3.2 New Consolidated Nuclear Operations Facilities

Under the Consolidation and Consolidation with Bridge Alternatives, target fabrication, post-irradiation processing, and purification, pelletization, and encapsulation of plutonium-238 would require construction of new nuclear operations facilities at the MFC at INL.

Construction would consist of two new facilities and an addition to an existing facility, several miscellaneous new equipment pads and enclosures for support utilities, and miscellaneous site work for drainage, connection to electrical and mechanical utilities, and paving from new buildings to existing site roads. The proposed construction consists of a new Plutonium-238 Facility, Support Building, Radiological Welding Laboratory, and a new road connecting the proposed new facilities at MFC to the ATR at the RTC (INL 2005c). **Figure 2–9** presents the area at the MFC at INL where the new facilities would be located. The location of the proposed new road and alternate new roads are shown in Figure 2–12.

The proposed new RPS nuclear production facilities are currently in the conceptual design stage and, as a result, are not described in detail in this EIS. Conservative values were used to represent construction requirements and operational characteristics of these new facilities to bound the environmental impacts. The potential impacts of implementing the final designs are expected to be less than those presented in this EIS.

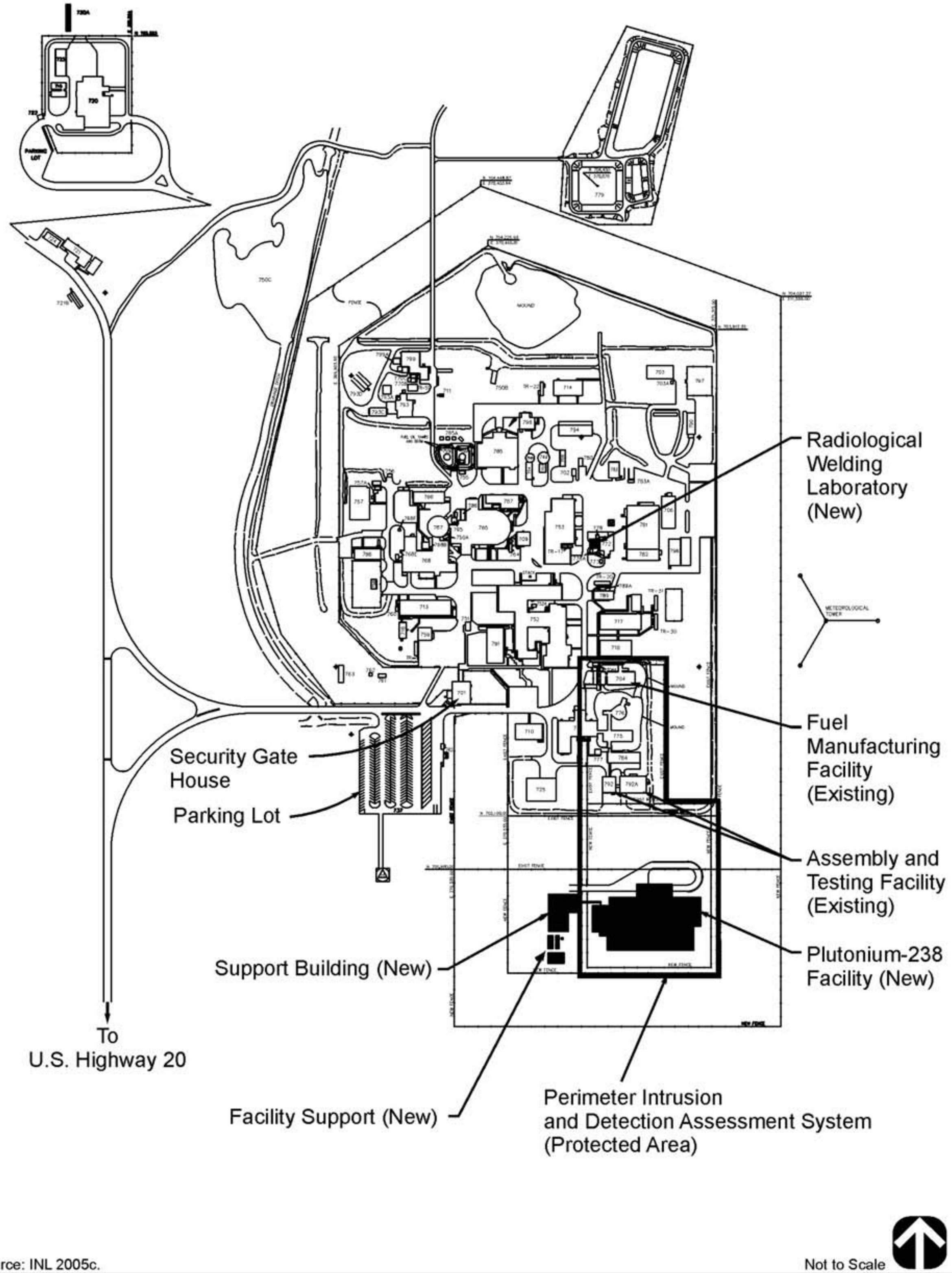
2.3.2.1 Plutonium-238 Facility

One of the proposed new facilities to be constructed at INL would be the Plutonium-238 Facility, located within the special security protected area of the MFC at INL. It would be used for neptunium-237 target fabrication; post-irradiation processing; and purification, pelletization, and encapsulation activities.

The Plutonium-238 Facility would be multistory and constructed from reinforced concrete, precast concrete, structural steel, and sheet metal. Due to safeguards and security measures, a major portion or all of the facility would be bermed with earth and other fill. The facility would consist of two wings: a production wing and a support wing. **Figure 2–10** shows the layout of this proposed new facility (INL 2005c).

The production wing would contain all of the process operations, which require a higher level of protection for safety and natural-phenomena hazards, such as seismic activity. It would have a basement level, a first floor near-grade level, and a second floor. Due to its higher natural-phenomena hazards, this wing would have reinforced concrete walls with precast beams or reinforced concrete floors and ceilings. Footings for the building and floors over grade would also be reinforced concrete. In addition, portions of the structure would utilize structural steel beams and columns with steel joints and sheet metal, specifically, top-floor levels and attached stair towers and vestibules. The total area of the wing's two floors would be approximately 14,100 square meters (152,000 square feet) (INL 2005c).

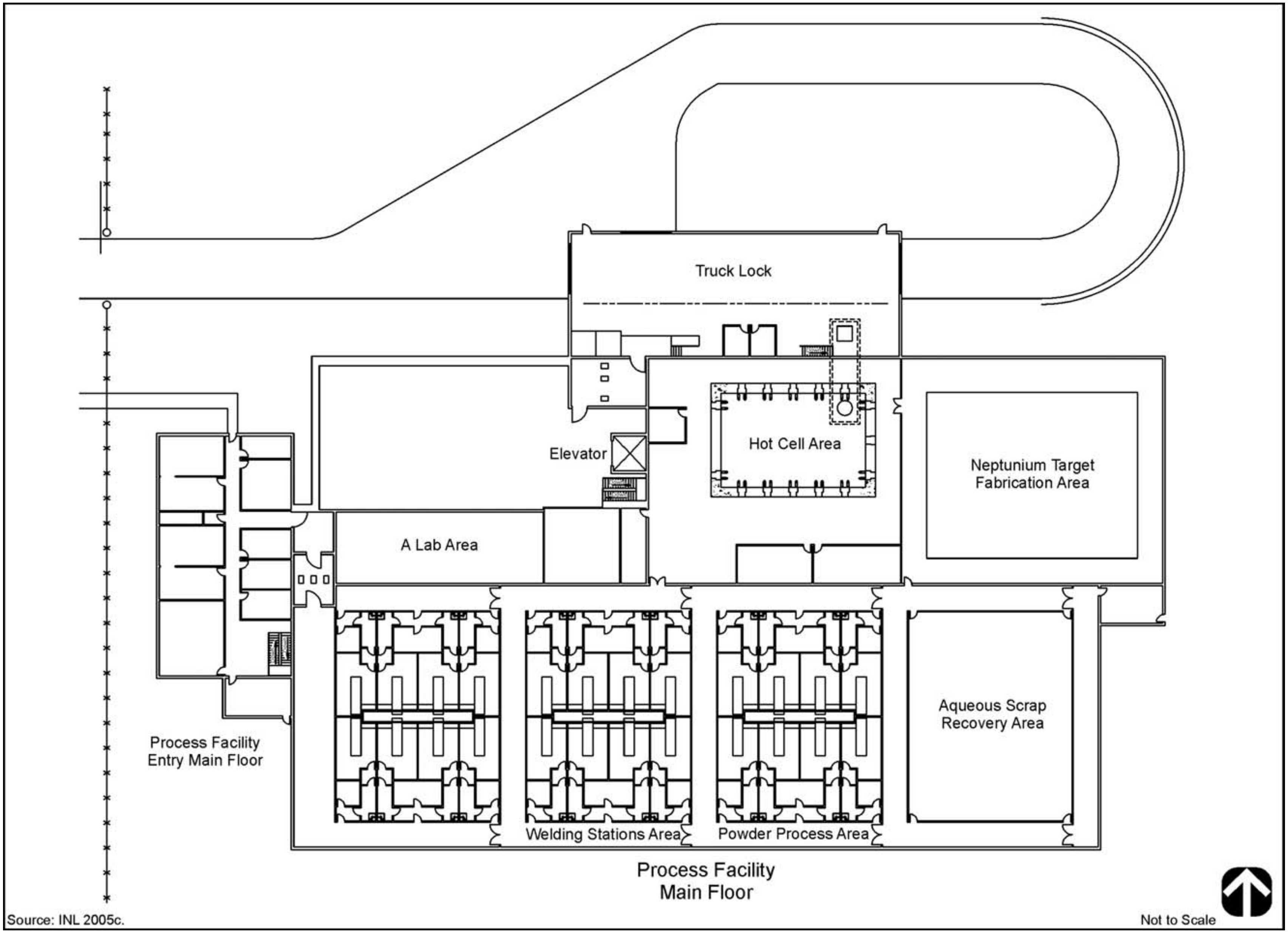
The production wing would have established physical confinement barriers consisting of walls, floors, ceilings, gloveboxes, and airlocks to prevent airborne contamination from escaping the facility. A minimum of two confinement barriers, primary and secondary, would separate any contamination from the exterior atmosphere. In addition, the wing would have exhaust systems with HEPA filters that would maintain airflow patterns and pressure differentials for proper contamination controls. The ventilation systems would work in conjunction with the physical barriers so that air would flow from clean areas toward areas of successively higher potential for radioactive contamination. Further, room pressures in these higher-potential areas would be lower than the outside atmospheric pressure, so any release would be contained within the facility. Exhausted air from the primary and secondary confinement barriers would be filtered by in-place efficiency-testable HEPA filters and then discharged to the building exhaust (INL 2005c).



Source: INL 2005c.

Not to Scale

Figure 2–9 Proposed Radioisotope Power Systems Consolidation Facilities at the Materials and Fuels Complex



Source: INL 2005c.

Not to Scale

Figure 2–10 Proposed New Plutonium-238 Facility at the Materials and Fuels Complex (Conceptual)

The support wing would have offices for the facility operations management team, a training room, restrooms, and would house security support personnel. The support wing could be designed to a lower natural-phenomena hazards performance category because no nuclear material operations would take place in the wing. The one-story support wing would be connected to the production wing. The wing would be constructed of reinforced concrete, precast beams, structural steel, insulated exterior metal siding and roofing, steel joints, concrete-slab floors, on-grade main floor, and metal pan and concrete fill for the second floor (if a second floor is required). The total area of the wing's two floors would be approximately 840 square meters (9,000 square feet) (INL 2005c).

Because the support wing would be connected to the production wing, room pressures in the support wing would be maintained at higher levels than in the production wing. This would prevent any contamination released in the production wing from migrating to the support wing. Further, the heating, ventilation, and air conditioning systems in each wing would be separate from one another to avoid mixing of air (INL 2005c).

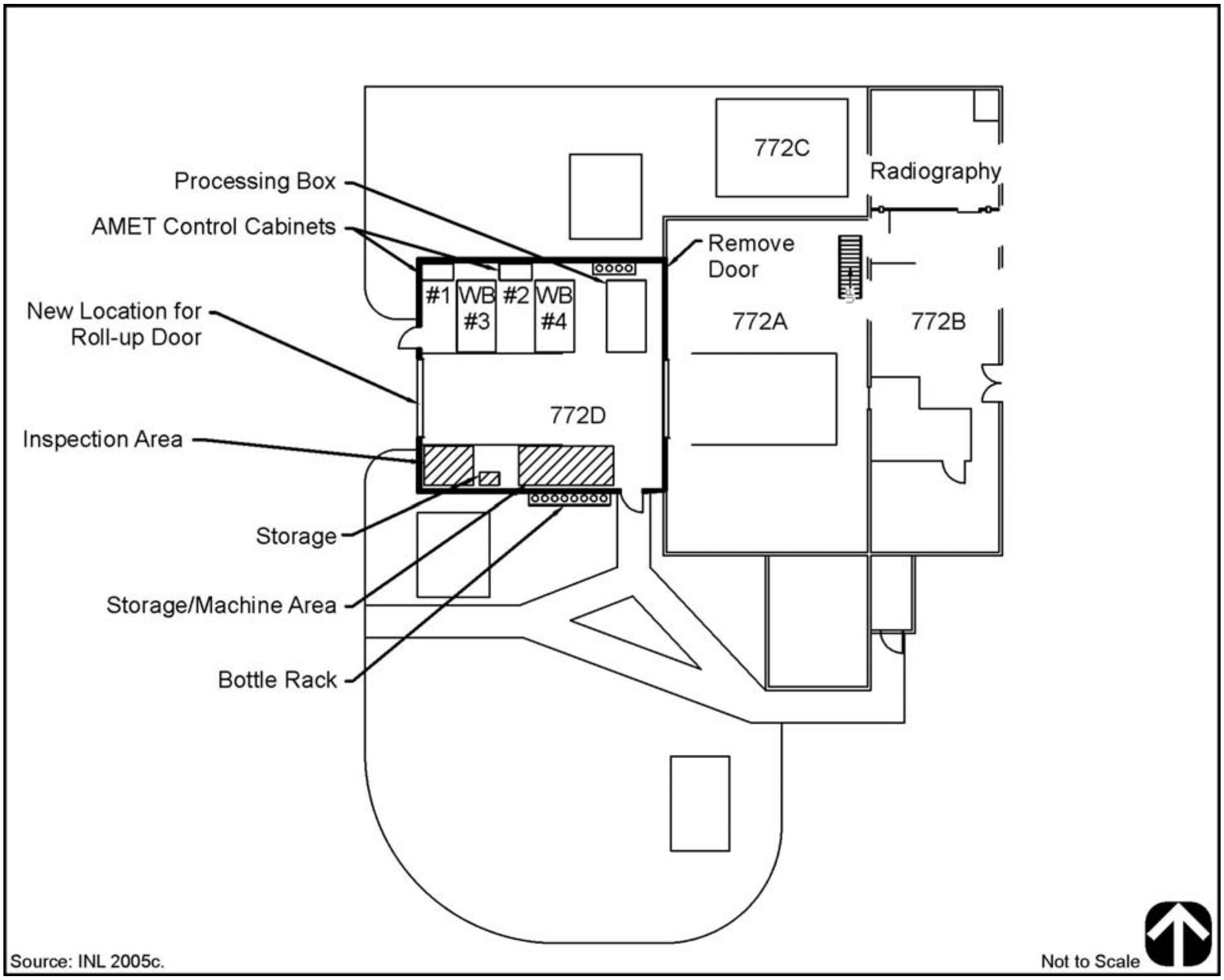
The production wing would devote substantial areas to waste processing. There would be special powder-processing stations within the wing for process scrap and off-specification material, dedicated to recovering the plutonium from waste materials and inserting it back into the main production process. Suspect contaminated wastes (both combustible and noncombustible, including out-of-box items such as personnel protective clothing), would likely qualify as low-level radioactive waste. Plutonium-process-contaminated noncombustibles would be packaged as transuranic waste for eventual shipment to the Waste Isolation Pilot Plant, near Carlsbad, New Mexico. Plutonium-process-contaminated solid combustible residues, which consist of in-glovebox job-control residues and components known to have been in direct contact with plutonium, such as tubing, plastic bottles, and glovebox gloves, would very likely be contaminated with measurable amounts of plutonium and would be sent to the residue reprocessing stations in the production wing (INL 2005c).

2.3.2.2 Support Building

The Support Building to the Plutonium-238 Facility, located outside of the protected area adjacent to the Plutonium-238 Facility, but physically separate, is another new facility proposed for construction at the MFC. It would provide a typical, office-type environment for its occupants. The building would contain a security entry/exit post for personnel entering and exiting the protected area. It would also contain restrooms, offices, and a conference room for mission-related personnel, and would have a main-floor level at grade with a second floor built above it. The Support Building would be constructed of structural steel, insulated exterior metal siding and roofing, steel joists, reinforced-concrete slab on-grade main floor, and metal pan and concrete fill for the second floor. The total area of the building's two floors would be approximately 2,900 square meters (30,750 square feet). No radioactive materials would be handled, and no waste processing or storage would be performed in this building (INL 2005c).

2.3.2.3 Radiological Welding Laboratory

The proposed new Radiological Welding Laboratory would be used for welding research and development in support of RPS nuclear production operations. This proposed new facility would be an addition (772D) to the existing Building 772 (772A, 772B, 772C) north of the ZPPR complex (see Figure 2–9 and **Figure 2–11**). Construction would consist of either reinforced concrete footings with structural steel columns and beams with insulated sheet metal wall and roof panels or reinforced-concrete walls with precast roof. The total area of the Radiological Welding Laboratory would be approximately 280 square meters (3,000 square feet) (INL 2005c).

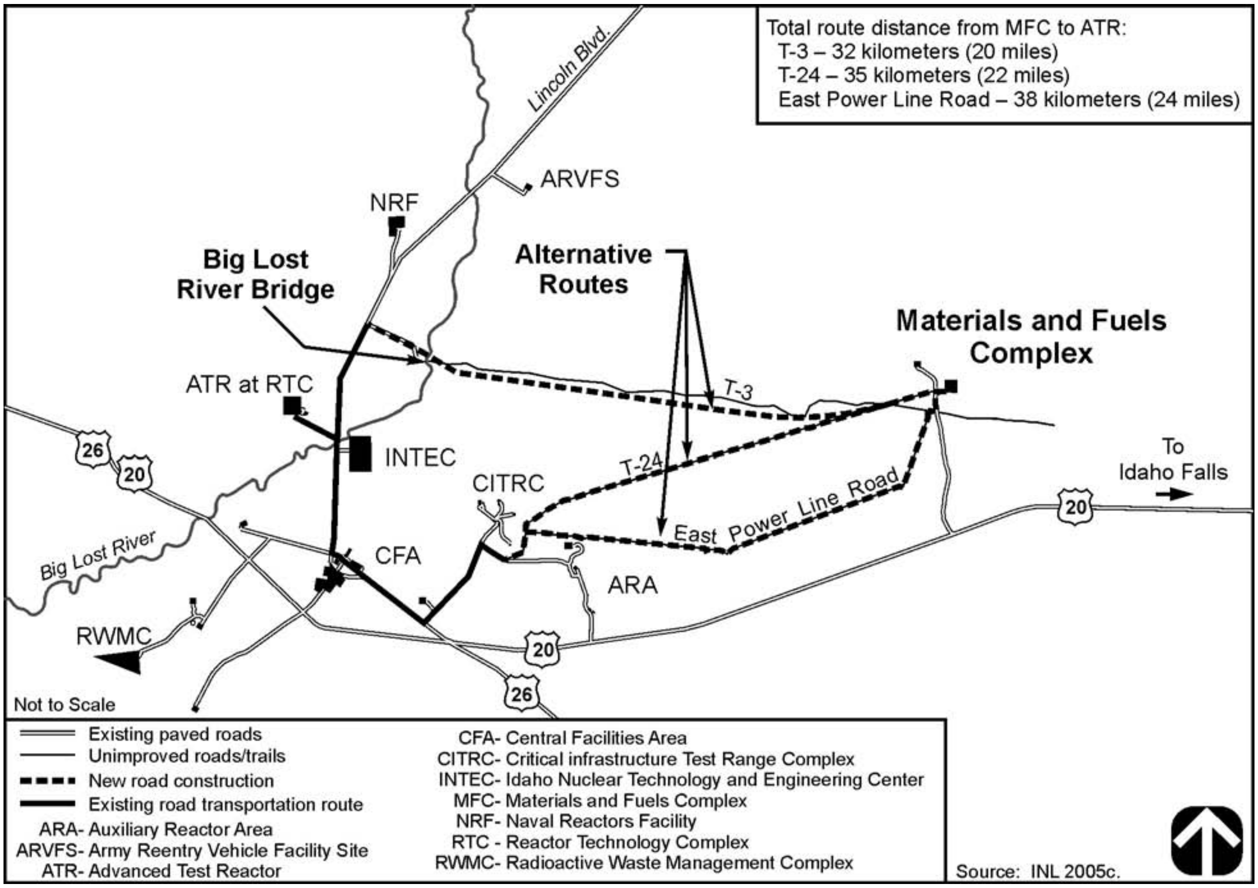


Source: INL 2005c.

Figure 2–11 Proposed New Radiological Welding Laboratory

2.3.2.4 New Road

A new road would be required to provide appropriate security measures for the transfer of targets between the MFC and ATR at INL and preclude shipment on public roads. DOE initially considered three alternative routes: the T-3, T-24, and the East Power Line Road routes. The new route designated T-3 has been subsequently dismissed from consideration (see Section 2.2.4.3). **Figure 2–12** presents these routes. The proposed new road at INL would be constructed between the Plutonium-238 Facility at MFC and ATR at the RTC, as shown in Figure 2–12. The road would be paved with asphalt over a compacted granular base. Width of the asphalt pavement would be approximately 6.7 meters (22 feet) with 2.7-meter (9-foot) granular shoulders on either side. The width of the construction corridor would be 18 meters (60 feet). Due to security requirements, the new road would be a Government road, with access restricted to INL contractor material transfers only and other official DOE projects (INL 2005c). The entire length of this restricted access road would be on DOE property. Each end would have swing-type closure gates, which would be padlocked shut when not in use. Additionally, warning signs would be located on either side of each gate advising the use of this road is for official DOE business only. Additional studies of all three routes including ecological and cultural resource surveys and regulatory consultations will be completed with the results presented in the Final EIS.



Source: INL 2005c.

Figure 2–12 New Road Alternative Routes

The T-3 Road, the northern and most direct route, would require that a new bridge be constructed across the Big Lost River. This bridge crossing would require a floodplain/wetlands assessment. A Preliminary Floodplain/Wetlands Assessment for this crossing has been prepared and included as Appendix F. Additional studies including a wetlands delineation for the T-3 Road crossing of the Big Lost River will be completed with the results presented in the Final EIS. In addition, approximately 24 kilometers (15 miles) of new road would need to be paved before the new road connects to internal INL paved roads north of the RTC.

The T-24 Road is located south of the T-3 Road. Approximately 16 kilometers (10 miles) would need to be paved from the MFC until the road reaches the Critical Infrastructure Test Range Complex (CITRC) (formerly the Power Burst Facility) and connects to approximately 19 kilometers (12 miles) of INL internal roads leading to the RTC (INL 2005c). Although less direct than following the T-3, this route would use an existing bridge crossing.

The East Power Line Road is located south of both the T-3 and T-24 Roads. An advantage is that this road is currently maintained at a higher level than the T-3 and T-24 routes because of ongoing power line maintenance. As with the T-24 Road, approximately 19 kilometers (12 miles) would need to be paved from the MFC before the new road connects to internal INL paved roads at CITRC (INL 2005c). This route would use an existing bridge crossing.

2.4 Construction Requirements

The construction requirements discussed below pertain only to the proposed new construction at INL. Modifications to existing facilities, such as REDC at ORNL, were analyzed in the *NI PEIS*.

Construction methods and materials employed on the project would be typical conventional light-industrial[3] for the administrative offices and support functions building and heavy-industrial, nuclear facility construction for the nuclear laboratory elements.

All construction work would be planned, managed, and performed to ensure that standard worker safety goals are met. All work would be performed in accordance with good management practices, with regulations promulgated by the Occupational Safety and Health Administration, and in accordance with various DOE Orders involving worker and site safety practices. To prevent serious injuries, all site workers (including contractors and subcontractors) would be required to submit and adhere to a construction safety and health plan. Following approval of this plan, site inspectors would routinely verify that construction contractors and subcontractors were adhering to the plan, including all Federal and state health and safety standards (INL 2005c).

Site work would be required to support the new facilities and the new addition. Site grading would be required for proper stormwater drainage away from the facilities. New underground duct banks, manholes, steam and condensate piping, potable water, fire protection water, compressed air piping, inert gas piping, chilled water, and refrigeration piping would be required for connection of the new facilities and addition to the existing site utilities and new support equipment. New concrete walks and aprons with asphalt paved roads would be required for connecting the new facilities to the rest of the site's infrastructure of roads and sidewalks (INL 2005c).

The site is situated over lava beds, with outcroppings apparent around the site. One such outcropping is located just east of the existing Assembly and Testing Facility (see Figure 2–7). Rock excavation, especially excavation of lava rock, can be costly. In an effort to avoid large quantities of rock excavation, a site for the Plutonium-238 Facility has tentatively been selected that is directly south of the Assembly and Testing Facility. An alternate location to be examined is less than a mile east of the Assembly and Testing Facility but within the PIDAS and the observed outcropping. Either of these locations provides sufficient building space to allow the side of the Plutonium-238 Facility to be shifted laterally if necessary to miss or reduce the amount of rock excavation that would be encountered for placement of its basement footings. Another criterion to judge the site location would be the connection of the new facility to existing site utilities, such as sanitary waste, steam and condensate, and potable water. This would have to be evaluated on a cost basis along with the rock excavation costs of each site to determine the best option with the least cost (INL 2005c). No additional NEPA analysis would be required for this alternate location because the impacts would be the same or bounded by the impacts assessed in this EIS.

Construction of the proposed new facilities at the MFC is expected to last approximately 2 years (2008 and 2009). The facilities would be operational beginning in 2011 (INL 2005c).

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[3] *Light industry refers to the use of small-scale construction machinery.*

2.5 Summary of Environmental Consequences Analyzed in the Environmental Impact Statement

2.5.1 Introduction

This section presents a comparison of the potential environmental impacts associated with the alternatives for RPS production to aid the reader in understanding the differences among the three alternatives. The information in this section is based on the descriptions of each alternative presented earlier in this chapter and the potential environmental consequences (presented in Chapter 4). Because the potential environmental impacts associated with each of the alternatives can be described in terms of construction impacts and operations impacts, the potential impacts are compared in those two areas. **Table 2–3** at the end of this chapter provides quantitative information that supports the text below.

2.5.2 Construction Impacts

No Action Alternative—Under the No Action Alternative, as described in Section 2.2.1, there would be no new construction. Accordingly, no environmental impacts would result from construction under this alternative, beyond those described for the modification of the REDC in the *NI PEIS*.

Consolidation Alternative—Under the Consolidation Alternative, as described in Section 2.2.2, there would be impacts associated with constructing the new facilities and the new road at INL. Several new buildings would be constructed at the MFC at INL, disturbing approximately 24 hectares (60 acres) of land. Up to an additional 51 hectares (125 acres) of land would be disturbed for the new road. Disturbance of this land could impact land use and ecological and cultural resources. Construction of buildings in the MFC administrative area would be consistent with the industrial land use in this area. Construction of the new road would change the land use of this corridor, but would be consistent with the land use in the INL core zone. One of the three routes analyzed would require a floodplain/wetlands assessment (see Appendix F).

Construction outside the fenced areas of the MFC would remove all vegetation, which consists of big sagebrush habitat, as well as some areas of crested wheatgrass. Construction would affect animal populations. Less-mobile animals such as reptiles and small mammals are not expected to survive. Ground disturbance could be scheduled to avoid the breeding season of birds so that nests would be avoided. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby.

The EBR-II, designated as a Nuclear Historical Landmark by the American Nuclear Society, would not be impacted by the construction. A cultural resources study would be conducted at the proposed construction sites prior to any construction activities. Any prehistoric or historic resources, including those that are or may be eligible for listing on the National Register of Historic Places, would be identified. Special care would be taken to identify any cultural resources during the construction of the new road. These resources would be identified through site surveys and consultation with the State Historic Preservation Officer. No decision would be made relative to the use of existing buildings, the construction of any proposed facilities, or the new road prior to completion of the consultation process with the State Historic Preservation Office. Specific concerns about the presence, type, and location of American Indian resources would be addressed through consultation with the potentially affected tribes in accordance with the Agreement-in-Principle between the Shoshone-Bannock Tribes and DOE, dated December 10, 2002, as well as the National Historic Preservation Act, the Native American Graves Protection and Repatriation Act, and the American Indian Religious Freedom Act, as applicable.

Construction activities would likely result in no or minor impacts on site infrastructure, geology and soils, water resources, and socioeconomics. Construction activities could result in small temporary increases in concentrations of criteria air pollutants, but these would be below ambient air quality standards. Any increases in noise would be temporary and would be imperceptible at the site boundary, which is approximately 6.4 kilometers (4 miles) from the MFC. Construction activities would not result in radiological impacts to the health and safety of the public or facility workers. Waste generated during construction would be adequately managed by the existing INL waste management infrastructure, including the use of offsite commercial waste management facilities.

Consolidation with Bridge Alternative—Under the Consolidation with Bridge Alternative, as described in Section 2.2.3, impacts associated with constructing the new facilities and the new road at INL would be identical to those under the Consolidation Alternative. See Consolidation Alternative for a summary of these impacts.

2.5.3 Operations Impacts

RPS production capabilities would use similar facilities, procedures, resources, and numbers of workers during operations, regardless of the location of the facilities. As such, similar infrastructure support would be needed, similar emissions and waste would be produced, and similar impacts on workers would occur. Under each alternative, the environmental conditions would be different (e.g., population, site boundaries, meteorology, etc.). These site differences would lead to some differences in environmental impacts based on the same operations. For most environmental areas of concern, however, these differences would be minimal. There would be no significant operations impact differences among the alternatives on land resources, site infrastructure, geology and soils, water resources, air quality, noise, ecological resources (including threatened and endangered species), cultural resources, socioeconomics, or worker risks. Additionally, all alternatives have adequate existing waste management facilities to treat, store, and/or dispose of waste that would be generated by these operations. Under all alternatives, all impacts would be within regulated limits and would comply with Federal, state, and local requirements.

There would be small differences in potential radiological impacts on the public among the alternatives. However, for all alternatives, public radiation exposure would be small and well below regulatory limits and limits mandated by DOE Orders. For all sites, the maximally exposed offsite individual would receive less than 4.5×10^{-6} millirem per year from normal operational activities. This corresponds to a 35-year excess latent cancer fatality (LCF) risk of 9.5×10^{-11}. DOE Order 5400.5 has a public exposure limit of 100 millirem per year at the site boundary. The impacts of consolidation of RPS operations at INL would be the smallest because of the remoteness of the site, leading to lower public radiation exposure. Under all alternatives, the total dose to the population within 80 kilometers (50 miles) would be no more than 1.5×10^{-4} person-rem per year from radiological releases during normal operations. This corresponds to a 35-year excess LCF risk of 3.2×10^{-6} among the exposed population.

Potential impacts of accidents were estimated using computer modeling. In the event of an accident involving operational activities, the projected population risk of LCF under the No Action Alternative would be 4.5×10^{-3}; under the Consolidation Alternative would be 5.1×10^{-5}; and for the Consolidation with Bridge Alternative 2.5×10^{-4}. Overall, activities under the No Action Alternative would produce the highest potential accident impact, primarily due to the fact that existing facilities at ORNL and LANL are located closer to the general public than the facilities at INL under the Consolidation Alternative.

Effects of radiological exposure to the public and worker health and safety are discussed in Appendix C of this EIS.

2.5.4 Transportation Risks

One of the major differences between the alternatives is that the No Action Alternative would require continuing intersite transportation of radioactive materials between INL, ORNL, and LANL, whereas the Consolidation Alternative would require continuing transportation only within the boundaries of INL. Transportation impacts under the Consolidation with Bridge Alternative would be less under the No Action Alternative for 5 years and would be the same as under the Consolidation Alternative for 35 years. The inventory of plutonium-238 at LANL and Pantex would be transported to INL from 2009 to 2022 and would not be dependent on the completion of new facilities at INL under the Consolidation and Consolidation with Bridge Alternatives. Although the potential risks would differ among the alternatives, primarily as a function of the transportation distance, the impacts would be very small. Under all alternatives, the potential risks of such transportation would be small, with no LCFs expected for the worker or the general population, and no fatalities expected as a result of traffic or radiological accidents.

2.5.5 Preferred Alternative

Council on Environmental Quality regulations require an agency to identify its Preferred Alternative(s), if one or more exists, in the Draft EIS (40 CFR 1502.14[e]). The Preferred Alterative is the alternative that the agency believes would fulfill its statutory mission, giving consideration to environmental, economic, technical, and other factors. The Preferred Alternative for the *Consolidation EIS* is to consolidate RPS nuclear operations at INL, as proposed under the Consolidation Alternative. The selection of this as the Preferred Alternative is based on security, transportation, mission, and programmatic factors. There is no preferred route between the MFC and ATR at INL under the Consolidation and Consolidation with Bridge Alternatives.

2.5.6 Key Environmental Findings

Based on the analyses completed for this *Consolidation EIS*, certain key findings were identified. These key findings are summarized below.

- Transportation impacts would be higher under the No Action Alternative than under the Consolidation or Consolidation with Bridge Alternatives, primarily due to no interstate transportation being required for new plutonium-238 production after the consolidation of nuclear operations at INL.

- Consolidated nuclear operations at INL would result in the lowest radiological risk to the public during normal operations and from accidents and to workers from accidents; nuclear operations at ORNL under the No Action Alternative would have the highest radiological risk of the three alternatives to the public during normal operations and from accidents.

- Construction of new RPS nuclear production facilities and a new road at INL would have an impact on land, water, air quality, ecological, and cultural resources under the Consolidation and Consolidation with Bridge Alternatives. Depending on the chosen routing, impacts to the Big Lost River floodplain could also occur.

- Operations impacts would be very small under each alternative, including radiological impacts to workers during normal operations, as well as air quality and noise impacts, socioeconomics impacts, public health and safety impacts from radiological and chemical accidents, environmental justice impacts, or cumulative impacts.

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Table 2–3 Summary of Environmental Consequences of Alternatives

Resource	*No Action Alternative*		*Consolidation Alternative*		*Consolidation with Bridge Alternative*	
	INL		*INL*		*INL*	
Land Resources						
Construction (total land disturbed)	No impact due to no construction		New facilities - 24 ha / New road - up to 51 ha			
Operations (total land occupied)	No impact due to use of existing facilities		New facilities - 12 ha [a] / New road - up to 36 ha [b]			
Site Infrastructure						
Construction (total requirements)	No impact due to no construction		204,000 liters diesel fuel, 397,000 liters gasoline, 148,000 liters propane, 1.64 M liters water, 22 kilometers of new road			
Operations (annual requirements)	2,039 megawatt-hours electricity, 189,000 liters fuel oil, 27.5 M liters water		10,639 megawatt-hours electricity, 989,000 liters fuel oil, 87,000 liters diesel fuel, 16,300 liters gasoline, 74.4 M liters water			
Geology and Soils						
Construction	No impact due to no construction		Minor soil erosion, bedrock excavation, 255,000 cubic meters borrow material			
Operations	No impact due to use of existing facilities		No impact from existing and new facilities			
Water Resources and Floodplain						
Construction	No impact due to no construction		Potential for new bridge construction (T-3 route) would encroach on the Big Lost River floodplain; other routes would use existing bridge			
Operations (annualized impacts)	27.5 M liters water, 27.5 M liters sanitary wastewater		74.4 M liters water, 0.023 M liters process wastewater, 74.4 M liters sanitary wastewater			
Air Quality and Noise						
Construction	No impact due to no construction		Minor temporary nonradiological air and noise impact			
Operations	Minor nonradiological air and noise impact		Minor nonradiological air and noise impact			
Ecological Resources						
Construction	No impact due to no construction		New facilities and new road - shrub-steppe/grassland disturbed; minimal impacts to wetlands, aquatic resources, or threatened and endangered species; some disturbance to wildlife			
Operations	No impact due to use of existing facilities		New facilities - 12 ha permanently disturbed; new road - up to 36 ha permanently disturbed; minimal impacts to wetlands, aquatic resources, and threatened and endangered species			
Cultural Resources						
Construction	No impact due to no construction		Construction of new facilities and road could impact cultural resources. A cultural resource survey would be conducted prior to construction			
Operations	No impact due to use of existing facilities		No impact from existing and new facilities			
Socioeconomics						
Construction	No impact due to no construction		No noticeable changes; 245 workers (peak)			
Operations	No impact due to use of existing facilities		No noticeable changes; potential for up to 75 new jobs			
Public Health and Safety - Normal Operations (annual)	***Dose***	***LCF (35-year)***	***Dose***	***LCF (35-year)***	***Dose ****	***LCF ****
Population dose (person-rem/yr)	1.7×10^{-6}	3.5×10^{-8}	1.9×10^{-5}	4.1×10^{-7}	1.2×10^{-6} / 1.9×10^{-5}	3.5×10^{-9} / 4.1×10^{-7}
Average individual dose (rem/yr)	4.7×10^{-12}	9.9×10^{-14}	5.4×10^{-11}	1.1×10^{-12}	4.7×10^{-12} / 5.4×10^{-11}	1.4×10^{-14} / 1.1×10^{-12}
MEI dose (rem/yr)	1.4×10^{-10}	2.9×10^{-12}	1.6×10^{-9}	3.4×10^{-11}	1.4×10^{-10} / 1.6×10^{-9}	4.2×10^{-13} / 3.4×10^{-11}
Total worker dose (person-rem/yr)	1.2	0.025	32.2	0.68	1.2 / 32.2	0.0036 / 0.68
Average worker dose (rem/yr)	0.017	3.6×10^{-4}	0.49	0.010	0.017 / 0.49	5.1×10^{-5} / 0.010
Public Health and Safety - Radiological Accidents (maximum annual cancer risk, LCF)						
Population	0.0026 LCF		5.1×10^{-5} LCF			
MEI	3.0×10^{-8} LCF		8.2×10^{-8} LCF			
Noninvolved worker	3.0×10^{-7} LCF		2.3×10^{-6} LCF			
Public Health & Safety - Chemical Accidents						
Site boundary concentration	0		Less than ERPG-1			
Environmental Justice	No disproportionately high and adverse impacts on minority or low-income populations					
Waste Management (annual cubic meters)						
Transuranic waste	**		20			
Low-level radioactive waste	1		215			
Mixed low-level radioactive waste	**		5.4			
Hazardous waste	**		6,500 kilograms			
Transportation (program total)						
Incident free – population	22.1 person-rem / 0.013 LCF		0.43 person-rem / 0.00026 LCF [c]			
Incident free – workers	14.6 person-rem / 0.009 LCF		0.77 person-rem / 0.00046 LCF [c]			
Accidents – population (radiological)	0.0038 person-rem / 2.3×10^{-6} LCF		0.0002 person-rem / 1.25×10^{-7} LCF [c]			
Accidents – traffic fatalities	0.036		0.00042			
Cumulative Impacts	Minimal impact					

ha = hectares, LCF = latent cancer fatality, M = million, NA = not applicable, MEI = maximally exposed individual, ERPG = Emergency Response Planning Guideline.

* The first number is for doses during the time period 2007-2011 and 5-year LCFs. The second number is for doses during the period 2012-2047 and 35-year LCFs.

** The amount is insignificant, or minimal waste is generated.

[a] New facilities would not change Visual Resource Contrast rating of affected areas.

[b] New road would likely change Visual Resource Contrast rating along currently undeveloped portions of proposed route.

Table 2–3 Summary of Environmental Consequences of Alternatives (continued)

No Action Alternative		***Consolidation with Bridge Alternative***		***All Alternatives***		
ORNL		***ORNL***		***LANL***		
No impact due to no construction				No impact due to no construction		
No impact due to use of existing facilities				No impact due to use of existing facilities		
No impact due to no construction				No impact due to no construction		
Negligible increase in electricity, 2.86 M liters water				870 megawatt-hours electricity, 78,000 cubic meters natural gas, 0.19 M liters water		
No impact due to no construction				No impact due to no construction		
No impact due to use of existing facilities				No impact due to use of existing facilities		
No impact due to no construction				No impact due to no construction		
2.86 M liters water, 0.025 M liters process wastewater, 2.83 M liters sanitary wastewater				0.19 M liters water, < 0.0012 M liters process wastewater, 0.19 M liters sanitary wastewater		
No impact due to no construction				No impact due to no construction		
Minor nonradiological air impact and noise impact				Minor nonradiological air and noise impact		
No impact due to no construction				No impact due to no construction		
No impact due to use of existing facilities				No impact due to use of existing facilities		
No impact due to no construction				No impact due to no construction		
No impact due to use of existing facilities				No impact due to use of existing facilities		
No impact due to no construction				No impact due to no construction		
No impact due to use of existing facilities				No impact due to use of existing facilities		
Dose	***LCF (35-year)***	***Dose ****	***LCF ****	***Dose***	***LCF (35-year)*** [d]	***LCF (5-year)*** [e]
1.5×10^{-4}	3.2×10^{-6}	4.8×10^{-5} / NA	1.4×10^{-7} / NA	1.8×10^{-5}	3.8×10^{-7}	5.4×10^{-8}
1.1×10^{-10}	2.2×10^{-12}	4.2×10^{-11} / NA	1.3×10^{-13} / NA	3.0×10^{-11}	6.3×10^{-13}	9.0×10^{-14}
4.5×10^{-9}	9.5×10^{-11}	1.8×10^{-9} / NA	5.4×10^{-12}	1.0×10^{-9}	2.1×10^{-11}	3.0×10^{-12}
12	0.25	12 / NA	0.036 / NA	19	0.4	0.057
0.170	0.0036	0.170 / NA	5.1×10^{-4} / NA	0.240	0.005	7.1×10^{-4}
0.0045 LCF		1.7×10^{-4} LCF		0.00025 LCF		
1.6×10^{-6} LCF		6.4×10^{-7} LCF		1.4×10^{-7} LCF		
1.0×10^{-5} LCF		1.2×10^{-5} LCF		2.3×10^{-6} LCF		
Less than ERPG-1				0		
No disproportionately high and adverse impacts on minority or low-income populations						
11		4.4		13		
60		24		150		
Less than 5		Less than 2		0.34		
6,500 kilograms		2,600 kilograms		**		
				35-Year [d]	***5-Year*** [e]	
22.1 person-rem / 0.013 LCF		0.89 person-rem / 0.00053 LCF [c]		22.1 person-rem / 0.013 LCF	3.2 person-rem / 0.0019 LCF	
14.6 person-rem / 0.009 LCF		1.33 person-rem / 0.00081 LCF [c]		14.6 person-rem / 0.009 LCF	2.09 person-rem / 0.0013 LCF	
0.0038 person-rem / 2.3×10^{-6} LCF		0.0004 person-rem / 2.44×10^{-7} LCF [c]		0.0038 person-rem / 2.3×10^{-6} LCF	0.00054 person-rem / 3.3×10^{-7} LCF	
0.036		0.00061		0.036	0.0051	
Minimal impact				Minimal impact		

[c] Includes one-time transportation of available and usable plutonium-238 from LANL and Pantex to MFC at INL.

[d] No Action Alternative - continuing operations.

[e] Consolidation and Consolidation with Bridge Alternative - operation through 2011.

CHAPTER 3
AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

This chapter describes the affected environments at Idaho National Laboratory (INL) in Idaho, Los Alamos National Laboratory (LANL) in New Mexico, and Oak Ridge National Laboratory (ORNL) in Tennessee as they appear today. This information provides the context for understanding the environmental consequences and also serves as a reference from which environmental changes brought about by the actions proposed for implementation under both the No Action and the action alternatives in this environmental impact statement (EIS) can be evaluated. The affected environments at INL, LANL, and ORNL are described for the following areas: land resources, site infrastructure, geology and soils, water resources, air quality and noise, ecological resources, cultural resources, socioeconomics, human health risk, environmental justice, waste management and pollution prevention, and environmental restoration.

3.1 Introduction

In accordance with the Council on Environmental Quality, National Environmental Policy Act (NEPA) implementing regulations (40 *Code of Federal Regulations* [CFR] 1500 through 1508) for preparing an EIS, the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." The affected environment descriptions presented in this chapter provide the context for understanding the environmental consequences described in Chapter 4 of this EIS. They serve as a reference from which any environmental changes brought about by implementing the Proposed Action and alternatives can be evaluated; the reference conditions are the currently existing conditions.

For this *Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)*, the candidate sites are INL, LANL, and ORNL (located within the boundaries of the Oak Ridge Reservation [ORR]). For each U.S. Department of Energy (DOE) site, each resource area is described, first for the overall DOE site as a whole, and then for the specific location(s) within the site that may be particularly affected by the Proposed Action and alternatives. The level of detail varies depending on the potential for impacts resulting from each alternative.

The following site-specific and recent project-specific documents were important sources of information in describing the existing environment at each of the candidate sites. Numerous other sources of site- and resource-related data were also used in the preparation of this chapter and are cited as appropriate.

- *Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico (LANL SWEIS)*, DOE/EIS-0238 (DOE 1999a)

- *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS)*, DOE/EIS-0310 (DOE 2000f)

- *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)*, DOE/EIS-0319 (DOE 2002d)

- *Finding of No Significant Impact and Final Environmental Assessment for the Future Location of the Heat Source/Radioisotope Power System Assembly and Test Operations Currently Located at the Mound Site*, DOE/EA-1438 (DOE 2002c)
- *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement,* DOE/EIS-0287 (DOE 2002e)

DOE evaluated the environmental impacts of the Proposed Action within defined regions of influence at each of the candidate sites and along potential transportation routes. The regions of influence are specific to the type of effect evaluated and encompass geographic areas within which any significant impact would be expected to occur. For example, human health risks to the general public from exposure to airborne contaminant emissions were assessed for an area within an 80-kilometer (50-mile) radius of the proposed facilities. The human health risks of shipping materials between sites were evaluated for populations living along roadways linking the DOE sites. Economic effects such as job and income changes were evaluated within a socioeconomic region of influence that includes the county in which the site is located and nearby counties in which substantial portions of the site's workforce reside. Brief descriptions of the regions of influence are given in **Table 3–1**. More detailed descriptions of the regions of influence and the methods used to evaluate impacts are presented in Appendix B of this EIS.

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

Environmental Resources	*Region of Influence*
Land resources	The site and the areas immediately adjacent to the site
Site infrastructure	The site
Geology and soils	Geologic and soil resources within the site and nearby offsite areas
Water resources	Onsite and adjacent surface water bodies and groundwater
Air quality	The site and nearby offsite areas within local air quality control regions where significant air quality impacts could occur and Class I areas within 100 kilometers (62 miles)
Noise	The site, nearby offsite areas, access routes to the sites, and transportation corridors
Ecological resources	The site and adjacent areas
Cultural resources	The area within the site and adjacent to the site boundary
Socioeconomics	The counties where approximately 90 percent of site employees reside
Human health risk	The site, offsite areas within 80 kilometers (50 miles) of the site, and the transportation corridors between the sites where worker and general population radiation, radionuclide, and hazardous chemical exposures could occur
Environmental justice	The minority and low-income populations within 80 kilometers (50 miles) of the site and along transportation corridors between the sites
Waste management and pollution prevention	The site
Environmental restoration	The site

Note: For the purpose of describing the affected environment, the term site is used to refer to INL, LANL, and ORNL.

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

3.2 Idaho National Laboratory

INL is located on approximately 230,700 hectares (570,000 acres) in southeastern Idaho, and is 55 kilometers (34 miles) west of Idaho Falls, 61 kilometers (38 miles) northwest of Blackfoot, and 35 kilometers (22 miles) east of Arco (see **Figure 3–1**). INL is owned by the Federal Government and administered, managed, and controlled by DOE. It is primarily located within Butte County, but portions of the site are also in Bingham, Jefferson, Bonneville, and Clark Counties. The site is roughly equidistant from Salt Lake City, Utah, and Boise, Idaho (DOE 2000f).

There are 450 buildings and 2,000 support structures at INL, with more than 279,000 square meters (3 million square feet) of floor space in varying conditions of utility. INL has approximately 25,100 square meters (270,000 square feet) of covered warehouse space and an additional 18,600 square meters (200,000 square feet) of fenced yard space. The total area of the various machine shops is 3,035 square meters (32,665 square feet) (DOE 2000f).

Fifty-two research and test reactors have been used at INL over the years to test reactor systems, fuel and target design, and overall safety. In addition to nuclear research reactors, other INL facilities are operated to support reactor operations. These facilities include high- and low-level radioactive waste processing and storage sites; hot cells; analytical laboratories; machine shops; and laundry, railroad, and administrative facilities. Other activities include management of one of DOE's largest storage sites for low-level radioactive waste and transuranic waste (DOE 2000f).

The Materials and Fuels Complex (MFC) (formerly known as Argonne National Laboratory-West) is located in the southeastern portion of INL, about 61 kilometers (38 miles) west of the city of Idaho Falls. The MFC is designated as a testing center for advanced technologies associated with nuclear power systems. The MFC has 52 major buildings, including reactor buildings, laboratories, warehouses, technical and administrative support buildings, and craft shops that comprise 55,700 square meters (600,000 square feet) of floor space (DOE 2002d). Five nuclear test reactors have operated at the MFC, although only one is currently active, a small reactor used for radiography examination of experiments, waste containers, and spent nuclear fuel. Principal facilities located at the MFC include the Fuel Manufacturing Facility (FMF), Assembly and Testing Facility, Transient Reactor Test Facility, Fuel Conditioning Facility, Hot Fuel Examination Facility, Zero Power Physics Reactor (ZPPR), and Experimental Breeder Reactor II (EBR-II).

The Reactor Technology Complex (RTC) is located in the southwestern portion of INL. The Materials Test Reactor and Engineering Test Reactor (both shut down), the Reactor Technology Complex Hot Cells, and Advanced Test Reactor (ATR), are located within the RTC. In addition, numerous support facilities (i.e., storage tanks, maintenance buildings, warehouses), laboratories, and sanitary and radioactive waste treatment facilities are in the area (DOE 2000f). The following descriptions of the affected environment at INL, MFC, and RTC are based all or in part on information provided in the *TA-18 Relocation EIS* (DOE 2002d) and the *NI PEIS* (DOE 2000f) which are incorporated by reference.

3.2.1 Land Resources

3.2.1.1 Land Use

The Federal Government, the state of Idaho, and various private parties own lands immediately surrounding INL. Regional land uses include grazing, wildlife management, mineral and energy production, recreation, and crop production. Small communities and towns near the INL boundaries include Mud Lake and Terraton to the east; Arco, Butte City, and Howe to the west; and Atomic City to the south. Two national natural landmarks border INL: Big Southern Butte (2.4 kilometers [1.5 miles] south) and Hell's Half Acre (2.6 kilometers [1.6 miles] southeast). A portion of Hell's Half Acre National Natural Landmark is designated as a Wilderness Study Area. The Black Canyon Wilderness Study Area is adjacent to INL, and the Craters of the Moon Wilderness Area is located about 20 kilometers (12 miles) southwest of INL's western boundary. On November 9, 2000, President Clinton signed a Presidential Proclamation that added 267,500 hectares (661,000 acres) to the 21,850-hectare (54,000-acre) Craters of the Moon National Monument, which encompasses this wilderness area.

Land use categories at INL include facility operations, grazing, general open space, and infrastructure such as roads. Approximately 60 percent of the site is used for cattle and sheep grazing. Generalized land uses at INL and the surrounding vicinity are shown in **Figure 3–2**. Facility operations include industrial and support operations associated with energy research and waste management activities. Land is also used for recreation and environmental research associated with the designation of INL as a National Environmental Research Park. Much of INL is open space that has not been designated for specific use. Some of this space serves as a buffer zone between INL facilities and other land uses. Recently, 29,950 hectares (74,000 acres) of open space in the north-central portion of the site were designated as the INL Sagebrush Steppe Ecosystem Reserve. This area represents one of the last sagebrush steppe ecosystems in the United States and provides a home for a number of rare and sensitive species of plants and animals. Approximately 2 percent of the total INL site area (4,600 hectares [11,400 acres]) is used for facilities and operations. Facilities are sited within a central core area of about 93,100 hectares (230,000 acres) (Figure 3–2). Public access to most facilities is restricted. DOE land use plans and policies applicable to INL are discussed in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203 (DOE 1995).

All county plans and policies encourage development adjacent to previously developed areas to minimize the need for infrastructure improvements and to avoid urban sprawl. Because INL is remote from most developed areas, its lands and adjacent areas are not likely to experience residential and commercial development, and no new development is planned near the site. Recreational and agricultural uses, however, are expected to increase in the surrounding area in response to greater demand for recreational areas and the conversion of rangeland to cropland.

The Fort Bridger Treaty of July 3, 1868, secured the Fort Hall Reservation as the permanent homeland of the Shoshone-Bannock Peoples. According to the treaty, tribal members reserved rights to hunting, fishing, and gathering on surrounding unoccupied lands of the United States. While INL is considered occupied land, it was recognized that certain areas on the INL site have significant cultural and religious significance to the tribes. A 1994 Memorandum of Agreement with the Shoshone-Bannock Tribes provides tribal members access to the Middle Butte to perform sacred or religious ceremonies or other educational or cultural activities.

Materials and Fuels Complex

The total land area at MFC is 328 hectares (810 acres); however, site facilities are principally situated within about 20 hectares (50 acres), or 6 percent of the site. MFC is located 7 kilometers (4.3 miles) northwest of the nearest site boundary. Land within the fenced portion of the site has been heavily disturbed, with buildings, parking lots, and roadways occupying most areas and no natural habitat present. The FMF is located within the main fenced portion of the site, while the Transient Reactor Test Facility is located about 1.2 kilometers (0.75 miles) to the northeast. Land within the site will continue to be used for nuclear and nonnuclear scientific and engineering experiments for DOE, private industry, and academia (DOE 2002d).

Reactor Technology Complex

Land in the RTC is currently disturbed, and is designated for reactor operations. The area includes about 15 hectares (37 acres) within the security fence, plus several sewage and waste ponds outside of the fence. The RTC is about 11 kilometers (6.8 miles) southeast of the nearest site boundary and about 2.6 kilometers (1.6 miles) northwest of the Big Lost River (DOE 2000f).

Figure 2–12 shows three potential routes for the proposed new road between the MFC and the RTC. Each of these routes include unimproved roads that are subject to maintenance only rarely to ensure that they remain passable in emergency/security situations and for power line maintenance. The northernmost route would follow along the existing T-3 Road (the Old Stagecoach/Jeep Trail), a remote road that currently extends approximately 24 kilometers (15 miles) and passes through undisturbed rangelands. To its south, the T-24 Road extends from MFC approximately 16 kilometers (10 miles) through undisturbed rangelands to the fenced perimeter of the Critical Infrastructure Test Range Complex (CITRC), where it connects to improved interior INL site roads. Further south, the East Power Line Road extends from MFC approximately 19 kilometers (12 miles) until reaching CITRC, and is maintained to a higher level than the T-3 and T-24 roads because of ongoing activities related to the power lines (INL 2005c).

3.2.1.2 Visual Resources

The Bitterroot, Lemhi, and Lost River Mountain ranges border INL on the north and west. Volcanic buttes near the southern boundary of INL can be seen from most locations on the site. INL generally consists of open desert land predominantly covered by big sagebrush and grasslands. Pasture and farmland border much of the site. There are 10 facility areas on the INL site. Although INL has a comprehensive facility and land use plan, no specific visual resource standards have been established. INL facilities have the appearance of low-density commercial/industrial complexes widely dispersed throughout the site. Structure heights generally range from 3 to 30 meters (10 to 100 feet); a few stacks and towers reach 76 meters (250 feet). Although many INL facilities are visible from highways, most are more than 0.8 kilometers (0.5 miles) from public roads (DOE 2000f). The operational areas are well defined at night by security lights.

Lands adjacent to INL are under Bureau of Land Management jurisdiction and have a Visual Resource Contrast Class II rating. Undeveloped lands within the INL site, including the corridors along the potential routes of the new road between the MFC and the RTC, have a Visual Resource Contrast rating consistent with Classes II and III. Management activities within these classes may be seen, but should not dominate the view (DOI 1986). The Black Canyon Wilderness Study Area adjacent to INL is under consideration by the Bureau of Land Management for Wilderness Area designation, approval of which would result in an upgrade of its Visual Resource Contrast rating from Class II to Class I. The Hell's Half Acre Wilderness Study Area is 2.6 kilometers (1.6 miles) southeast of INL's eastern boundary. This area, famous for its lava flow and hiking trails, is managed by the Bureau of Land Management. The Craters of the Moon Wilderness Area is about 20 kilometers (12 miles) southwest of INL's western boundary (DOE 2000f).

Materials and Fuels Complex

Developed areas within MFC are consistent with a Class IV Visual Resource Contrast rating in which management activities dominate the view and are the focus of viewer attention. The tallest structure at MFC is the Fuel Conditioning Facility stack, which is 61 meters (200 feet) in height. The site is visible from Highway 20. Facilities that stand out from the highway include the Transient Reactor Test Facility, Hot Fuel Examination Facility, the EBR-II containment shell, and ZPPR. Natural features of visual interest within a 40-kilometer (25-mile) radius of MFC include the East Butte at 9 kilometers (5.6 miles), Middle Butte at 11 kilometers (6.8 miles), Hell's Half Acre National Natural Landmark and Hell's Half Acre Wilderness Study Area at 15 kilometers (9.3 miles), Big Lost River at 19 kilometers (11.8 miles), and Big Southern Butte National Natural Landmark at 30 kilometers (18.6 miles) (DOE 2002d).

Reactor Technology Complex

Developed areas within the RTC are consistent with a Visual Resource Management Class IV rating. The tallest structure at ATR within the RTC is the main stack, which can be seen from Highways 20, 26, and 22. Natural features of visual interest within a 40-kilometer (25-mile) radius include Big Lost River at 2.6 kilometers (1.6 miles), Middle Butte at 20 kilometers (12 miles), Big Southern Butte National Natural Landmark at 18 kilometers (11 miles), East Butte at 23 kilometers (14 miles), Hell's Half Acre Wilderness Study area at 35 kilometers (22 miles), and Saddle Mountain at 40 kilometers (25 miles) (DOE 2000f).

3.2.2 Site Infrastructure

Characteristics of INL's utility and transportation infrastructure are described below and summarized in **Table 3–2.** Section 3.2.8.4 further discusses local transportation infrastructure, and Section 3.2.11 describes the site's waste management infrastructure.

Table 3–2 Idaho National Laboratory Sitewide Infrastructure Characteristics

Resource	***Site Usage***	***Site Capacity***
Transportation		
Roads (kilometers)	140 [a]	Not applicable
Railroads (kilometers)	48	Not applicable
Electricity		
Energy consumption (megawatt-hours per year)	156,639	481,800
Peak load (megawatts)	36	55
Fuel		
Natural gas (cubic meters per year)	476,000	Not applicable
Fuel oil (heating) (liters per year)	8,700,000	Not limited [b]
Diesel fuel (liters per year)	2,471,000	Not limited [b]
Gasoline (liters per year)	1,444,000	Not limited [b]
Propane (liters per year)	238,940	Not limited [b]
Water (liters per year)	4,200,000,000	43,000,000,000 [c]

[a] Includes asphalt-paved roads.
[b] Capacity is only limited by the ability to ship resources to the site.
[c] Water right allocation.
Note: To convert kilometers to miles, multiply by 0.621; liters to gallons, multiply by 0.264; and cubic meters to cubic feet, multiply by 35.315.
Sources: DOE 2002d, 2002e, 2002f.

3.2.2.1 Ground Transportation

Two interstate highways serve the INL regional area. Interstate 15, a north-south route that connects several cities along the Snake River, is approximately 40 kilometers (25 miles) east of INL. Interstate 86 intersects Interstate 15 approximately 64 kilometers (40 miles) south of INL and provides a primary linkage from Interstate 15 to points west. Interstate 15 and U.S. Highway 91 are the primary access routes to the Shoshone-Bannock reservation. U.S. Highways 20 and 26 are the main access routes to the southern portion of INL and the MFC (see Figure 3–2). Idaho State Routes 22, 28, and 33 pass through the northern portion of INL, with State Route 33 providing access to the northern INL facilities (DOE 2002e). The road network at INL provides for onsite ground transportation. About 140 kilometers (87 miles) of paved surface have been developed out of the 445 kilometers (276 miles) of roads on the site, including 29 kilometers (18 miles) of service roads that are closed to the public (Table 3–2). Most of the roads are adequate for the current level of normal transportation activity and could handle increased traffic volume.

The Union Pacific Railroad's Blackfoot-to-Arco Branch crosses the southern portion of INL and provides rail service to the site. This branch connects with a DOE spur line at Scoville Siding, then links with developed areas within INL. There are 48 kilometers (30 miles) of railroad track at INL. Rail shipments to and from INL usually are limited to bulk commodities, spent nuclear fuel, and radioactive waste (DOE 2002d).

3.2.2.2 Electricity

DOE presently contracts with the Idaho Power Company to supply electric power to INL. The contract allows for power demand of up to 45,000 kilowatts (45 megawatts), which can be increased to 55,000 kilowatts (55 megawatts) by notifying Idaho Power in advance. Power demand above 55,000 kilowatts is possible but would have to be negotiated with Idaho Power. Idaho Power transmits power to INL via a 230-kilovolt line to the Antelope substation, which is owned by PacifiCorp (Utah Power Company). PacifiCorp also has transmission lines to this substation, which provides backup in case of problems with the Idaho Power system. At the Antelope substation, the voltage is dropped to 138 kilovolts, then transmitted to the DOE-owned Scoville substation via two redundant feeders. The INL transmission system is a 138-kilovolt, 105-kilometer (65-mile) loop configuration that encompasses seven substations, where the power is reduced to distribution voltages for use at the various INL facilities. The loop allows for a redundant power feed to all substations and facilities (DOE 2002e).

Site electrical energy availability is about 481,800 megawatt-hours per year based on the contract load limit of 55,000 kilowatts (55 megawatts) for 8,760 hours per year. Current electrical energy consumption at INL is 156,639 megawatt-hours annually (based on 2000 data) (DOE 2002f). The recorded peak load was about 39 megawatts (DOE 2002e); the contract-limited peak load capacity for INL is 55 megawatts (Table 3–2). Current electrical usage at MFC is about 28,700 megawatt-hours per year (DOE 2002d).

3.2.2.3 Fuel

Fuel consumed at INL includes natural gas, fuel oil (heating fuel), diesel fuel, gasoline, and propane. All fuels are transported to the site for use and storage. Fuel storage is provided for each facility, and the inventories are restocked as necessary (DOE 2002d). INL site-wide fuel oil consumption was approximately 8,700,000 liters (2,300,000 gallons) in 2000, while natural gas consumption was about 476,000 cubic meters (16,816,000 cubic feet) during the same time period. Total diesel fuel consumption was about 2,471,000 liters (652,900 gallons), total gasoline consumption was about 1,444,000 liters (381,347 gallons), and total propane consumption was about 238,940 liters (63,121 gallons) (see Table 3–2) (DOE 2002f).

In 2001, MFC used 2,000,000 liters (549,000 gallons) of fuel oil, down from a peak of 2,500,000 liters (657,000 gallons) used in 1995. The usage of fuel oil varies with the severity of the winters (DOE 2002f).

3.2.2.4 Water

The Snake River Plain Aquifer is the source of all water used at INL. The water is provided by a system of about 30 wells, together with pumps and storage tanks. That system is administered by DOE, which holds the Federal Reserved Water Right of 43 billion liters (11.4 billion gallons) per year for the site (DOE 2002d). INL site-wide groundwater production and usage is approximately 4,200 million liters (1,100 million gallons) annually (see Table 3–2) (DOE 2002e). INL discharges result in a much smaller net water use than what is pumped from the aquifer. The MFC water supply and distribution system is a combination fire-protection, potable, and service water system supplied from an underground aquifer via two onsite deep production wells. The deep wells (EBR-II #1 and EBR-II #2) have a pumping capacity of 3,400 liters (900 gallons per minute) (or 1,790 million liters [473 million gallons] annually). Well water is pumped to a 757,000-liter (200,000-gallon) primary storage tank and then through the distribution system for potable, service, and fire-protection use. A second 757,000-liter (400,000-gallon) water storage tank is reserved for fire protection and maintained at full capacity. The deep wells can be valved to either storage tank or directly to the distribution system, if necessary. Currently, MFC water demand and usage from its two production wells is approximately 182 million liters (48 million gallons) annually (ANL 2003).

3.2.3 Geology and Soils

3.2.3.1 Geology

INL occupies a relatively flat area on the northwestern edge of the Eastern Snake River Plain, part of the Eastern Snake River Plain Physiographic Province. The area consists of a broad plain that has been built up from the eruptions of multiple flows of basaltic lava over the past 4 million years. Four northwest-trending volcanic rift zones which cut across the Eastern Snake River Plain have been identified as the source areas for these eruptions. The Eastern Snake River Plain is bounded on the north and south by the north-to-northwest-trending mountains of the northern Basin and Range Physiographic Province, with peaks up to 3,660 meters (12,000 feet) in height separated by intervening basins filled with terrestrial sediments and volcanic rocks. The peaks are sharply separated from the intervening basins by late Tertiary to Quaternary normal faults. The basins are 5 to 20 kilometers (3 to 12 miles) wide and grade onto the Eastern Snake River Plain. Several northwest-trending front-range faults have been mapped in the immediate vicinity of INL. To the northeast, the Eastern Snake River Plain is bounded by the Yellowstone Plateau (ANL 2003, DOE 2002e). **Figure 3–3** shows the major geologic features of INL and vicinity.

The mountains northwest of the Eastern Snake River Plain and near INL are composed of thick sequences of late Precambrian through Pennsylvanian sedimentary strata, mostly limestones. They occurred within westward-dipping thrust sheets that formed during east-directed compression (ANL 2003). The upper 1 to 2 kilometers (0.6 to 1.2 miles) of the crust beneath INL is composed of a sequence of Quaternary age (recent to 2 million years old) basalt lava flows and poorly consolidated sedimentary interbeds collectively called the Snake River Group. The lava flows at the surface range from 2,100 to 2 million years old (DOE 2002e, 2002d). The sediments are composed of fine-grained silts that were deposited by wind; silts, sands, and gravels deposited by streams; and clays, silts, and sands deposited in lakes such as Mud Lake and its much larger ice-age predecessor, Lake Terreton. The accumulation of these materials in the Eastern Snake River Plain has resulted in the observed sequence of interlayered basalt lava flows and sedimentary interbeds. Basaltic volcanism on the Eastern Snake River Plain has been a sporadic process. During the long periods of inactivity between volcanic events, sediments accumulated to thicknesses of less than 1 meter (3.3 feet) to greater than 60 meters (197 feet). During short periods of volcanic activity, several lava flows commonly accumulated to thicknesses reaching several tens of meters. Basalt lava flows were erupted from vents concentrated in the four volcanic rift zones and along the central axis of the Eastern Snake River Plain (the Axial Volcanic Zone) (see Figure 3–3). The basalts, along with intercalated sediments, are underlain by a great thickness of rhyolitic volcanic rocks that were erupted when the area was over the Yellowstone hotspot, more than 4 million years ago (ANL 2003). **Figure 3–4** depicts the general stratigraphy beneath INL.

Several Quaternary rhyolite domes are located along the Axial Volcanic Zone near the south and southeast borders of INL. Their names and ages are Big Southern Butte (300,000 years), a rhyolite dome near Cedar Butte (400,000 years), East Butte (600,000 years), Middle Butte (age unknown), and an unnamed butte near East Butte (1.2 million years). Paleozoic carbonate rocks (limestones), late-Tertiary rhyolitic volcanic rocks, and large alluvial fans are located in limited areas along the northwest margin of INL. A wide band of Quaternary mainstream alluvium (unconsolidated gravels and sands) extends along the course of the Big Lost River from the southwestern corner of INL to the Big Lost River Sinks area in north-central INL. Lacustrine (lake) deposits of clays and sands deposited in ice-age Lake Terreton are located in the northern part of INL. Beach sands deposited at the high stand of Lake Terreton were reworked by winds in late Pleistocene and Holocene times to form large dune fields (eolian deposits) in the northeastern part of INL. Elsewhere on INL, the basaltic lava flows are variably covered with a thin veneer of eolian silt (loess), which can be up to several meters thick, but mostly range from 0 to 1 meter (3.3 feet) or 2 meters (6.6 feet) thick (ANL 2003).

Within INL, mineral resources include sand, gravel, pumice, silt, clay, and aggregate (e.g., sand, gravel, and crushed stone). These resources are extracted at several quarries or pits at INL and used for road construction and maintenance, new facility construction and maintenance, waste burial activities, and ornamental landscaping. The geologic history of the Eastern Snake River Plain makes the potential for petroleum production at INL very low. The potential for geothermal energy exists at INL and in parts of the Eastern Snake River Plain; however, a study conducted in 1979 identified no economic geothermal resources (DOE 2002e).

The Arco Segment of the Lost River Fault is thought to terminate about 7 kilometers (4.3 miles) from the INL boundary. The Howe Segment of the Lemhi Fault terminates near the northwest boundary of the site (Figure 3–3). Both segments are considered capable or potentially active. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100).

The seismic characteristics of the Eastern Snake River Plain and the adjacent Basin and Range Province are different. The Eastern Snake River Plain has historically experienced infrequent small-magnitude earthquakes. In contrast, the major episode of Basin and Range faulting that began 20 to 30 million years ago continues today. Since the installation of INL's seismic network in 1971, only 29 microearthquakes (magnitude less than 1.5) have been detected within the Eastern Snake River Plain. However, INL's seismic stations record about 2,000 annually elsewhere in southeast Idaho (Bechtel BWXT Idaho 2003). Thus, the Eastern Snake River Plain and INL have a relatively low seismicity as compared to adjacent regions.

The largest historic earthquake near INL took place on October 28, 1983, about 90 kilometers (56 miles) northwest of the western site boundary, near Borah Peak in the Lost River Range (part of the Basin and Range). It occurred on the middle portion of the Lost River Fault. The earthquake had a surface-wave magnitude of 7.3 (moment magnitude of 6.9). The reported Modified Mercalli Intensity (MMI) ranged from V to IX at the event's epicenter. The RTC experienced an MMI of VI during this event with no damage to the ATR (DOE 2002d). Since 1973, 25 earthquakes have been recorded within 100 kilometers (62 miles) of south-central INL ranging in magnitude from 2.8 to 3.9. These represent minor earthquakes, with none centered closer than 76 kilometers (47 miles) from the south-central portion of the site (USGS 2005a).

Earthquake-produced ground motion is expressed in units of "g" (force of acceleration relative to that of the earth's gravity). Two differing measures of this motion are peak (ground) acceleration and response spectral acceleration. New seismic hazard metrics and maps developed by the U.S. Geological Survey have been adapted for use in the International Building Code and depict maximum considered earthquake ground motion of 0.2- and 1.0-second spectral acceleration, respectively, based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability of occurrence of about 1 in 2,500. Appendix B of this EIS provides a more detailed explanation of these maps and their use. For south-central INL facilities, the calculated maximum considered earthquake ground motion ranges from approximately 0.31g for an 0.2-second spectral response acceleration to 0.13g for a 1.0-second spectral response acceleration. The calculated peak ground acceleration for the given probability of exceedance at the site is approximately 0.13g (USGS 2005b).

Based on the maximum considered earthquake ground motions, INL is located in the broadly defined region of low and moderate to high seismicity. Ground motions in these regions are controlled by earthquake sources that are not well defined, with estimated maximum earthquake magnitudes having relatively long return periods. Maximum considered earthquake ground motions encompass those that could cause substantial structural damage to buildings, thus presenting safety concerns for occupants (equivalent to an MMI of VII and up). Specifically, maximum considered earthquake ground motions of about 0.50g at 0.2 seconds and 0.20g at 1.0 second are representative of MMI VII earthquake damage (BSSC 2004). For comparison, the aforementioned Borah Peak earthquake produced peak horizontal (ground) accelerations ranging from 0.022g to 0.078g at INL (DOE 2002e). Table B–7 in Appendix B of this EIS shows the approximate correlation between MMI, earthquake magnitude, and peak ground acceleration.

Earthquakes greater than moment magnitude 5.5 and associated strong ground shaking and surface fault rupture are not likely to occur within the Eastern Snake River Plain, based on its seismic history and geology. Moderate to strong ground shaking from earthquakes in the Basin and Range could affect INL (DOE 2002e). Consequently, INL has supported efforts to estimate the levels of ground shaking that can be expected at INL facilities from all earthquake sources in the region. The estimates are in the form of levels of ground shaking that would not be exceeded in specified time periods. A probabilistic ground motion study for all facility areas was finalized in 2000. The INL ground motion evaluation incorporated results of all geologic, seismologic, and geophysical investigations conducted by many investigators since the 1960s. Fault segments closest to INL facilities, the Lost River and Lemhi Faults, were studied in detail to estimate their maximum earthquake magnitudes, distances to INL facilities, when the last earthquakes occurred, and how often they have occurred in the past. The results of these investigations indicate that these faults are capable of generating earthquakes of magnitude 7 to 7.2 and that the most recent earthquakes occurred more than 15,000 years ago (Bechtel BWXT Idaho 2003).

INL seismic design basis events are incorporated into the INL Architectural and Engineering Standards based on seismic studies. New facilities and facility upgrades are designed in accordance with the requirements specified in applicable DOE standards and orders (DOE 2002e). As stated in DOE Order 420.1A, DOE requires that nuclear or nonnuclear facilities be designed, constructed, and operated so that the public, workers, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes. The mean peak ground acceleration, determined by the INL Natural Phenomena Hazards Committee, has been incorporated into the architectural and engineering standards.

Basaltic volcanic activity occurred from about 2,100 to 4 million years ago in the INL site area. Although no eruptions have occurred on the Eastern Snake River Plain during recorded history, lava flows of the Hell's Half Acre lava field erupted near the southern INL boundary as recently as 5,400 years ago. The most recent eruptions within the area occurred about 2,100 years ago 30 kilometers (19 miles) southwest of the site at the Craters of the Moon Wilderness Area. The estimated recurrence interval for volcanism associated with the five identified volcanic zones ranges from 16,000 to 100,000 years (DOE 2002d). These zones are depicted in Figure 3–3.

3.2.3.2 Soils

Four basic soilscapes exist at INL: river-transported sediments deposited on alluvial plains, fine-grained sediments deposited into lake or playa basins, colluvial sediments originating from bordering mountains, and wind-blown sediments over lava flows. The alluvial deposits follow the courses of the modern Big Lost River and Birch Creek. The playa soils are found in the north-central part of the site. The colluvial sediments are located along the western edge of INL. Wind-blown sediments (silt and sand) covering lava plains occupy the rest of the landscape of the site. The thickness of surficial sediments ranges from less than 0.3 meters (1 foot) at basalt outcrops east of the Idaho Nuclear Technology and Engineering Center (INTEC) to 95 meters (312 feet) near the Big Lost River sinks. No soils designated as prime farmland exist within INL boundaries (DOE 2002d).

Materials and Fuels Complex

The nearest capable fault to MFC is the Howe Segment of the Lemhi Fault, which is located 31 kilometers (19 miles) northwest of the site. MFC is located within the Axial Volcanic Zone, which has an estimated recurrence interval for volcanism of 16,000 years. The site is situated within a topographically closed basin. Low ridges of basalt found east of the area rise as high as 30 meters (100 feet) above the level of the plain. Sediments cover most of the underlying basalt on the plain, except where pressure ridges form basalt outcrops. Soils in the MFC area generally consist of light brown-gray well-drained silty loams to brown extremely stony loams. Soils are highly disturbed within developed areas of the site (DOE 2002d).

Reactor Technology Complex

The nearest capable fault to the RTC is the Howe Segment of the Lemhi Fault, which is about 19 kilometers (12 miles) north-northeast of ATR. Surficial materials within the site area consist of Big Lost River alluvium comprised mostly of gravel, gravelly sands, and sands ranging from 9 to 15 meters (30 to 50 feet) in depth. A relatively thin layer of silt and clay underlies the alluvium in some locations creating a low-permeability layer at the basalt bedrock interface. These sediments overlie the interbedded basalts of the Snake River Group, with basaltic rock exposed at the surface to the north and west of the RTC. The sedimentary interbeds of the Snake River Group consist mainly of silts, clayey silts, and sandy silts. There is no potential for unstable conditions due to lava tubes at the site. Soils on the site, although highly disturbed by existing facilities, are derived from the Big Lost River alluvium. The soils and sediments are not subject to liquefaction (DOE 2000f).

3.2.4 Water Resources

3.2.4.1 Surface Water

INL is in the Mud Lake-Lost River Basin (also known as the Pioneer Basin). This closed drainage basin includes three main streams—the Big and Little Lost Rivers and Birch Creek (**Figure 3–5**). These three streams are essentially intermittent and drain the mountain areas to the north and west of INL, although most flow is diverted for irrigation in the summer months before it reaches the site boundaries. Flow that reaches INL infiltrates the ground surface along the length of the streambeds in the spreading areas at the southern end of INL and, if the streamflow is sufficient in the ponding areas (playas or sinks) in the northern portion of INL. During dry years, there is little or no surface water flow on the INL site. Because the Mud Lake-Lost River Basin is a closed drainage basin, water does not flow off INL, but instead infiltrates the ground surface to recharge the aquifer or is consumed by evapotranspiration. The Big Lost River flows southeast from Mackay Dam, past Arco and onto the Snake River Plain. On the INL site near the southwestern boundary, a diversion dam prevents flooding of downstream areas during periods of heavy runoff by diverting water to a series of natural depressions or spreading areas. During periods of high flow or low irrigation demand, the Big Lost River continues northeastward past the diversion dam, passes within about 60 meters (200 feet) of INTEC, and ends in a series of playas 24 to 32 kilometers (15 to 20 miles) northeast of INTEC and RTC, where the water infiltrates the ground surface.

Flow from Birch Creek and the Little Lost River infrequently reaches INL. The water in Birch Creek and Little Lost River is diverted in summer months for irrigation prior to reaching INL. During periods of unusually high precipitation or rapid snow melt, water from Birch Creek and Little Lost River can enter INL from the northwest and infiltrate the ground, recharging the underlying aquifer.

Other than the three intermittent streams, the only other surface water bodies on the site include natural wetland-like ponds and manmade percolation and evaporation ponds (DOE 2002d). The latter are used for wastewater management at INL. Discharges to the ground surface are through infiltration ponds, trenches, and a sprinkler irrigation system. Infiltration ponds include the INTEC New Percolation Ponds, Test Area North/Technical Support Facility Sewage Treatment Plant Disposal Pond, RTC, Cold Waste Pond, MFC Industrial Waste Pond and ditch, MFC Sanitary Lagoons, and the Naval Reactors Facility (NRF) Industrial Waste Ditch. Also at INTEC, wastewater is discharged to the INTEC Sewage Treatment Plant and associated infiltration trenches, and through a sprinkler irrigation system at the Central Facilities Area, used during the summer months to land-apply industrial and treated sanitary wastewater (DOE 2004f).

Discharge of wastewater to the land surface is regulated under Idaho Wastewater-Land Application Permit rules (IDAPA 2004c). An approved Wastewater-Land Application Permit normally requires monitoring of nonradioactive parameters in the influent waste, effluent waste, and groundwater, as applicable. The Wastewater-Land Application Permits generally require compliance with Idaho groundwater quality primary constituent standards and secondary constituent standards in specified groundwater monitoring wells (IDAPA 2004b). The permits specify annual discharge volume, application rates, and effluent quality limits. As required, an annual report is prepared and submitted to the Idaho Department of Environmental Quality (DOE 2004f).

Waterbodies in Idaho are designated by the Department of Environmental Quality to protect water quality for existing or other designated uses. Big Lost River, Little Lost River, and Birch Creek in the vicinity of INL have been designated for cold water aquatic communities, salmonid spawning, and primary contact recreation, with the Big Lost River sinks and channel and lowermost Birch Creek also classified for domestic water supply and as special resource waters (IDAPA 2004a). In general, the water qualities of the Big Lost River, Little Lost River, and Birch Creek are similar, with the chemical qualities reflecting the carbonate mineral compositions of the mountain ranges drained by them along with the quality of irrigation water return flows. Surface waters, however, are not used for drinking water on the site, nor is effluent discharged directly to them, so there are no surface water rights issues at INL. None of the rivers or streams on or near the INL site have been classified as Wild and Scenic (DOE 2002d).

Although there are no routine process wastewater discharges to surface waters, DOE maintains compliance with National Pollutant Discharge Elimination System (NPDES) permit provisions including the *NPDES General Permit for Storm Water Discharges from Industrial Activities* and *NPDES General Permit for Storm Water Discharges from Construction Activities*. Revised requirements for the *NPDES General Permit for Storm Water Discharges from Industrial Activities* became effective in 2000. A modified *NPDES Storm Water Multi-Sector General Permit for Industrial Activities* was also published in 2000 and INL gained coverage under this permit in January 2001. The Environmental Monitoring Unit of the management and operations contractor monitors storm water in accordance with permit requirements. Results are reported in the annual site environmental reports. *INL's General Permit for Storm Water Discharges from Construction Sites* was issued in June 1993. The permit has been renewed twice since issuance. The *INL Storm Water Pollution Prevention Plan for Construction Activities* provides measures and controls to prevent pollution of storm water from construction activities at INL. Worksheets are completed for construction projects and are appended to the plan. Inspections of construction sites are performed in accordance with permit requirements (DOE 2003c).

In accordance with NPDES permit provisions, 68 visual storm water examinations were performed at 22 locations in 2003. No rainfall, snowmelt, or discharge down injection wells was observed at 14 monitoring points; therefore, no visual examinations were performed or analytical samples collected at those locations. The visual examinations performed in 2003 showed satisfactory implementation of the *INEEL Storm Water Pollution Prevention Plan for Industrial Activities*, and no corrective actions were required or performed during the year. Analytical samples were collected for qualifying rain events that potentially discharged to waters of the United States at applicable monitoring locations. Potential discharges to waters of the United States from a qualifying storm occurred at two locations at the Radioactive Waste Management Complex and the T-28 North gravel pit. Although the potential for discharge to waters of the United States exists, there was no indication that such a discharge occurred for these events. The measured concentrations for total suspended solids, iron, magnesium, and chemical oxygen demand exceeded the benchmark concentration levels at both locations for one or more samples. These parameters have been above benchmark concentrations at these locations in the past. No deficiencies in pollution prevention practices have been identified in these areas that would lead to high concentrations for these parameters, and no definite cause has been identified. However, iron and magnesium are common soil-forming minerals and may be attributed to suspended sediment, deposited onsite from high winds and landfill operations, in the storm water discharge. Storm drain filters for petroleum and sediment are in place and maintained regularly to provide additional pollution prevention (DOE 2004f).

Surface water locations outside of the INL boundary are sampled twice a year for gross alpha, gross beta, and tritium. In 2003, 12 surface water samples from 5 offsite locations were collected along the Snake River. One sample had a detectable gross alpha concentration of 1.53 picocuries per liter compared to the U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) of 15 picocuries per liter. Nine of 12 samples had measurable gross beta activity, while only 1 sample had measurable tritium. Detectable gross beta activity levels ranged from 3.13 to 8.01 picocuries per liter, as compared to the EPA screening level of 50 picocuries per liter. Concentrations in this range are consistent with those measured in the past and cannot be differentiated from natural decay products of thorium and uranium that dissolve into water as the water passes through the surrounding basalts of the Eastern Snake River Plain. The highest tritium concentration was 94.7 picocuries per liter, as compared to the EPA MCL in drinking water of 20,000 picocuries per liter (DOE 2003c, 2004f).

Flooding on the Big Lost River was evaluated for potential impact on INL facilities, including an examination of flooding potential due to the failure of Mackay Dam, 72 kilometers (45 miles) upstream of the INL, from a probable maximum flood (see Figure 3–5). The maximum flood evaluated was assumed to result in the overtopping and rapid failure of Mackay Dam. This flood would result in a peak surface water elevation at INTEC of 1,499 meters (4,917 feet), with a peak flow of 1,892 cubic meters (66,830 cubic feet) per second in the Big Lost River measured near INTEC. The average elevation at INTEC is 1,499 meters (4,917 feet). At this peak water surface elevation, portions of INTEC would be flooded, especially at the north end. The RTC would not be flooded, however. Because the ground surface at INL and INTEC is relatively flat, floodwaters outside the banks of the Big Lost River would spread over a large area and pond in the lower lying areas. Although predicted flood velocities would be relatively slow with shallow water depths, some facilities could be impacted. There is no record of any historical flooding at INTEC from the Big Lost River, although evidence of flooding in geologic time exists (DOE 2002e). The INL diversion dam, constructed in 1958 and enlarged in 1984, was designed to secure INL from the 300-year flood (estimated peak flow of slightly above 142 cubic meters [5,000 cubic feet] per second) of the Big Lost River by directing flow through a diversion channel into four spreading areas (DOE 2002d). The effects of systematic (non-instantaneous) failure of the diversion dam were included in the flood analysis.

Additional work is currently being performed by DOE at INL to further refine the floodplain boundaries of the Big Lost River as a basis to support future flood hazard assessments. The results of this effort, if available, will be included in the Final *Consolidation EIS* (see Appendix F).

Materials and Fuels Complex

There are no named streams within the MFC area and no permanent natural surface water features near the area. Neither the 100-year flood nor flooding scenarios that involve the failure of Mackay Dam on the Big Lost River indicate that floodwaters would reach MFC (Figure 3–5).

Nevertheless, an unnamed dry streambed lies within several hundred feet of the Transient Reactor Test Facility Control Building adjacent to the main MFC site. As much as 1.5 million cubic meters (53 million cubic feet) of water could flow within a few hundred feet of the Transient Reactor Test Facility Control Building during a 100-year storm if worst-possible frozen-ground conditions existed. In addition, a flood-control diversion dam is located about 805 meters (0.5 miles) south of the Hot Fuel Examination Facility. This dam was built to control surface water flows from the south from severe spring-weather precipitation with frozen ground (inhibiting groundwater absorption that could affect the MFC site). Water flowing from the south is diverted to the west and through a ditch along the western boundary of the MFC site; this ditch discharges to the Industrial Waste Pond (ANL 2003).

Two small sewage lagoons and the Industrial Waste Pond are located outside the MFC boundary fence to the northwest. The 1-hectare (2.4-acre) Industrial Waste Pond is used for disposal of industrial cooling and storm water emanating from MFC facilities (ANL 2003).

Reactor Technology Complex

There are no named streams within the RTC; there are only unnamed drainage ditches that carry storm flows away from buildings and facilities at the site. Neither the 100-year flood nor flooding scenarios that involve the failure of the Mackay Dam indicate floodwaters would inundate the RTC (DOE 2000f).

3.2.4.2 Groundwater

The Snake River Plain Aquifer lies below the INL site. It covers an area of approximately 25,000 square kilometers (9,600 square miles) in southeastern Idaho. Aquifer boundaries are formed by contact of the aquifer with less permeable rocks at the margins of the Eastern Snake River Plain. These boundaries correspond to the mountains on the west and north and the Snake River on the east (ANL 2003). This aquifer is the major source of drinking water for southeastern Idaho and has been designated a Sole

Source Aquifer by EPA (DOE 2002d and 2002e). Water storage in the aquifer is estimated at some 2,500 billion cubic meters (2 billion acre-feet), and irrigation wells can yield 26,000 liters (7,000 gallons) per minute (DOE 2002e). The aquifer is composed of numerous relatively thin basalt flows with interbedded sediments extending to depths in excess of 1,067 meters (3,500 feet) below land surface. Figure 3–4 shows the relationship of these strata from boreholes drilled at INL. The interbeds accumulated over time as some basalt flows were exposed at the surface long enough to collect sediment. These sedimentary interbeds lie at various depths, with their distribution and continuity controlled by basalt flow topography, sediment input, and subsidence rate. In some instances, the process of sediment accumulation resulted in discontinuous distributions of relatively impermeable sedimentary interbeds which led to localized perching of groundwater. The U.S. Geological Survey has estimated that the thickness of the active portion of the Snake River Plain Aquifer at INL ranges between 75 and 250 meters (250 to 820 feet). Depth to the water table ranges from about 60 meters (200 feet) below land surface in the northern part of the site to more than 274 meters (900 feet) in the southern part (ANL 2003).

Water in the aquifer mainly moves horizontally on a regional basis through basalt interflow zones, which are comprised of highly permeable rubble zones between basalt flows. Groundwater flow is primarily toward the southwest. On a local basis, the flow direction can be affected by recharge from rivers, surface water spreading areas, and heterogeneities in the aquifer. Transmissivity in the aquifer ranges from roughly 100 to 10,000 square meters (1,000 to 100,000 square feet) per day and, in places, exceeds 100,000 square meters (1 million square feet) per day (ANL 2003). Later flow rates in the aquifer have been reported to range from about 1.5 to 6.1 meters (5 to 20 feet) per day (DOE 2002d).

The Big Lost River, Little Lost River, and Birch Creek terminate at sinks on or near INL and recharge the aquifer. Recharge occurs through the surface of the Eastern Snake River Plain from flow in the channel of the Big Lost River and its diversion area. Additionally, recharge may occur from melting of local snowpacks during years in which snowfall accumulates on the Eastern Snake River Plain and from local agricultural-irrigation activities (ANL 2003). Valley underflow from the mountains to the north and northeast of the Eastern Snake River Plain has also been cited as a source of recharge (DOE 2002e). Aquifer discharge is via large spring flows to the Snake River and water pumped for irrigation. The aquifer discharges approximately 8.8 billion cubic meters (7.1 million acre-feet) of water annually to springs and rivers (ANL 2003). Major areas of springs and seepages from the aquifer occur in the vicinity of the American Falls Reservoir (southwest of Pocatello), and the Thousand Springs area (near Twin Falls) between Milner Dam and King Hill (DOE 2002e).

Perched water occurs in the vadose zone at INL when sediments or dense basalt with low permeability impedes the downward flow of water to the aquifer (DOE 2002e). These perched water tables tend to slow the migration of pollutants that might otherwise reach the Snake River Plain Aquifer. Perched water tables have been detected beneath the INTEC and the RTC and are mainly attributed to disposal ponds (DOE 2002d).

INL has an extensive groundwater quality-monitoring network maintained by the U.S. Geological Survey. This network includes 178 observation or production wells in the Snake River Plain Aquifer and auger holes from which samples are collected and analyzed for selected organic, inorganic, and radioactive substances. INL also routinely monitors drinking water quality via 17 production wells and 10 distribution systems (DOE 2004f).

Historical waste disposal practices have produced localized plumes of radiochemical and chemical constituents in the Snake River Plain Aquifer at INL. Of principal concern over the years have been the movements of the tritium and strontium-90 plumes. The general extent of these plumes beneath INL is shown in **Figure 3–6**.

The INTEC facility used direct injection as a disposal method until 1984. This wastewater contained high concentrations of both tritium and strontium-90. Injection at the INTEC was discontinued in 1984, and the injection well was sealed in 1990. When direct injection ceased, wastewater from INTEC was directed to a pair of shallow percolation ponds, where the water infiltrated into the subsurface. Disposal of low- and intermediate-level radioactive waste solutions to the percolation ponds ceased in 1993 with the installation of the Liquid Effluent Treatment and Disposal Facility. The RTC also discharged contaminated wastewater, but to a shallow percolation pond. The RTC pond was replaced in 1993 by a flexible plastic- (hypalon-) lined evaporative pond, which stopped the input of tritium to groundwater, and the new INTEC percolation ponds went into operation in August 2002 (DOE 2004f).

Concentrations of tritium in the area of aquifer contamination have continued to decrease. Two monitoring wells downgradient of RTC (Well 65) and INTEC (Well 77) have continually shown the highest tritium concentrations in the aquifer over time and are considered representative of maximum concentration trends in the rest of the aquifer. The average tritium concentration in Well 65 near RTC decreased from 13,000 picocuries per liter in 2002 to 9,400 picocuries per liter in 2003, and the average tritium concentration in Well 77 south of INTEC decreased from 13,800 picocuries per liter in 2002 to 13,400 picocuries per liter in 2003. The EPA MCL for tritium in drinking water is 20,000 picocuries per liter. The values in both Well 65 and Well 77 have remained below the EPA MCL of 20,000 picocuries per liter in recent years as a result of radioactive decay, a decrease in tritium disposal rates, and dilution within the Snake River Plain Aquifer (DOE 2004f).

Strontium-90 contamination originates from INTEC as a remnant of the earlier injection of wastewater. No strontium-90 groundwater contamination has been detected in the vicinity of RTC. All strontium-90 at RTC was disposed to infiltration ponds in contrast to the direct injection that occurred at INTEC. At RTC, strontium-90 is retained in surficial sedimentary deposits, interbeds, and in the perched groundwater zones. The area of the strontium-90 contamination from INTEC is approximately the same as it was in 1991. Concentrations of strontium-90 in wells have remained relatively constant since 1989. The concentration in Well 65 did increase between 2002 and 2003 from 1.5 to 2.55 picocuries per liter. Concentrations in Well 77 decreased from 2.0 picocuries per liter in 2002 to 1.8 picocuries per liter in 2003, as compared to the EPA MCL of 8 picocuries per liter. The upward trend in strontium-90 concentrations in the wells sampled over the last 10 years is thought to be due, in part, to a lack of recharge from the Big Lost River that would act to dilute the strontium-90. Also, an increase in the disposal of other chemicals into INTEC percolation ponds may have changed the affinity of strontium-90 on soil and rock surfaces, causing it to become more mobile (DOE 2004f).

From 1982 to 1985, INL used about 7.9 billion liters (2.1 billion gallons) per year from the Snake River Plain Aquifer, the only source of water at INL. This represents less than 0.3 percent of the groundwater withdrawn from that aquifer. Since 1950, DOE has held a Federal Reserved Water Right for the INL site that permits a pumping capacity of approximately 2.3 cubic meters (80 cubic feet) per second, with a maximum water consumption of 43 billion liters (11.4 billion gallons) per year. Total groundwater withdrawal at INL historically averages between 15 and 20 percent of that permitted amount (DOE 2002d). INL's production well system currently withdraws a total of about 4.5 billion liters (1.2 billion gallons) of water annually (see Section 3.2.2.4). Most of the groundwater withdrawn for use by INL facilities is returned to the subsurface via percolation ponds (DOE 2002d).

Materials and Fuels Complex

The depth of the water table of the Snake River Plain Aquifer beneath MFC ranges between 183 and 213 meters (600 to 700 feet), and groundwater flow is generally to the southwest across the site. All water used at MFC is groundwater from the underlying aquifer and is withdrawn via two production wells (see Section 3.2.2.4).

The MFC samples five wells (four monitoring and one production) twice a year for radionuclides, metals, total organic carbon, total organic halogens, and water quality parameters as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) for Waste Area Group 9. Gross alpha, gross beta, and certain uranium isotopes were measured in groundwater during 2002. Uranium isotopes and gross alpha and gross beta activity have been measured in these wells in the past. The concentrations are consistent with concentrations attributable to natural sources of uranium- and thorium-series radionuclides, and the concentrations are the same for both upgradient and downgradient wells, implying a natural source for this radioactivity. Samples for gross alpha, gross beta, and tritium were also collected from the entrance to the drinking water distribution system in accordance with the Safe Drinking Water Act. Values for both gross alpha concentration and gross beta concentration were well below EPA drinking water MCLs. No detectable concentrations of tritium were reported. The annual nitrate sample results were below the respective MCLs (DOE 2004f).

Reactor Technology Complex

All water used at RTC is groundwater from the Snake River Plain Aquifer tapped by three deep wells (RTC-01, RTC-02, and RTC-03). The depth to the groundwater at the RTC is approximately 140 meters (460 feet). In general, RTC, encompassing the ATR complex, uses approximately 190 million liters (50 million gallons) of water per month. In 1998, groundwater withdrawals from these three wells for RTC uses totaled approximately 1.80 billion liters (475.5 million gallons). For 1999, total groundwater production was similar at about 1.78 billion liters (471 million gallons). Water use by individual facilities within RTC is not generally metered.

As part of routine potable production well system monitoring, water from the RTC distribution system was sampled and analyzed in 1998 for copper and nitrogen as nitrate, with concentrations measuring 1.2 and 1.1 milligrams per liter, respectively; results were below the established MCLs. In 1998, the RTC distribution system was also monitored for purgeable organics such as total trihalomethanes with a maximum detected concentration of 0.3 micrograms per liter, below the MCL of 100 micrograms per liter. The tritium concentration measured in the RTC potable water distribution system during 1998 was much lower than at INTEC and other sites with a maximum concentration of 30 picocuries per liter (MCL of 20,000 picocuries per liter). U.S. Geological Survey monitoring well data for tritium indicate that tritium concentrations continue to decrease, as observed near INTEC, with the concentration in Well 65 south of RTC decreasing from about 37,800 picocuries per liter in 1991 to 21,200 picocuries per liter in 1995 (DOE 2000f).

3.2.5 Air Quality and Noise

3.2.5.1 Air Quality

The climate at INL and the surrounding region is characterized as that of a semiarid steppe. The average annual temperature at INL is 5.6 degrees Celsius (°C) (42 degrees Fahrenheit [°F]); average monthly temperatures range from a minimum of -8.8 °C (16.1 °F) in January to a maximum of 20 °C (68 °F) in July. The average annual precipitation is 22 centimeters (8.7 inches). Prevailing winds at INL are southwest or northeast. The annual average wind speed is 3.4 meters per second (7.5 miles per hour).

Nonradiological Releases

INL is within the Eastern Idaho Intrastate Air Quality Control Region (#61). None of the areas within INL and its surrounding counties are designated as nonattainment areas with respect to the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (40 CFR 81.313). The nearest nonattainment area for particulate matter is in Pocatello, about 80 kilometers (50 miles) to the south. Applicable NAAQS and Idaho State ambient air quality standards are presented in **Table 3–3**.

Table 3–3 Modeled Ambient Air Concentrations from Idaho National Laboratory Sources

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*INL Concentration* [b] *(micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	10,000 [c] 40,000 [c]	71 350
Lead	Quarterly	1.5	0.0081
Nitrogen dioxide	Annual	100 [c]	2.3
Ozone	8 hours 1 hour	157 235	(d) (d)
PM_{10}	Annual 24 hours	50 [c] 150 [c]	1.3 20
$PM_{2.5}$	Annual 24 hours	15 [e] 65 [e]	1.3 [f] 2.0 [f]
Sulfur dioxide	Annual 24 hours 3 hours	80 [c] 365 [c] 1,300 [c]	4.5 32 140

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. NAAQS (40 CFR Part 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 annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Maximum concentrations occur at receptors along public roads. Included existing INL facilities with actual 1997 INL emissions, plus reasonably foreseeable sources such as the Advanced Mixed Waste Treatment Project, CPP-606 steam production boilers, as accounted for in the Continued Operation Alternative cumulative concentrations presented in the *Idaho High Level Waste and Facilities Disposition Final EIS*.

[c] Federal and state standard.

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

[e] Federal standard.

[f] Assumed to be the same as PM_{10} because there is no specific data for $PM_{2.5}$.

Note: NAAQS also include standards for lead. No sources of lead emissions have been identified for any alternative evaluated. Emissions of hazardous air pollutants not listed here have been identified at INL, but are not associated with any of the alternatives evaluated.

Sources: 40 CFR 50, DOE 2002e.

The primary source of air pollutants at INL is combustion of fuel oil for heating. Other emission sources include waste burning, industrial processes, stationary diesel engines, vehicles, and fugitive dust from waste burial and construction activities. Emissions for 2004 are presented in **Table 3–4**.

Table 3–4 Air Pollutant Emissions at Idaho National Laboratory in 2004 [a]

Pollutant	*Sources other than MFC*	*MFC*
Nitrogen dioxide	52.9	5.1
PM_{10}	2.9	0.3
Sulfur dioxide	7.2	1.1
Volatile organic compounds	1.3	0.3

MFC = Materials and Fuels Complex.

[a] Values in metric tons per year.

Note: To convert from metric tons to (short) tons, multiply by 1.1023.

Source: DOE 2005b.

Routine offsite monitoring for nonradiological air pollutants is generally only performed for particulate matter and nitrogen oxide. Monitoring for PM_{10} (particulate matter less than or equal to 10 microns in aerodynamic diameter) is performed at the site boundary and at communities beyond the boundary. In 2003, 60 samples were collected at Rexburg (about 60 kilometers [19.3 miles] east of the site). The PM_{10} concentrations at Rexburg for 2003 ranged from 0.42 to 153.9 micrograms per cubic meter. Sixty samples were collected at Blackfoot, with concentrations ranging from 1.3 to 173.7 micrograms per cubic meter. Fifty-nine samples were collected at Atomic City, with concentrations ranging from 0.7 to 73.0 micrograms per cubic meter. High 24-hour concentrations were attributed to high winds and exceptionally high airborne dust concentrations. All annual average concentrations at these monitors were below the ambient standard (DOE 2004f).

Monitoring for nitrogen dioxide is performed at two onsite locations. Quarterly mean concentrations at the Van Buran Boulevard location ranged from 2.9 to 3.9 parts per billion with an annual mean of 3.5 parts per billion. Quarterly means at the Experimental Field Station ranged from 7.4 to 10.7 parts per billion, with a mean concentration of 9.1 parts per billion based on two quarters of data. The mean concentrations were well below the ambient standard of 54 parts per billion.

Some monitoring data have also been collected by the National Park Service at the Craters of the Moon Wilderness Area. The monitoring program has shown no exceedances of the 1-hour ozone standard, low levels of sulfur dioxide (except for one exceedance of the 24-hour standard in 1985), and total suspended particulates within applicable standards. Note that the total suspended particulate standards have been replaced with PM_{10} standards.

Materials and Fuels Complex

The existing ambient air concentrations attributable to sources at INL, including MFC, are presented in Table 3–3. These concentrations are based on dispersion modeling at the INL site boundary and public roads. The estimated baseline was based on the modeled pollutant concentrations presented in the *Idaho High Level Waste and Facilities Disposition Final EIS* as a modified baseline for assessing cumulative impacts. Sources included existing INL facilities with actual 1997 INL emissions, plus reasonably foreseeable sources such as the Advanced Mixed Waste Treatment Project. In order to account for the CPP-606 steam production boilers that were accounted for only as elements of the waste processing alternatives, the Continued Operation Alternative cumulative concentrations are presented as the baseline (DOE 2002e). Concentrations shown in Table 3–3 represent a small percentage of the ambient air quality standards. Concentrations of any hazardous or toxic compounds would be well below regulatory levels.

Reactor Technology Complex

The ATR facility operates a diesel generator as a source of backup electrical power. This generator is a source of nonradioactive air emissions at ATR. Other diesel engines are also operated periodically and contribute to air emissions. The existing ambient air pollutant concentrations attributable to sources at ATR are presented in **Table 3–5**. These concentrations are estimated using SCREEN3 and are expected to overestimate the contribution to site boundary concentrations (DOE 2000f).

Because INL sources are limited and background concentrations of criteria pollutants are well below ambient standards, INL emissions should not result in air pollutant concentrations that violate the ambient air quality standards.

The nearest Prevention of Significant Deterioration Class I area to INL is the Craters of the Moon Wilderness Area in Idaho, 53 kilometers (33 miles) west-southwest from the center of the site. A Class I area is one in which very little increase in pollution is allowed due to the pristine nature of the area. There are no other Class I areas within 100 kilometers (62 miles) of INL. INL and its vicinity are classified as a Class II area in which more moderate increases in pollution are allowed.

Table 3–5 Comparison of Modeled Ambient Air Concentrations from the Advanced Test Reactor Sources with Most Stringent Applicable Standards or Guidelines

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline (micrograms per cubic meters)* [a]	*ATR Concentration (micrograms per cubic meters)*
Carbon monoxide	8 hours	10,000 [b]	33.6
	1 hour	40,000 [b]	48
Nitrogen dioxide	Annual	100 [b]	9.19
Ozone	1 hour	235 [c]	(d)
PM_{10}	Annual	50 [b]	4.72
	24 hours	150 [b]	37.7
Sulfur dioxide	Annual	80 [b]	1.50
	24 hours	365 [b]	12
	3 hours	1,300 [b]	26.9

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 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 annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and state standard.

[c] Federal 8-hour standard is currently under litigation.

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

Source: DOE 2000f.

EPA has established Prevention of Significant Deterioration increments for certain pollutants, such as sulfur dioxide, nitrogen dioxide, and particulate matter. The increments specify a maximum allowable increase above a certain baseline concentration for a given averaging period, and apply only to sources constructed or modified after a specified baseline date. These sources are known as increment-consuming sources. The baseline date is the date of submittal of the first application for a Prevention of Significant Deterioration permit in a given area.

Prevention of Significant Deterioration permits have been obtained for the coal-fired steam-generating facility next to INTEC and the Fuel Processing Facility, which is not expected to be operated. In addition to these facilities, INL has other increment-consuming sources onsite. Current amounts of Prevention of Significant Deterioration increment consumption in Class I and Class II areas by INL sources based on dispersion modeling analyses are specified in **Tables 3–6** and **3–7**, respectively (DOE 2002e).

Radiological Releases—Primary releases of radiological air pollutants at INL and localized releases at MFC are presented in **Table 3–8**. During 2003, an estimated 7,794 curies of radioactivity were released to the atmosphere from all INL sources. Of this, MFC released 539 curies and the RTC released 1,180 curies. Approximately 6,020 curies were released from the INTEC area of INL.

Routine monitoring for radiological air pollutants is performed at locations within, around, and distant from INL. The monitors are operated by the management and operations contractor and the Environmental Surveillance, Education and Research contractor. The management and operations contractor monitoring network includes 13 onsite monitors and 4 distant monitors. The Environmental Surveillance, Education and Research contractor monitoring network includes three onsite monitors, seven nearby monitors, and six distant monitors. The distant monitors are located as far away as Jackson, Wyoming, and Craters of the Moon National Monument. These monitoring programs and recent results are described in Chapter 4 of the *Idaho National Engineering and Environmental Laboratory Site Environmental Report Calendar Year 2003* (DOE 2004f).

Table 3–6 Prevention of Significant Deterioration Increment Consumption at Craters of the Moon Wilderness (Class I) Area by Existing (1996) and Projected Sources Subject to Prevention of Significant Deterioration Regulation

Pollutant	*Averaging Period*	*Allowable Prevention of Significant Deterioration Increment* [a] *(micrograms per cubic meter)*	*Amount of Prevention of Significant Deterioration Increment Consumed (micrograms per cubic meter)*
Nitrogen dioxide	Annual	2.5	0.27
Respirable particulates [b]	Annual 24 hours	4 8	0.032 0.61
Sulfur dioxide	Annual 24 hours 3 hours	2 5 25	0.23 3.4 11

[a] All increments specified are state of Idaho standards (ID DEQ 2004).

[b] Data on particulate size are not available for most sources. For purposes of comparison to the respirable particulate increments, it is conservatively assumed that all particulates emitted are of respirable size (i.e., 10 microns or less in diameter).

Note: Estimated increment consumption includes existing INL sources subject to Prevention of Significant Deterioration regulation and includes INTEC CPP-606 boilers. Increment consumption was modeled using the CALPUFF model in screening mode.

Source: DOE 2002e.

Table 3–7 Prevention of Significant Deterioration Increment Consumption at Class II Areas by Existing (1996) and Projected Sources Subject to Prevention of Significant Deterioration Regulation at Idaho National Laboratory

Pollutant	*Averaging Period*	*Allowable Prevention of Significant Deterioration Increment* [a] *(micrograms per cubic meter)*	*Amount of Prevention of Significant Deterioration Increment Consumed (micrograms per cubic meter)*
Nitrogen dioxide	Annual	25	8.8
Respirable particulates [b]	Annual 24 hours	17 30	0.53 10
Sulfur dioxide	Annual 24 hours 3 hours	20 91 512	3.6 27 120

[a] All increments specified are state of Idaho standards (ID DEQ 2004).

[b] Data on particulate size are not available for most sources. For purposes of comparison to the respirable particulate increments, it is conservatively assumed that all particulates emitted are of respirable size (i.e., 10 microns or less in diameter).

Note: Estimated increment consumption includes existing INL sources, subject to Prevention of Significant Deterioration regulations and includes INTEC CPP-606 boilers. Class II increment consumption was modeled using the ISCST3 dispersion model.

Source: DOE 2002e.

3.2.5.2 Noise

Major noise emission sources within INL include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most INL industrial facilities are far enough from the site boundary that noise levels from these sources are not measurable or are barely distinguishable from background levels at the boundary.

Table 3–8 Radiological Airborne Releases to the Environment at Idaho National Laboratory in 2003

Emission Type	*Radionuclide* [a]	*MFC (curies)*	*Other Facilities at INL* [b] *(curies)*	*Total (curies)*
Noble gases	Argon-41	1.41	819	820
	Krypton-85	534	5,306	5,840
	Krypton-85m	–	2.31	2.31
	Xenon-133	–	14.8	14.8
	Xenon-135	–	12.3	12.3
Airborne particulates	Sodium-24	–	0.0002	0.0002
	Chromium-51	–	0.02	0.02
	Rubidium-88	–	0.27	0.27
	Strontium-90 [c]	–	0.041	0.041
	Technetium-99m	–	0.0004	0.0004
	Antimony-125	–	3.57×10^{-5}	3.57×10^{-5}
	Cesium-137	–	0.28	0.28
	Cesium-138	–	0.009	0.009
	Uranium-234	–	5.94×10^{-6}	5.94×10^{-6}
	Plutonium-238	–	0.00018	0.00018
Tritium, carbon-14, and iodine isotopes	Tritium (Hydrogen-3)	3.29	1,100	1,103
	Carbon-14	–	1.23	1.23
	Iodine-129	–	0.072	0.072
	Iodine-131	–	0.21	0.21
	Iodine-133	–	2.77×10^{-4}	2.77×10^{-4}
	Iodine-135	–	4.83×10^{-4}	4.83×10^{-4}
Total releases		539	7,255	7,794

[a] The table includes all radionuclides with total releases greater than 10^{-7} curies. Values are not corrected for decay after release.

[b] Facilities include INTEC, RTC, and NRF.

[c] Parent-daughter equilibrium assumed.

Note: Dashed lines indicate virtually no releases.

Source: DOE 2004f.

Existing INL-related noises of public significance result from the transportation of people and materials to and from the site and in town facilities via buses, trucks, private vehicles, and freight trains. Noise measurements along U.S. Route 20, about 15 meters (50 feet) from the roadway, indicate that traffic sound levels range from 64 to 86 decibels A-weighted (dBA), and that the primary source is buses (71 to 80 dBA). While few people reside within 15 meters (50 feet) of the roadway, the results indicate that INL traffic noise might be objectionable to members of the public residing near principal highways or busy bus routes. Noise levels along these routes may have decreased somewhat due to reductions in employment and bus service at INL in the last few years. The acoustic environment along the INL site boundary in rural areas and at nearby areas away from traffic noise is typical of a rural location; the average day-night sound level is in the range of 35 to 50 dBA. Except for the prohibition of nuisance noise, neither the state of Idaho nor local governments have established any regulations that specify acceptable community noise levels applicable to INL. The EPA guidelines for environmental noise protection recommend an average day-night sound level limit of 55 dBA to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). Land use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that annual day-night average sound levels less than 65 dBA are compatible with residential land uses (14 CFR Part 150). These guidelines further indicate that levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures. It is expected that, for most residences near INL, day-night average sound levels are compatible with residential land use, although noise levels may be higher than 65 dBA for some residences along major roadways.

Materials and Fuels Complex

No distinguishing noise characteristics at MFC have been identified. The MFC is 7 kilometers (4.3 miles) from the nearest site boundary, so the contribution from the area to noise levels at the site boundary is unmeasurable (DOE 2002d).

Reactor Technology Complex

No distinguishing noise characteristics at RTC have been identified. The RTC is far enough from the site boundary (11 kilometers [6.8 miles]) that noise levels at the site boundary from these sources are not measurable or are barely distinguishable from background levels (DOE 2000f).

3.2.6 Ecological Resources

3.2.6.1 Terrestrial Resources

INL lies in a cool desert ecosystem dominated by shrub-steppe communities. Most land within the site is relatively undisturbed and provides important habitat for species native to the region. Facilities and operating areas occupy 2 percent of INL; approximately 60 percent of the area around the periphery of the site is grazed by sheep and cattle. Although sagebrush communities occupy about 80 percent of INL, a total of 20 plant communities has been identified (**Figure 3–7**). These communities may be grouped into six types: shrub-steppe, juniper woodlands, native grasslands, modified ephemeral playas, lava, and wetland-like areas. In total, 398 plant taxa have been documented at INL (DOE 2002d and 2002e).

The interspersion of low sagebrush (*Artemisia arbuscula*) and big sagebrush (*Artemisia tridentate*) communities in the northern portion of INL and juniper communities in the northwestern and southeastern portions of the site are considered sensitive habitats. The former provide critical winter and spring range for greater sage grouse (*Centrocercus urophasianus)* and pronghorn (*Antilocapra americana*), while the latter are important to nesting raptors and songbirds. Riparian vegetation, primarily cottonwood (*Populus* sp.) and willow (*Salix* spp.) along the Big Lost River and Birch Creek provides nesting habitat for hawks, owls, and songbirds. Recently, approximately 29,950 hectares (74,000 acres) of open space in the north-central portion of the site was designated as the INL Sagebrush Steppe Ecosystem Reserve. The area represents some of the last sagebrush steppe habitat in the United States and provides habitat for numerous rare and sensitive plants and animals (DOE 2002d).

INL supports numerous animal species, including two amphibian, 11 reptile, 225 bird, and 44 mammal species. Common animals on the site include the short-horned lizard (*Phrynosoma douglassi*), gopher snake (*Pituophis melanoleucus*), sage sparrow (*Amphispiza belli*), Townsend’s ground squirrel (*Spermophilus townsendii*), and black-tailed jackrabbit (*Lepus californicus*). Important game animals include the greater sage grouse, mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and pronghorn. During some winters, 4,500 to 6,000 pronghorn, or about 30 percent of Idaho’s total pronghorn population, may be found on INL. Pronghorn wintering areas are located in the northeastern portion of the site, in the area of the Big Lost River sinks, in the west-central portion of the site along the Big Lost River, and in the south-central portion of the site. Hunting elk and pronghorn is permitted only within 0.8 kilometers (0.5 miles) of the site boundary on INL lands adjacent to agricultural lands. Numerous raptors, such as the golden eagle (*Aquila chrysaetos*) and prairie falcon (*Falco mexicanus*), and carnivores, such as the coyote (*Canis latrans*) and mountain lion (*Felis concolor*), are also found on INL. A variety of migratory birds have been found at INL (DOE 2002d).

Large wildfires in 1994, 1995, 1996, 1999, and 2000, played an important role in the ecology of INL. The most recent fires burned about 14,570 hectares (36,000 acres) in the summer and early fall of 2000 (DOE 2002e). The immediate effect of the fires on ecological resources at INL, aside from plants and animals that perished as a direct result of the fire, was the displacement of animals from their habitat. A longer-term concern is that non-native, invasive plant species may have a greater competitive advantage at the expense of native grasses and shrubs, especially where the ground was disturbed by fire fighting activities. Of particular concern is the loss of sagebrush, the dominant shrub of the shrub-steppe community. This plant is slow to regenerate since it must do so from seed, whereas many other plants regenerate from underground root systems. The slow recovery of sagebrush is likely to have a detrimental impact on greater sage grouse, which is dependent on this plant, particularly for critical winter habitat (DOE 2002d).

The MFC is located within one of several sagebrush communities found on INL (Figure 3–7). While sagebrush is present on undeveloped portions of the site, developed areas are nearly devoid of vegetation. Wildlife use of developed portions of the site is negligible; however, surrounding areas do provide natural habitat for a variety of animals. While elk and mule deer are the most important large mammals present in the area, many of the common species discussed above also would be expected. The MFC wastewater pond acts as an important source of water for wildlife found in the vicinity of the site (DOE 2002d).

The area in which the Radioisotope Power System (RPS) Nuclear Production Facility would be built is located immediately south of developed portions of the MFC. This site is on the edge of a burn area. It contains sagebrush with native grasses in the understory, as well as areas that have been replanted with crested wheatgrass (*Agropyron desertorum*). Wildlife present includes common species such as those noted above; few obligate sagebrush species are present (INL 2005c).

Three routes have been proposed to connect MFC with RTC (see Figure 2-12). While all three routes pass largely through sagebrush steppe habitat, both the T-3 Road and T-24 Road are quite rural with sagebrush and other vegetation not only growing to the edge of the road but between the tire tracks as well. Some portions of the T-3 Road in the vicinity of the Big Lost River and to the west of MFC have been burned in the past and are dominated by grasses. Portions of the East Power Line Road are also in areas that have previously burned and, in general, very little vegetation is growing on or directly adjacent to the road. Wildlife species including wintering elk, mule deer, and pronghorn, could occur along each of the routes (INL 2005c).

Vegetative communities in which big sagebrush is the dominant plant occur in the vicinity of RTC (Figure 3–7). Grasslands comprised primarily of crested wheatgrass also occur in the area. The RTC itself is a developed area with little or no native vegetation. Lawns and ornamental vegetation are used by a number of species such as songbirds, raptors, rabbits, and mule deer. Ponds in and around RTC are known to be frequented by waterfowl, shorebirds, swallows, passerines, and to a limited extent, by raptors such as the American kestrel (*Falco sparverius*), ferruginous hawk (*Buteo regalis*), and northern harrier (*Circus cyaneus*). Mammals have been observed at the disposal ponds despite perimeter fences, and amphibians have been reported at RTC Industrial Waste and Sewage Disposal Ponds (DOE 2000f).

3.2.6.2 Wetlands

Wetlands include “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (33 CFR 328.3). National Wetland Inventory maps prepared by the U.S. Fish and Wildlife Service (USFWS) have been completed for most of INL. These maps indicate that the primary wetland areas are associated with the Big Lost River, the Big Lost River spreading areas, and the Big Lost River sinks, although smaller (less than about

0.4 hectares [1 acre]) isolated wetlands also occur intermittently. Wetlands associated with the Big Lost River are classified as riverine/intermittent, indicating a defined stream channel with flowing water during only part of the year. The only areas of jurisdictional wetland are the Big Lost River sinks (DOE 2002d). Wetland areas on INL are shown in Figure 3–5.

Wetland vegetation exists along the Big Lost River, which is located 18 kilometers (11 miles) west of MFC; however, this vegetation is in poor condition because of recent years of only intermittent flows. The Big Lost River spreading areas and Big Lost River sinks are seasonal wetlands and are located 34 kilometers (21 miles) west-southwest and 23 kilometers (14 miles) northwest of MFC, respectively. These areas can provide more than 809 hectares (2,000 acres) of wetland habitat during wet years. Within MFC itself, small areas of intermittent marsh occur along cooling tower blowdown ditches (DOE 2002d).

The proposed northern routing of the new road connecting MFC and RTC would pass through the Big Lost River which, while classified as riverine/intermittent (see above), is not jurisdictional (DOE 2002d). This portion of the route primarily contains sagebrush steppe habitat (see Figure 3–7). Neither the proposed T-24 Road nor the East Power Line Road routings would pass through the Big Lost River wetland. Nevertheless, a Preliminary Floodplain/Wetland Assessment has been prepared for this proposed activity in accordance with 10 CFR 1022 (see Appendix F).

The Big Lost River, Big Lost River spreading areas, and the Big Lost River sinks are about 2 kilometers (1.2 miles) southeast, 13 kilometers (8 miles) southwest, and 21 kilometers (13 miles) north-northeast of RTC. Wetlands do not occur in RTC (DOE 2000f).

3.2.6.3 Aquatic Resources

Aquatic habitat on INL is limited to the Big Lost River, Little Lost River, Birch Creek, and a number of liquid waste disposal ponds. All three streams are intermittent and drain into four sinks in the north-central part of the site. Six species of fish have been observed within water bodies located onsite. Species observed in the Big Lost River include brook trout (*Salvelinus fontinalis*), rainbow trout (*Salmo gaidneri*), mountain whitefish (*Prosopium williamsoni*), speckled dace (*Rhinichthys osculus*), shorthead sculpin (*Cottus confuses*), and kokanee salmon (*Oncorhynchus nerka*). The Little Lost River and Birch Creek, northwest and northeast of the RTC, respectively, enter the site only during periods of high flow. Surveys of fish in these surface water bodies have not been conducted. The liquid waste disposal ponds on INL, while considered aquatic habitat, do not support fish (DOE 2002d).

There is no natural aquatic habitat on or in the vicinity of MFC. The nearest such habitat is the Big Lost River, which is located 18 kilometers (11 miles) west of the site. The MFC waste disposal ponds do not contain any fish populations, but do provide habitat for a variety of aquatic invertebrates (DOE 2002d).

The proposed northern routing of the new road connecting MFC with RTC would pass across the Big Lost River (see Chapter 2, Figure 2–12 of this EIS); however, as noted above, the river is intermittent, only entering INL during periods of high flow. Neither the proposed T-24 Road nor the East Power Line Road routings would pass across the Big Lost River.

Although a number of disposal ponds occur in the vicinity of RTC, they do not support populations of fish. Aquatic invertebrates, however, are supported by habitat provided by the ponds. The Big Lost River is 2 kilometers (1.2 miles) southeast of RTC (DOE 2000f).

3.2.6.4 Threatened and Endangered Species

Twenty Federal- and State-listed threatened, endangered, and other special status species occur, or possibly occur, on INL (**Table 3–9**). Federally-listed plants and animals include 2 threatened, 1 candidate, and 10 species of concern. Idaho special status species include 1 threatened, 2 priority, 3 sensitive, and 2 special monitor. The bald eagle is listed by the USFWS as threatened (but is proposed for delisting); it is also listed as threatened by the state. The bald eagle has rarely been seen in the western and northern portions of the site. The gray wolf, listed by the USFWS as threatened, experimental population, has been sighted several times on INL (INL 2005c). No critical habitat for threatened or endangered species, as defined in the Endangered Species Act, exists on INL.

The MFC area was surveyed in 1996 for threatened, endangered, and special status species. The only listed species observed was the peregrine falcon and the loggerhead shrike. While no peregrine falcon nests were found near MFC, one peregrine falcon was observed perched on a power line 1.5 kilometers (0.9 miles) from the site. Since then, the peregrine falcon has been delisted. The gray wolf, pigmy rabbit, and Townsend's big-eared bat were not identified in the vicinity of MFC during the surveys. In addition, no Federally- or state-listed plants were found in the vicinity of the site (DOE 2002d).

Recent observations of the area within which the Plutonium-238 Facility would be located have verified that no unusual wildlife is present and that habitat for threatened and endangered species does not exist. However, a rattlesnake hibernacula is located about 0.62 kilometers (1 mile) south of the site. There is growing concern for rattlesnakes within the state in recent years and, in fact, all reptiles receive protection in Idaho. It is possible that rattlesnakes, including the Great Basin rattlesnake, could migrate as far north as the proposed Plutonium-238 Facility site once they leave the hibernaculum in the spring (INL 2005c).

Although formal surveys for sensitive species have not been conducted along any of the alternative routes of the proposed road connecting MFC and RTC, no Federal or State threatened or endangered species have been observed. However, other special status animals listed in Table 3–9 have been found within the vicinity of the T-3 Road and could occur along the other routes as well. The sage grouse and pygmy rabbit have been observed adjacent to the T-3 Road and a ferruginous hawk nest is located 30 meters (100 yards) from the road. A survey of each of the alternative routes would be necessary in order to document the presence of sensitive species (INL 2005c).

No threatened, endangered, or other special status plant or animal species have been recorded at or near RTC. However, the bald eagle, pygmy rabbit, and Townsend's big-eared bat potentially occur in the area (DOE 2000f).

3.2.7 Cultural Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. INL has a well-documented record of cultural and paleontological resources. Past studies, which covered 4 percent of the site, identified 1,506 cultural resource sites and isolated finds, including 688 prehistoric sites, 38 historic sites, 753 prehistoric isolates, and 27 historic isolates. As of January 1998, approximately 7 percent of INL had been surveyed, raising the number of potential archaeological sites to 1,839. Most surveys have been conducted near significant facility areas in conjunction with major modification, demolition, or abandonment of site facilities.

Table 3–9 Listed Threatened, Endangered, and Special Status Species of Idaho National Laboratory

Common Name	*Scientific Name*	*Status*	
		Federal	*State*
Plants			
Cushion milk vetch	*Astragalus gilviflorus*		State Priority 1
Inconspicuous phacelia	*Phacelia inconspicua*	Candidate	
Lemhi milkvetch	*Astragalus aquilonius*		State Sensitive
Painted milkvetch	*Astragalus ceramicus var. apus*	Special Concern	
Puzzling halimolobos	*Halimolobos perplexa*		State Monitor
Narrowleaf oxytheca	*Oxytheca dedroidea*		State Sensitive
Nipple coryphantha	*Escobaria missouriensis*		State Monitor
Spreading gilia	*Iponopsis polycladon*		State Priority 2
Winged-seed evening primrose	*Camissonia pterosperma*		State Sensitive
Reptiles			
Northern sagebrush lizard	*Sceloporus graciosus graciosus*	Special Concern	
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Ferruginous hawk	*Buteo regalis*	Special Concern	
Greater sage grouse	*Centrocercus urophasianus*	Special Concern	
Long-billed curlew	*Numemius americanus*	Special Concern	
Mammals			
Gray wolf	*Canis lupus*	Threatened, Experimental, nonessential population	
Long-eared myotis	*Myotis evotis*	Special Concern	
Merriam's shrew	*Sorex merriami*	Special Concern	
Pygmy rabbit	*Brachylagus idahoensis*	Special Concern	
Townsend's big-eared bat	*Dorynorhinus townsendii*	Special Concern	
Western small-footed myotis	*Myotis ciliolabrum*	Special Concern	

Federal:

Candidate: Taxa for which the USFWS has on file sufficient information on biological vulnerability and threats to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded.

Special Concern: Species for which the USFWS is concerned about their population status and threats to their long-term viability. These species have no legal status under the Endangered Species Act.

Threatened: Taxa likely to be classified as Endangered within the foreseeable future throughout all or a significant portion of their range.

State:

State Sensitive: A taxon with small populations or localized distributions within Idaho that presently do not meet the criteria for classification as Priority 1 or 2, but whose populations and habitats may be jeopardized without active management or removal of threats.

State Monitor: Taxa that are common within a limited range or taxa that are uncommon, but have no identifiable threats.

State Priority 1: A taxon in danger of becoming extinct from Idaho in the foreseeable future if identifiable factors contributing to its decline continue to operate; these are taxa whose populations are present only at a critically low level or whose habitats have been degraded or depleted to a significant degree.

State Priority 2: A taxon likely to be classified as Priority 1 within the foreseeable future in Idaho, if factors contributing to its population decline or habitat degradation or loss continue.

Threatened: Any native species likely to be classified as Endangered within the foreseeable future throughout all or a significant portion of its Idaho range.

Sources: IFG 2005, INL 2005a and 2005c.

Cultural sites are often occupied continuously or intermittently over substantial timespans. For this reason, a single location may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented. However, the sum of these resources may be greater than the total number of sites reported due to such dual-use histories at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites, certain locations were used during both periods. DOE is currently evaluating the impacts to cultural resources from fire suppression activities during the Grid 40/Tea Kettle fire that burned across 19,830 hectares (49,000 acres) of the southwestern portion of the INL site on July 27 and 28, 2000.

3.2.7.1 Prehistoric Resources

Prehistoric resources identified at INL are generally reflective of American Indian hunting and gathering activities. A total of 688 prehistoric sites and 753 prehistoric isolates have been located. Most of the prehistoric sites are lithic scatters or locations (DOE 2002d). Resources appear to be concentrated along the Big Lost River and Birch Creek, atop buttes, and within craters or caves. They include residential bases, campsites, caves, hunting blinds, rock alignments, and limited-activity locations such as lithic and ceramic scatters, hearths, and concentrations of fire-affected rock. Although the northernmost route between MFC and RTC along the existing T-3 Road (the Old Stagecoach/Jeep Trail) has never been surveyed for archaeological resources, predictive modeling indicates the probable density of prehistoric archaeological sites in the area would be "medium to medium-high." A 1985 archaeological survey of the north side of T-24 Road documented 23 prehistoric archaeological sites. Although numerous prehistoric archaeological sites have been discovered along the East Power Line Road, past consultations with the State Historic Preservation Officer have determined that activities along portions of this road would have no adverse effect on significant archaeological materials (INL 2005c). Most known sites at INL have not been formally evaluated for nomination to the National Register of Historic Places, but are considered to be potentially eligible. Given the rather high density of prehistoric sites at INL, additional sites are likely to be identified as surveys continue.

Materials and Fuels Complex

The most recent cultural resource survey conducted near MFC took place in 1996 and covered an area to the south of the site that had been burned over by a wildfire and was proposed for revegetation. A total of 12 isolated finds and 2 archaeological sites were located. Isolated finds included items such as pieces of Shoshone brownware pottery and projectile points. The archaeological sites included projectile points, scrapers, and volcanic glass flakes. Areas within the fenced portion of the MFC site are highly disturbed and are not likely to yield significant archaeological material (DOE 2002d).

Reactor Technology Complex

A variety of archaeological survey projects have been completed in RTC. During a 1984 examination of a 100-meter-wide (328-foot-wide) corridor surrounding the fenced RTC perimeter, no prehistoric resources were identified. It is also unlikely that undisturbed prehistoric resources are present within the fenced perimeter of the facility, although no specific archaeological surveys have been conducted inside the fence. Although no prehistoric sites are known to occur around the periphery of RTC, significant sites have been documented in the vicinity, including a multi-component archaeological site, and smaller American Indian campsites (DOE 2000f).

3.2.7.2 Historic Resources

Thirty-eight historic sites and 27 historic isolates have been identified at the INL site. These resources are representative of European-American activities, including fur trapping and trading, immigration, transportation, mining, agriculture, and homesteading, as well as more recent military and scientific/engineering research and development activities. Examples of historic resources include

Goodale's Cutoff (a spur of the Oregon Trail), remnants of homesteads and ranches, irrigation canals, and a variety of structures from the World War II era.

Historic Land Status and Use Records from the early 1990s refer to the T-3 Road as the "Lost River Road to Idaho Falls." These records also indicate that at least one pioneer homestead is located on INL lands along this corridor. T-24 Road is not a historic trail and was probably constructed sometime after 1950 (INL 2005c).

The EBR-I, the first reactor to achieve a self-sustaining chain reaction using plutonium instead of uranium as the principal fuel component, is listed on the National Register of Historic Places and is designated as a National Historic Landmark. Many other INL structures built between 1949 and 1974 are considered eligible for the National Register because of their exceptional scientific and engineering significance, and their major role in the development of nuclear science and engineering since World War II. Additional historic sites are likely to exist in unsurveyed portions of INL (DOE 2002d).

Materials and Fuels Complex

A number of recent items, including farm implements, a belt buckle, broken glass, and a large scattering of cans, have been found in the vicinity of MFC. The EBR-II has been designated as an American Nuclear Society Historical Landmark (DOE 2002d).

Reactor Technology Complex

All three of the major reactors within RTC (the Materials Test Reactor, the Engineering Test Reactor, and ATR), along with numerous support facilities, are considered eligible for listing on the National Register of Historic Places. As a result of an historic building inventory conducted in 1997, 59 RTC buildings are considered to be eligible for the National Register (DOE 2000f).

3.2.7.3 Traditional Cultural Properties

Traditional cultural properties at INL are associated with the two groups of nomadic hunters and gatherers that used the region at the time of European-American contact: the Shoshone and Bannock. Both of these groups used the area that now encompasses INL as they harvested plant and animal resources and obsidian from Big Southern Butte and Howe Point. Because the INL site is considered part of the Shoshone-Bannock Tribes' ancestral homeland, it contains many localities that are important for traditional, cultural, educational, and religious reasons. This includes not only prehistoric archaeological sites that are important in the context of a religious or cultural heritage, but also features of the natural landscape and air, plant, water, and animal resources that have special significance (DOE 2002d). "Aviators' Cave," an important archaeological site that is a sacred area to the Shoshone-Bannock Tribes, is accessed from the T-3 Road and is located only a short distance from the existing road (INL 2005c).

Over the past two decades, efforts have been underway to assemble complete inventories of cultural resources in the vicinity of major operating facilities at INL. Prehistoric American Indian resources have been found in the vicinity of MFC (DOE 2002d). A variety of survey projects have been completed near RTC, including a 1984 examination of a 100-meters-wide (328-foot-wide) corridor surrounding the fenced perimeter of the site. No American Indian resources were identified within the surveyed area, and it is unlikely that undisturbed American Indian resources are present within the fenced perimeter of RTC, although no specific surveys have been conducted. Cultural resource surveys in the vicinity of RTC have identified small American Indian campsites, and an area that may be of traditional and cultural importance to the Shoshone-Bannock Tribes (DOE 2000f).

The region encompassing INL also has abundant and varied paleontological resources, including plant, vertebrate, and invertebrate remains in soils, lake and river sediments, and organic materials found in caves and archaeological sites. Vertebrate fossils recovered from the Big Lost River floodplain consist of isolated bones and teeth from large mammals of the Pleistocene or Ice Age. These fossils were discovered during excavations and well drilling operations. Fossils have been recorded in the vicinity of NRF. Occasional skeletal elements of fossil mammoth, horse, and camel have been retrieved from the Big Lost River diversion dam and Radioactive Waste Management Complex on the southwestern side of the INL site, and from river and alluvial fan gravels and Lake Terreton sediments near Test Area North. A mammoth tooth dating from the Pleistocene was recovered from RTC. In total, 24 paleontological localities have been identified on INL. Paleontological resources were not found in the immediate vicinity of MFC during a recent archaeological survey (DOE 2002d).

3.2.8 Socioeconomics

Statistics for population, housing, and local transportation are presented for the region of influence, a four-county area in Idaho in which 94.4 percent of all INL employees reside (**Table 3–10**). In 2001, INL employed an average of 8,100 persons (DOE 2002e).

Table 3–10 Distribution of Employees by Place of Residence in the Idaho National Laboratory Region of Influence in 1997

County	*Number of Employees*	*Total Site Employment (percent)*
Bonneville	5,553	67.0
Bingham	1,077	13.0
Bannock	615	7.4
Jefferson	583	7.0
Region of influence total	7,828	94.4

Source: DOE 2000f.

3.2.8.1 Regional Economic Characteristics

Between 2000 and 2003, the civilian labor force in the region of influence increased 4.4 percent, to the 2003 level of 123,383 (ID Commerce and Labor 2005). In 2003, the annual unemployment average in the four-county area was 4.1 percent, which was slightly less than the annual unemployment average for Idaho (5.4 percent) (ID DOL 2004).

In 2003, trade, utilities, and transportation represented the largest sector of employment in the region of influence (22.1 percent). This was followed by government (19.9 percent), and professional and business services (12.7 percent). The totals for these employment sectors in Idaho were 19.9 percent, 18.6 percent, and 4.3 percent, respectively (ID Commerce and Labor 2005).

3.2.8.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 3–11**. The 2000 population in the four-county area was 218,977 people. The predominant population in the region of influence is white; 7.6 percent of the population has a Hispanic or Latino ethnic background.

Table 3–11 Demographic Profile of the Population in the Idaho National Laboratory Region of Influence

	Bannock County	*Bingham County*	*Bonneville County*	*Jefferson County*	*Region of Influence*
Population					
2000 Population	75,565	41,735	82,522	19,155	218,977
1990 Population	66,026	37,583	72,207	16,543	192,359
Percent change from 1990 to 2000	14.4	11.0	14.3	15.8	13.8
Race (2000) (percent of total population)					
White	91.3	82.4	92.8	90.9	90.1
Black or African American	0.6	0.2	0.5	0.3	0.4
American Indian and Alaska Native	2.9	6.7	0.6	0.5	2.6
Asian	1.0	0.6	0.8	0.2	0.8
Native Hawaiian and other Pacific Islander	0.2	0.0	0.1	0.1	0.1
Some other race	2.1	8.0	3.7	6.8	4.2
Two or more races	2.0	2.1	1.5	1.3	1.8
Percent minority	10.5	21.4	9.8	11.5	12.4
Ethnicity (2000)					
Hispanic or Latino	3,540	5,550	5,703	1,907	16,700
Percent of total population	4.7	13.3	6.9	10.0	7.6

Source: DOC 2005.

Income information for the INL region of influence is included in **Table 3–12**. Bonneville County has the highest median household income of the four counties in the region of influence ($41,805) and the lowest percent of persons (10.1 percent) living below the poverty line. Bingham County has the lowest median household income ($36,423) but Bannock County has the largest number of individuals (13.9 percent) living below the poverty line. The average median household income in the four counties is comparable to the median household income of the state of Idaho ($37,572) during this same time period.

Table 3–12 Income Information for the Idaho National Laboratory Region of Influence

	Bannock	*Bingham*	*Bonneville*	*Jefferson*	*Idaho*
Median household income 2000 (dollars)	36,683	36,423	41,805	37,737	37,572
Percent of persons below poverty line (2000)	13.9	12.4	10.1	10.4	11.8

Source: DOC 2005.

3.2.8.3 Housing

Table 3–13 lists the total number of occupied housing units and vacancy rates in the region of influence. In 2000, of the total of 80,176 housing units in the region of influence, 93.7 percent were occupied and 6.3 percent were vacant. Bingham County had the greatest vacancy rate of the four counties at 6.9 percent and Bonneville County had the smallest vacancy rate at 5.7 percent. Home values were the most expensive in Bonneville County with a median housing value of $93,500 and the least expensive in Bingham County at $84,400.

Table 3–13 Housing in the Idaho National Laboratory Region of Influence

	Bannock	*Bingham*	*Bonneville*	*Jefferson*	*Region of Influence*
Housing (2000)					
Total units	29,102	14,303	30,484	6,287	80,176
Occupied housing units	27,192	13,317	28,753	5,901	75,163
Vacant units	1,910	986	1,731	386	5,013
Vacancy Rate (percent)	6.6	6.9	5.7	6.1	6.3
Median value (dollars)	90,000	84,400	93,500	91,900	89,950

Source: DOC 2005.

3.2.8.4 Local Transportation

U.S. Highways 20 and 26 are the main access routes to the southern portion of the INL site, and State Routes 22 and 33 provide access to the northern INL facilities (Figure 3–2).

DOE buses provide transportation between INL facilities and Idaho Falls for DOE and contractor personnel. The major railroad in the area is the Union Pacific Railroad. The railroad’s Blackfoot-to-Arco Branch provides rail service to the southern portion of the INL site. A DOE-owned spur connects the Union Pacific Railroad to INL by a junction at Scoville Siding. There are no navigable waterways within the area capable of accommodating waterborne transportation of material shipments to INL. Fanning Field in Idaho Falls, ID, and Pocatello Municipal Airport in Pocatello, ID, provide jet air passenger and cargo service for both national and local carriers. Numerous smaller private airports are located throughout the region of influence.

3.2.9 Human Health Risk

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

3.2.9.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of INL are shown in **Table 3–14**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to INL operations.

Releases of radionuclides to the environment from INL operations provide another source of radiation exposure to individuals in the vicinity of INL. Types and quantities of radionuclides released from INL operations in 2003 are listed in the *Idaho National Engineering and Environmental Laboratory Site Environmental Report for Calendar Year 2003* (DOE 2004f). The releases are summarized in Section 3.2.5.1 of this EIS. The doses to the public resulting from these releases are presented in **Table 3–15.** These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those of background radiation.

Table 3–14 Sources of Radiation Exposure to Individuals in the Idaho National Laboratory Vicinity Unrelated to Idaho National Laboratory Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
External (terrestrial and cosmic) [a]	123
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	Less than 1
Air travel	1
Consumer and industrial products	10
Total	428

[a] DOE 2004f.
[b] NCRP 1987.
[c] An average for the United States.

Table 3–15 Radiation Doses to the Public from Normal Idaho National Laboratory Operations in 2003 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed offsite individual (millirem)	10	0.035	4	0	100	0.035
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.022	None	0	100	0.022
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	0.00008	None	0	None	0.00008

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem per year limit from airborne emissions is required by the Clean Air Act (40 CFR 61), and the 4-millirem per year limit is required by the Safe Drinking Water Act (40 CFR 141). The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, *Radiation Protection of the Public and Environment; Proposed Rule,* as published in 58 *Federal Register* (FR) 16268. If the potential total dose exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.
[b] Based on an estimated population of 276,979 in 2003.
[c] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Source: DOE 2004f.

Using a risk estimator of 6.0×10^{-4} latent cancer fatalities (LCF) per rem (see Appendix C of this EIS), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from INL operations in 2003 is estimated to be 2.1×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of INL operations is 1 in 48 million (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

According to the same risk estimator, 1.3×10^{-5} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of INL from normal operations in 2003. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 2003 from all causes in the population living within 80 kilometers (50 miles) of INL would be 554. This expected number of fatal cancers is much higher than the fatal cancers estimated from INL operations in 2003.

INL workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at INL from operations in 2003 are presented in **Table 3–16**. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of 6.0×10^{-4} LCF per person-rem among workers (see Appendix C of this EIS), the number of projected fatal cancers among INL workers from normal operations in 2003 is 0.038.

Table 3–16 Radiation Doses to Workers from Normal Idaho National Laboratory Operations in 2003 (total effective dose equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average radiation worker (millirem)	None [b]	56 [c]
Total workers [c] (person-rem)	None	64 [c]

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999f); the site must make reasonable attempts to maintain individual worker doses below this level.

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

[c] There were 1,141 workers with measurable doses in 2003.

Source: DOE 2003e.

3.2.9.2 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 (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to 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 to the public may occur during normal operations at INL via inhalation of air containing hazardous chemicals released to the atmosphere by INL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 3.2.5.1. 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 INL workers during normal operations may include inhaling the workplace atmosphere, drinking INL potable water, and possible other contacts 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. INL workers are also protected by adherence to 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 utilized 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 INL are substantially better than required by standards.

3.2.9.3 Health Effect Studies

Epidemiological studies were conducted on communities surrounding INL to determine whether there are excess cancers in the general population. Two of these are described in more detail in Appendix M.4.4 of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996d). No excess cancer mortality was reported, and although excess cancer incidence was observed, no association with INL was established. A study by the state of Idaho completed in June 1996 found excess brain cancer incidence in the six counties surrounding INL, but a follow-up survey concluded that there was nothing that clearly linked all these cases to one another or any one thing (DOE 1996d).

Researchers from the Boston University School of Public Health, in cooperation with the National Institute of Occupational Safety and Health, are investigating the effects of workforce restructuring (downsizing) in the nuclear weapons industry. The health of displaced workers will be studied. Under a National Institute of Occupational Safety and Health cooperative agreement, the epidemiological evaluation of childhood leukemia and paternal exposure to ionizing radiation included the INL site. This study found no evidence of a link between brain cancer or leukemia and paternal employment at INL (DOE 2002d). Another study begun in October 1997, *Medical Surveillance for Former Workers at INL*, is being carried out by a group of investigators consisting of the Oil, Chemical, and Atomic Workers International Union; Mount Sinai School of Medicine; the University of Massachusetts at Lowell; and Alice Hamilton College. A mortality study of the workforce at INL was conducted by the National Institute of Occupational Safety and Health. DOE has implemented an epidemiological surveillance program to monitor the health of current INL workers. A discussion of this program is given in Appendix M.4.4 of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996d).

3.2.9.4 Accident History

Since the early 1950s, there have been eight criticality accidents at INL (DOE 2002d). Some accidents resulted from intentional experiments, but the power excursion was significantly larger than expected. The accidents occurred during processing, control rod maintenance, critical experiment setups, and intentional destructive power excursions. These accidents resulted in various levels of radiation exposure to the involved workers and in no damage to, small damage to, or total loss of the equipment. The exposure to the public from these accidents was minimal.

DOE conducted a study, the *Idaho National Engineering Laboratory Historical Dose Evaluation*, to estimate the potential offsite radiation doses for the entire operating history of INL (DOE 1996d). Releases resulted from a variety of tests and experiments as well as a few accidents at INL. The study concluded that these releases contributed to the total radiation dose during test programs of the 1950s and early 1960s. The frequencies and sizes of releases have declined since that time. During more than the last decade of operations at INL facilities, there have been no serious unplanned or accidental releases of radioactivity or other hazardous substances.

3.2.9.5 Emergency Preparedness and Security

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

Government agencies whose plans are interrelated with the *INL Emergency Plan for Action* include the state of Idaho; Bingham, Bonneville, Butte, Clark, and Jefferson Counties; the Bureau of Indian Affairs; and the Fort Hall Indian Reservation. INL contractors are responsible for responding to emergencies at their facilities. Specifically, the Emergency Action Director is responsible for recognition, classification, notification, and protective action recommendations. At INL, emergency preparedness resources include fire protection from onsite and offsite locations and radiological and hazardous chemical material response. Emergency response facilities include an emergency control center at each facility, at the INL Warning Communication Center, and at the INL Site Emergency Operations Center. Seven INL medical facilities are available to provide routine and emergency service. 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 May 1997.

3.2.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income.

Figure 3–8 shows MFC and region of potential radiological impacts. As shown in the figure, the region includes Idaho Falls, portions of the Fort Hall Indian Reservation, and Pocatello.

Fourteen counties in Idaho are included or partially included in the potentially affected area: Bannock, Bingham, Blaine, Bonneville, Butte, Caribou, Clark, Custer, Fremont, Jefferson, Lemhi, Madison, Minidoka, and Power (see **Figure 3–9**). **Table 3–17** provides the total minority composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, approximately 13 percent of the county residents identified themselves as members of a minority group. Hispanics and American Indians or Alaska Natives comprised more than 80 percent of the minority population.

The percentage of population for whom poverty status was determined in potentially affected counties in 2000 was approximately 14 percent. In 2000, nearly 12 percent of the total population of Idaho reported incomes less than the poverty threshold. In terms of percentages, minority populations and low-income resident populations in 2000 in potentially impacted counties were slightly higher than the state percentage.

Table 3–17 Populations in Potentially Affected Counties Surrounding the Materials and Fuels Complex in 2000

Population Group	*Population*	*Percentage of Total*
Minority	41,447	12.6
Hispanic	28,828	8.8
Black or African American	1,085	0.3
American Indian and Alaska Native	5,732	1.7
Asian	1,984	0.6
Native Hawaiian and Pacific Islander	257	0.1
Two or more races	3,417	1.0
Some other race	174	0.1
White	286,862	87.4
Total	328,339	100.0

Source: DOC 2005.

3.2.11 Waste Management and Pollution Prevention

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

3.2.11.1 Waste Inventories and Activities

INL manages the following types of waste: high-level radioactive, transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Because there is no high-level waste associated with the Proposed Action, this waste type is not discussed in this EIS. Waste generation rates and the inventory of stored waste from activities at INL are provided in **Table 3–18**. INL waste management capabilities are summarized in **Table 3–19**.

Table 3–18 2004 Waste Generation Rates and Inventories at Idaho National Laboratory

Waste Type	*Generation Rate (cubic meters in 2004)* [a]	*Inventory as of 12/31/04 (cubic meters)*
Transuranic	10 [b]	61,553 [b,c]
Low-level radioactive	9,846 [d]	704 [d]
Mixed low-level radioactive	1,373 [d]	899 [d]
Hazardous	422 [d]	163 [d]
Nonhazardous		
Liquid	3,333,900 [e]	Not applicable [f]
Solid	49,430 [d]	Not applicable [f]

[a] Calendar Year 2004 (1/1/04 to 12/31/04).

[b] Transuranic includes alpha low-level.

[c] Transuranic inventory based on 65,000 cubic meters reduced by 3,447 cubic meters shipped to WIPP to date. Volume does not include the buried transuranic waste, which is estimated at 62,000 cubic meters.

[d] Excludes CERCLA waste generation, which is nonrecurring.

[e] Includes both industrial and sanitary waste volumes.

[f] Generally, nonhazardous wastes are not held in long term storage.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079.

Source: INL 2005c.

Table 3–19 Waste Management Facilities at Idaho National Laboratory

Facility Name/Description	*Facility Number*	*Capacity*	*Status*	*Applicable Waste Types*			
				TRU	*LLW*	*MLLW*	*HAZ*
Treatment Facility (cubic meters per day except as otherwise specified)							
NWCF Debris Treatment Process	CPP-659	160	Permitted			X	X
NWCF HEPA Filter Leach System	CPP-659	0.34	Permitted			X	X
Contaminated Equipment Storage Building	MFC-794	1.7	Permitted	X		X	X
HFEF	MFC-785	1.7	Permitted	X		X	X
Sodium Components Maintenance Shop	MFC-793	7.6	Permitted			X	X
Transient Reactor Test Facility	MFC-720	1.7	Permitted	X		X	X
Advance Mixed Waste Treatment Project Waste Storage Facility	RWMC	80	Permitted	X		X	
Advance Mixed Waste Treatment Project Waste Storage Facility	WMF-676	130	Permitted	X		X	
Remote Treatment Project	MFC	(a)	Planned	X	X	X	
Storage Facilities (capacity in cubic meters)							
NWCF Storage	CPP-659	2242	Permitted			X	X
Radioactive Mixed Waste Staging Facility	CPP-1617	8494	Permitted			X	X
Hazardous Chemical and Radioactive Waste Storage Facility	CPP-1619	52	Permitted			X	X
RWMC Waste Storage Facility	WMF-628	8176	Permitted	X		X	
SWEPP Storage Area	WMF-610	107	Permitted	X	X	X	
Contaminated Equipment Storage Building (cubic meters per day)	MFC-794	57	Permitted	X		X	X
HFEF	MFC-785	41	Permitted	X		X	X
Radioactive Scrap and Waste Facility	MFC-771	201	Permitted	X	X	X	X
Sodium Components Maintenance Shop	MFC-793	120	Permitted			X	X
Sodium Storage Building	MFC-703	182	Permitted			X	X
Transient Reactor Test Facility	MFC-720	27	Permitted	X		X	X
TRU Storage Pad (TSA)-Pad 1/Pad R (TSA-1/TSA-R)	RWMC	76600	Interim Status	X		X	
TSA-Retrieval Enclosure Retrieval Modification Facility	RWMC	93409 (includes TSA-1 and TSA-R volume)	Interim Status	X		X	
Advance Mixed Waste Treatment Project Waste Storage Facility	RWMC	72598	Permitted	X		X	

TRU = transuranic, LLW = low-level radioactive, MLLW = mixed low-level radioactive, HAZ = hazardous, NWCF = New Waste Calcining Facility, HEPA = high-efficiency particulate air filter, HFEF = Hot Fuel Examination Facility, RWMC = Radioactive Waste Management Complex, SWEPP = Stored Waste Examination Pilot Plant, TSA = Transuranic Storage Area.

[a] Facility in planning stage. Capacity will be determined after design is completed.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079.

Source: INL 2005c.

3.2.11.2 Transuranic Waste

Transuranic waste generated since 1972 is segregated into contact-handled and remotely handled categories and stored at the Radioactive Waste Management Complex in a form designed for eventual retrieval. Some transuranic waste is also stored at the Radioactive Scrap and Waste Facility at MFC. Virtually no transuranic waste is generated at INL. Most of the transuranic waste in storage was received from the Rocky Flats Environmental Technology Site. Transuranic waste is currently being stored, pending shipment to the Waste Isolation Pilot Plant (WIPP) in New Mexico. Transuranic waste will be treated to meet WIPP waste acceptance criteria, packaged in accordance with DOE and U.S. Department of Transportation (DOT) requirements, and transported to WIPP for disposal (DOE 1996d). The first shipment of transuranic waste from INL was received at WIPP on April 28, 1999 (DOE 2000f).

3.2.11.3 Low-Level Radioactive Waste

Liquid low-level radioactive wastes are discharged to the two double-lined ponds at RTC for evaporation. The two test reactor evaporation ponds have a capacity of 36,790 cubic meters (48,100 cubic yards) each with a flow rate of 30 liters (8 gallons) per minute (DOE 2000f).

Liquid low-level radioactive waste is solidified before disposal. Low-level radioactive waste disposal occurs in pits and concrete-lined soil vaults in the subsurface disposal area of the Radioactive Waste Management Complex. Approximately 60 percent of the low-level radioactive waste generated at INL is treated for volume reduction prior to disposal at the Radioactive Waste Management Complex. Additionally, some low-level radioactive waste is shipped offsite to be incinerated, and the residual ash is returned to INL for disposal. The Radioactive Waste Management Complex is expected to be filled to capacity by the year 2030, although some proposals would close the low-level radioactive waste disposal facility by 2006.

3.2.11.4 Mixed Low-Level Radioactive Waste

Mixed low-level radioactive waste is divided into two categories for management purposes: alpha mixed low-level radioactive waste and beta-gamma mixed low-level radioactive waste. Most of the alpha mixed low-level radioactive waste stored at INL is waste that has been reclassified from mixed transuranic waste and is managed as part of the transuranic waste program. Therefore, this section deals only with beta-gamma mixed low-level radioactive waste.

Mixed low-level radioactive waste, including polychlorinated biphenyl–contaminated low-level radioactive waste, is stored at several onsite areas awaiting the development of treatment methods. Mixed low-level radioactive waste is stored at the Mixed Waste Storage Facility (or Waste Experimental Reduction Facility Waste Storage Building) and in portable storage units at the CITRC area. In addition, smaller quantities of mixed low-level radioactive waste are stored in various facilities at INL, including the Hazardous Chemical/Radioactive Waste Facility at INTEC and the Radioactive Sodium Storage Facility and Radioactive Scrap and Waste Storage Facility at MFC. Although mixed wastes are stored in many locations at INL, the bulk of that volume is solid waste stored at the Radioactive Waste Management Complex.

As part of the INL Site Treatment Plan and Consent Order required by the Federal Facility Compliance Act, preferred treatment options have been identified to eliminate the hazardous waste component for many types of mixed low-level radioactive waste. Mixed low-level radioactive waste is or will be processed to RCRA land disposal restrictions treatment standards through several treatment facilities. Those treatment facilities and the operational status of each follow: (1) Waste Experimental Reduction Facility Incinerator (shutdown), (2) Waste Experimental Reduction Facility Stabilization (operational),

(3) Test Area North cask dismantlement (operational), (4) Sodium Process Facility (standby), (5) High-Efficiency Particulate Air Filter Leach (operational), (6) Waste Reductions Operations Complex Macroencapsulation, (7) Debris Treatment (operational), and (8) Advanced Mixed Waste Treatment Project. Commercial treatment facilities are also being considered, as appropriate. Currently, limited amounts of mixed low-level radioactive waste are disposed of at Envirocare of Utah.

3.2.11.5 Hazardous Waste

Approximately 1 percent of the total waste generated at INL (not including liquid nonhazardous waste) is hazardous waste. Most of the hazardous waste generated annually at INL is transported offsite for treatment and disposal. Offsite shipments are surveyed to determine that the wastes have no radioactive content and, therefore, are not mixed waste. Highly reactive or unstable materials such as waste explosives are addressed on a case-by-case basis and are either stored, burned, or detonated, as appropriate.

3.2.11.6 Nonhazardous Waste

Approximately 90 percent of the solid waste generated at INL is classified as industrial waste and is disposed of onsite in a landfill complex in the Central Facilities Area or offsite at the Bonneville County landfill. The onsite landfill complex contains separate areas for petroleum-contaminated media, industrial waste, and asbestos waste. The onsite landfill is 4.8 hectares (12 acres), and is being expanded by 91 hectares (225 acres) to provide capacity for at least 30 years.

Sewage is disposed of in surface impoundments in accordance with terms of the October 7, 1992, Consent Order. Wastewater in the impoundments is allowed to evaporate, and the resulting sludge is placed in the landfill. Solids are separated and reclaimed where possible.

3.2.11.7 Waste Minimization

The DOE Idaho Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at INL. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The Idaho Operations Office published its first *Waste Minimization Plan* in 1990, which defined specific goals, methodologies, responsibilities, and achievements of programs and organizations. INL now promotes the incorporation of pollution prevention into all planning activities, as well as the concept that pollution prevention is integral to mission accomplishment. In 2002, INL reported 38 pollution prevention projects, which resulted in a waste reduction of 13,906 metric tons (34,306 tons). The cost of operations was decreased by more than $9 million. Examples of pollution prevention projects at INL include the fabrication of lead bricks from over 90,720 kilograms (200,000 pounds) of radioactively contaminated lead taken from dismantled casks and shielding, which were reused/recycled by the Idaho State University Accelerator Center and the sale of a variety of items including desks, chairs, used tires, scrap metal, and computer components to the public, resulting in avoided waste disposal costs of $5,472,772 and sales receipts of $294,284, which will be used toward INL Excess Warehouse operating expenses (DOE 2003c).

3.2.11.8 *Waste Management PEIS* Records of Decision

The *Waste Management PEIS* RODs affecting INL are shown in **Table 3–20**. Decisions on the various waste types were announced in a series of RODs published on the *Waste Management PEIS* (DOE 1997b). The initial transuranic waste ROD was issued on January 20, 1998 (63 FR 3629) with several subsequent amendments; the hazardous waste ROD was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste ROD was published on February 18, 2000 (65 FR 10061). The transuranic waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare transuranic waste for disposal at WIPP. Each DOE site that has or will generate transuranic waste will, as needed, prepare and store its transuranic waste onsite until the waste is shipped to WIPP. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of their nonwastewater hazardous waste, and ORR and the Savannah River Site (SRS) will continue to treat some of their own nonwastewater hazardous waste onsite in existing facilities, where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste ROD states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites and disposal will continue to the extent practicable onsite at INL, LANL, ORR, and SRS. In addition, the Hanford Site and Nevada Test Site (NTS) will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at the Hanford Site, INL, ORR, and SRS, and disposed of at the Hanford Site and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at INL is presented in the hazardous waste and low-level radioactive waste and mixed low-level radioactive waste RODs. Transuranic waste is currently being stored, pending shipment to WIPP for disposal (DOE 1996d).

Table 3–20 *Waste Management PEIS* Records of Decision Affecting Idaho National Laboratory

Waste Type	*Preferred Action*
Transuranic	Certify, dispose at WIPP.
Low-level radioactive	DOE has decided to treat INL's low-level radioactive waste onsite. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at INL. This includes the onsite treatment of INL's wastes and could include treatment of some mixed low-level radioactive waste generated at other sites. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of INL nonwastewater hazardous waste. DOE will also continue to use onsite facilities for wastewater hazardous waste. [b]

WIPP = Waste Isolation Pilot Plant, INL = Idaho National Laboratory.

[a] From the ROD for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).

[b] From the ROD for hazardous waste (63 FR 41810).

Sources: 63 FR 41810; 65 FR 10061.

3.2.12 Environmental Restoration Program

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at INL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

EPA placed INL on the National Priorities List on December 21, 1989. In accordance with CERCLA, DOE entered into a consent order with EPA and the state of Idaho to coordinate cleanup activities at INL under one comprehensive strategy. This agreement integrates DOE's CERCLA response obligations with RCRA corrective action obligations. In 1991, DOE signed the Federal Facility Agreement and Consent Order with the EPA and the state of Idaho. In general, the agreement is designed to (DOE 2005a):

- Establish procedures and a schedule for prioritizing, implementing, and monitoring remediation in accordance with applicable Federal and State laws;

- Expedite remediation as much as possible to protect human health and the environment;

- Facilitate cooperation, information exchange, and participation between the agencies;
- Minimize duplication of analyses and documentation; and
- Provide opportunities for the public to stay informed and involved in selecting cleanup remedies.

Since the Federal Facility Agreement and Consent Order was signed in December 1991, INL has cleaned up thousands of unexploded World War II era munitions and removed tons of radioactively contaminated soil and out-of-service tanks. In addition, INL operates many treatment systems to clean up or destroy contaminants in and over the Snake River Plain Aquifer (DOE 2005a). Since 1991, 22 RODs have been signed and are being implemented, three remedial investigation/feasibility studies are under development, and more than 70 percent of CERCLA actions have been completed (DOE 2003c). The successful site cleanups have produced beneficial environmental impacts, including risk reductions.

The Federal Facility Agreement and Consent Order divided major INL facilities into 10 waste area groups (WAGs), each containing a number of areas potentially contaminated with hazardous waste. WAGs 1 through 9 correspond to facility areas at INL. WAG 10 corresponds to sitewide concerns and includes the Snake River Plain Aquifer. Contaminated areas found after a ROD is signed are included in WAG 10. WAGs are further broken down into operable units for management purposes (DOE 2005a).

Following a site investigation, and after the public is involved in selection of a remedy for a contaminated site, a ROD is issued that describes the remedy for the site in detail. Since the Federal Facility Agreement and Consent Order was signed in 1991, all but three RODs have been signed. The three remaining are also the most challenging and have been the focus of public concern. They are (DOE 2005a):

- Operable Unit 3-14, remediation of contaminated soils in and around the tank farm at the INTEC;
- Operable Unit 7-13/14, remediation of buried waste at the Radioactive Waste Management Complex’s Subsurface Disposal Area; and
- Operable Unit 10-08, final comprehensive remediation of the Snake River Plain Aquifer and miscellaneous sites not covered within other WAGs.

Remediation activities at WAG 2 (RTC) are nearly complete. In 2002, investigation of newly identified sites that may contain contamination continued. Institutional controls were maintained, and an annual inspection report was published (DOE 2003c).

Contaminated sites at WAG 9 (MFC) include tanks and wastewater handling/disposal systems, such as ditches and ponds. DOE has been testing the use of plants to remove both radioactive and nonradioactive constituents from contaminated soils (i.e., phytoremediation) at several sites at MFC. The results are promising and have been supported through additional testing. The DOE Chicago Operations Office believes the remediation goals have been met at each of the sites, thereby excluding the need to continue with phytoremediation (DOE 2003c).

As directed by a ROD signed in 2000, MFC is treating the sodium-bonded spent nuclear fuel from EBR-II. Spent nuclear fuel from the reactor has been stored at MFC since the reactor was shut down in 1994. The treatment technology, in development for the last decade, is an electrometallurgical process that reduces overall volume and produces more stable waste forms. The process removes the reactive metal sodium component from the spent nuclear fuel and converts the long-lived transuranic elements and fission products into ceramic and metallic waste forms (INEEL 2003).

In May 2002, DOE, the Idaho Department of Environmental Quality, and the EPA signed a letter of intent formalizing an agreement to pursue accelerated risk reduction and cleanup at INL (DOE 2003c). The *Environmental Management Performance Management Plan for Accelerating Cleanup of the Idaho National Engineering and Environmental Laboratory* (DOE 2002b) describes DOE's plan to accelerate the reduction of environmental risk at INL by completing its cleanup responsibility faster and more efficiently. The plan describes how DOE will address risk reduction and elimination by stabilizing and dispositioning materials such as sodium-bearing liquid wastes, spent nuclear fuel, and special nuclear materials many years earlier than currently planned. The plan describes nine strategic initiatives DOE proposes to eliminate or reduce environmental risks at INL (DOE 2002b):

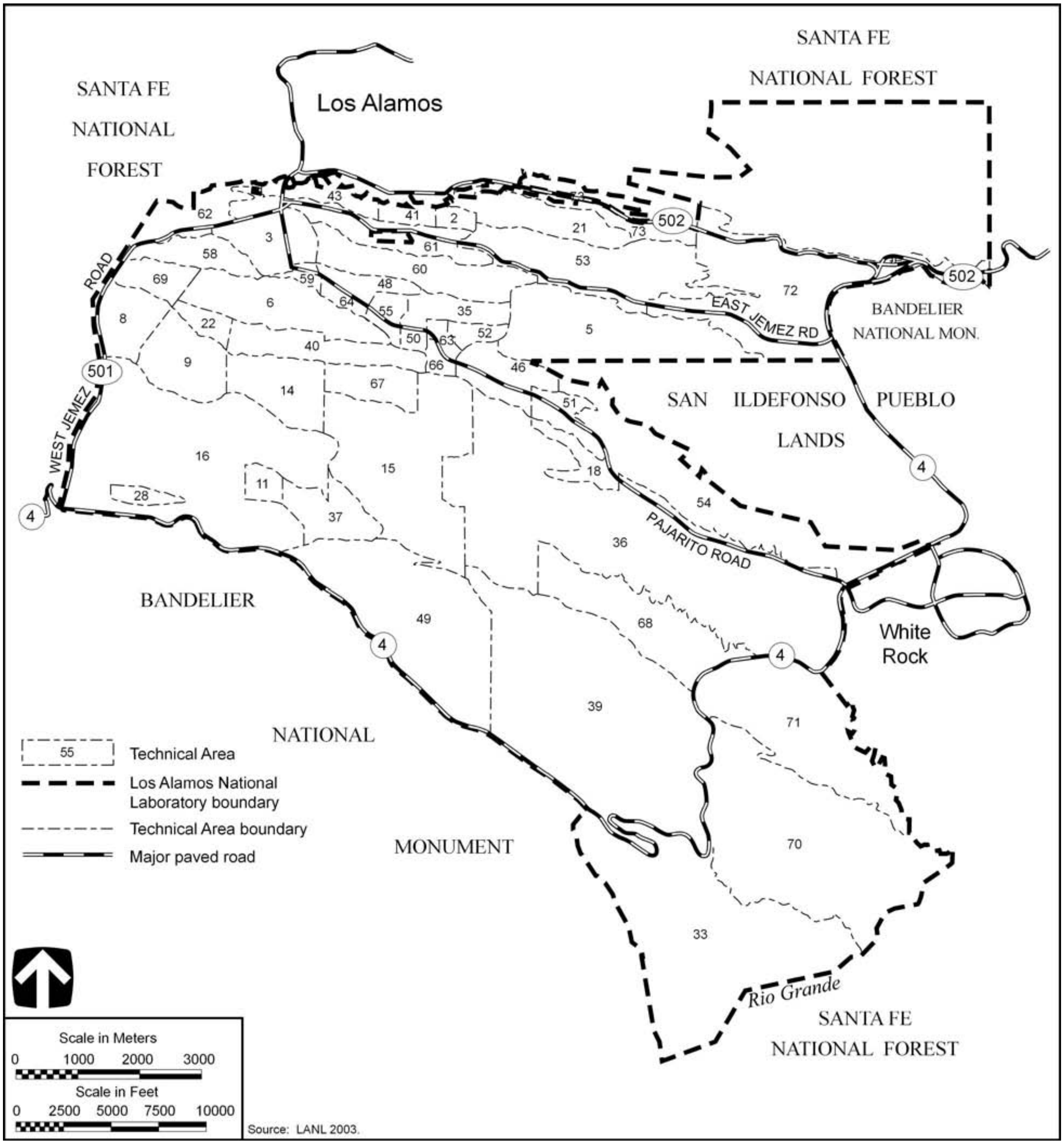
- Accelerate tank farm closure.
- Accelerate high-level radioactive waste calcine removal from Idaho.
- Accelerate consolidation of spent nuclear fuel to INTEC.
- Accelerate offsite shipments of transuranic waste stored at the Transuranic Storage Area.
- Accelerate remediation of miscellaneous contaminated areas.
- Eliminate onsite treatment and disposal of low-level radioactive waste and mixed low-level radioactive waste.
- Transfer all Environmental Management-managed special nuclear material offsite.
- Remediate buried waste at the Radioactive Waste Management Complex.
- Accelerate consolidation of INL facilities and reduce the footprint.

At the 2020 end state in the plan, some activities would continue: shipment of spent nuclear fuel to a repository; retrieval, treatment, packaging, and shipment of calcine high-level waste to a repository; and final dismantlement of remaining Environmental Management buildings. Additionally, the site will continue with ongoing activities such as groundwater monitoring well beyond the 2020 end state identified in the plan. These activities will be completed by 2035, with the exception of some minor activities leading to long-term stewardship (DOE 2002b). More information on regulatory requirements for waste disposal is provided in Chapter 5 of this EIS.

3.3 Los Alamos National Laboratory

LANL is located on approximately 26,480 acres (10,716 hectares) of land in north central New Mexico (**Figure 3–10**). The site is located 97 kilometers (60 miles) north-northeast of Albuquerque, New Mexico, 40 kilometers (25 miles) northwest of Santa Fe, New Mexico, and 32 kilometers (20 miles) southwest of Española, New Mexico. LANL is owned by the Federal Government and administered by DOE's National Nuclear Security Administration (NNSA). It is operated by the University of California under contract to DOE. Portions of LANL are located in Los Alamos and Santa Fe Counties. DOE's principal missions are national security, energy resources, environmental quality, and science, and each of these missions is supported by activities conducted at LANL.

LANL is divided into 48 separate technical areas (TAs) not including TA-0 (which comprises leased space within the Los Alamos townsite), with location and spacing that reflect the site's historical development patterns, regional topography, and functional relationships (**Figure 3–11**). While the number of structures changes somewhat with time (e.g., as a result of the Cerro Grande Fire in 2000; see Section 4.2.1.1), there are 916 permanent structures, 512 temporary structures, and 1,362 miscellaneous buildings with approximately 538,000 square meters (5.8 million square feet) that could be occupied (LANL 2004a).



Source: LANL 2003.

Figure 3–11 Technical Areas of Los Alamos National Laboratory

The Plutonium Facility at TA-55 at LANL is where plutonium-238 is currently purified, pelletized, and encapsulated. TA-55 is located in the west-central portion of LANL. The Plutonium Facility at TA-55 provides research and applications in chemical and metallurgical processes for 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. Additional activities include the means to safely and securely ship, receive, handle, and store nuclear materials, as well as manage the waste and residue produced by TA-55 operations (DOE 1999a). Unless otherwise referenced, the following descriptions of the affected environment at LANL and TA-55 are based all or in part on information provided in the *LANL SWEIS* (DOE 1999a), which is incorporated by reference.

3.3.1 Land Resources

3.3.1.1 Land Use

Land use in this region is linked to the economy of northern New Mexico, which depends heavily on tourism, recreation, agriculture, and the state and Federal Governments for its economic base. Local communities are generally small, such as the Los Alamos townsite with under 12,000 residents, and primarily support urban uses including residential, commercial, light industrial, and recreational facilities. The region also includes American Indian communities; lands of the Pueblo of San Ildefonso share LANL's eastern border, and a number of other Pueblos are clustered nearby. Major governmental bodies that serve as land stewards and determine land uses within Los Alamos and Santa Fe Counties include the county governments, DOE, the U.S. Forest Service, the National Park Service, the state of New Mexico, the U.S. Bureau of Land Management, 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 (see **Figure 3–12**).

Land use characterization at LANL is based on the most hazardous activities in each TA and is organized into six categories:

Support—Includes TAs with only support facilities that do not perform research and development activities and are generally free from chemical, radiological, or explosive hazards; also includes undeveloped TAs other than those that serve as buffers.

Research and Development—Includes TAs that perform research and development activities with associated chemical and radiological hazards, but that are generally free of explosives hazards; does not include waste disposal sites.

Research and Development/Waste Disposal—The remaining research and development areas (i.e., those areas that are generally free of explosives hazards and have existing waste disposal sites).

Explosives—Includes TAs where explosives are tested or stored, but does not include waste disposal sites.

Explosives/Waste Disposal—The remaining sites where explosives are tested or stored (i.e., those with existing waste disposal sites).

Buffer—Land identified in each of the usage types described above also may serve as a buffer area. This last land use category therefore includes areas that serve only as buffers for the safety or security of other TAs, usually explosives areas.

LANL is divided into TAs that are used for building sites, experimental areas, and waste disposal locations. However, those uses account for only a small part of the total land area of the site. In fact, only 5 percent of the site is estimated to be unavailable to most wildlife (because of security fencing). Most of the site is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands. In 1977, DOE designated LANL as a National Environmental Research Park, which is used by the national scientific community as an outdoor laboratory to study the impacts of human activities on piñon-juniper woodland ecosystems (DOE 2002d). In 1999, the White Rock Canyon Wildlife Reserve was dedicated. It is about 405 hectares (1,000 acres) in size and is located on the southeast perimeter of LANL. The reserve is managed jointly by DOE and the National Park Service for its significant ecological and cultural resources and research potential (DOE 2003d).

Los Alamos County has prepared a preliminary draft of the *Los Alamos County Comprehensive Plan, 2001-2014* as part of the process to update its 1987 plan (previously addressed in the *LANL SWEIS*) (DOE 1999a, Los Alamos County 2004). The county consists of approximately 28,272 hectares (69,860 acres) of land, most of which is owned by the Federal Government. Only about 3,521 hectares (8,700 acres), including land that has been transferred from DOE (see below), are under county jurisdiction, with much of this land located within the Los Alamos townsite and White Rock. When Federal land changes ownership, the new owner is required to submit for general plan amendment and zoning before the land can be developed (Los Alamos County 2004). In 1999, Los Alamos County leased 16.8 hectares (41.5 acres) of land adjacent to TA-3 from LANL for development of a research park; to date, about 2 hectares (5 acres) have been developed (LANL 2003, 2005).

As a result of the passage of Public Law 105-119, Section 632, 10 tracts (consisting of 29 subtracts) comprising 1,952 hectares (4,824 acres) were designated for conveyance and transfer from DOE to the Incorporated County of Los Alamos and the Pueblo of San Ildefonso. However, the conveyance and transfer of 257 hectares (634 acres) has been deferred. Thus, the total land to be turned over totals 1,696 hectares (4,190 acres). To date, 894 hectares (2,209 acres) have been turned over, including all but 1.4 hectares (3.4 acres) to the Pueblo of San Ildefonso (LANL 2004a).

On the evening of May 4, 2000, employees of the National Park Service ignited a prescribed burn in a forested area approximately 2.2 kilometers (3.5 miles) west of LANL. The area of the burn was within the boundaries of Bandelier National Monument along a mountain slope of the Cerro Grande (DOE 2000d). The next day the fire was declared a wildfire. By the time it was fully contained on June 8, the fire had consumed approximately 17,400 hectares (43,000 acres), including about 3,035 hectares (7,500 acres) on LANL (LANL 2004a). Direct effects of the fire on land use included impacts on numerous site structures. Of the 332 structures affected by the fire, 236 were impacted, 68 damaged, and 28 destroyed (ruined beyond economic repair). Fire mitigation work, such as flood retention facilities, affected about 20.2 hectares (50 acres) of undeveloped land (LANL 2003). Following the fire, the Cerro Grande Rehabilitation Project was created to facilitate and implement post-fire activities. A *Wildfire Hazard Reduction Project Plan* (LANL 2001a) was developed to identify and prioritize projects and to provide guidelines for project implementation. This plan called for the treatment, including thinning of existing stands, of up to 4,047 hectares (10,000 acres) to reduce wildfire hazard. As of 2004, 2,947 hectares (7,283 acres) had been treated (LANL 2005).

TA-55 is also located within the Research and Development land use category (see Figure 3–12). Facilities at TA-55 are located on a 16-hectare (40-acre) site that is situated 1.8 kilometers (1.1 miles) south of the Los Alamos townsite. Forty-three percent of the site has been developed. The main complex has five connected buildings; the Nuclear Materials Storage Facility is separate from the main complex but shares an underground transfer tunnel. A security fence to aid in physical safeguarding of special nuclear material bounds the entire site. The Cerro Grande Fire at times threatened structures at TA-55 (LANL 2000b), however, no permanent buildings were damaged or destroyed.

3.3.1.2 Visual Resources

The topography in northern New Mexico is rugged, especially in the vicinity of LANL. Mesa tops are cut by deep canyons, creating sharp angles in the land form. 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 of vegetation and height of which may change over time and can affect the visibility of an area within the LANL viewshed. Undeveloped lands within LANL have a Bureau of Land Management Visual Resource Contrast rating of Classes II and III. Management activities within these classes may be seen but should not dominate the view (DOI 1986).

For security reasons, much of the development within LANL has occurred out of the public's view. Passing motorists or nearby residents can see only a small fraction of what is actually there. Prior to the Cerro Grande Fire, the view of most LANL property from many stretches of area roadways was that of woodlands and brushy areas. Views from various locations in Los Alamos County and its immediate surroundings have been altered by the Cerro Grande Fire. Although the visual environment is still diverse, interesting, and panoramic, portions of the visual landscape are dramatically stark. Rocky outcrops forming the mountains are now visible through the burned forest areas. The eastern slopes of the Jemez Mountains, instead of presenting a relatively uniform view of dense green forest, are now a mosaic of burned and unburned areas. Grasses and shrubs initially will replace forest stands and will contribute to the visual contrast between the burned and unburned areas for many years. Local effects include reduced visual appeal of trails and recreation areas (DOE 2000d).

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 within the core part of LANL, the TA-3 area. Developed areas within LANL are consistent with a Class IV Visual Resource Contrast rating, in which management activities dominate the view and are the focus of viewer attention (DOE 2002d).

TA-55 is located on a mesa about 1.6 kilometers (1 mile) southeast of TA-3. While not visible from lower elevations, TA-55 is visible from higher elevations to the west along the upper reaches of the Pajarito Plateau rim, from where it appears as one of several scattered built-up areas among the heavily forested areas of the site. Developed portions of TA-55 have a Class IV Visual Resource Contrast rating (DOE 2002d).

3.3.2 Site Infrastructure

Characteristics of LANL's utility and ground transportation infrastructure are summarized in **Table 3–21**. Section 3.3.8.4 further discusses local transportation infrastructure, and Section 3.3.11 describes the site's waste management infrastructure.

3.3.2.1 Site Ground Transportation

LANL is accessible via NM Routes 4 and 502, with the central portion of LANL (including TA-55) accessible from the east from NM 4 via Pajarito Road which bisects the LANL site. About 130 kilometers (80 miles) of paved roads and parking surface have been developed on LANL. There is no railway service connection at the site.

Table 3–21 Los Alamos National Laboratory Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	130 [a]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity [b]		
Energy (megawatt-hours per year)	492,671	963,600
Peak load (megawatts)	88	110
Fuel		
Natural gas (cubic meters per year)	34,500,000 [c]	229,400,000 [d]
Liquid fuels (liters per year)	Negligible	Not limited
Water (liters per year)	1,430,000,000	2,050,000,000 [e]

[a] Includes paved roads and paved parking areas only.
[b] Usage and capacity values are for the entire Los Alamos Power Pool.
[c] Usage value for LANL plus baseline usage for other Los Alamos County users.
[d] Entire service area capacity which includes LANL and other Los Alamos area users.
[e] Equivalent to 30 percent of the water right allocation from the main aquifer.
Note: To convert kilometers to miles, multiply by 0.621; liters to gallons, multiply by 0.264; and cubic meters to cubic feet, multiply by 35.315.
Sources: DOE 2003d, LANL 2004b.

3.3.2.2 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 administered by DOE and originates from the Norton Substation near White Rock, and the second line (the Reeves Line) is owned by the Public Service Company of New Mexico and originates from the Bernalillo-Algodones Substation. Both substations are owned by the Public Service Company of New Mexico (DOE 2003d).

Import capacity is limited only by the physical capability (thermal rating) of the transmission lines. The import capacity is approximately 110 to 120 megawatts from a number of hydroelectric, coal, and natural gas power generators throughout the western United States (DOE 2003d, LANL 2004b).

Within LANL, DOE also operates a gas-fired steam and electrical power generating plant at TA-3 (TA-3 Co-generation Complex), and maintains various low-voltage transformers at LANL facilities and approximately 55 kilometers (34 miles) of 13.8-kilovolt distribution lines. DOE also maintains two power distribution substations: the Eastern TA Substation and the TA-3 Substation (DOE 2003d). As part of ongoing electric reliability upgrades at LANL, DOE completed construction of the new Western TA Substation in 2002. This 115/13.8-kilovolt substation has a main transformer rated at 56-megavolt-amperes (or about 45 megawatts). The substation will provide redundant capacity for LANL and the Los Alamos townsite in the event of an outage at either of LANL's two existing substations (DOE 2003d, LANL 2004b).

Other projects to improve the reliability of electric power transmission to the Power Pool include construction of a third transmission line and associated substation and uncrossing the two existing transmission lines (the Norton and Reeves Lines) where they cross on LANL. The new transmission line would be constructed in two segments: (1) from the Norton Substation to a new substation (Southern TA) to be constructed near White Rock, and (2) from the new Southern TA Substation to the Western TA

Substation. The first segment would be constructed at 345 kilovolts but operated in the short term at 115 kilovolts, as large pulse power loads at LANL will need the higher voltage in the future. The second segment would be constructed and operated at 115 kilovolts. Construction of the new transmission line and uncrossing the existing lines is projected to start in 2005 and require 1 year to complete (LANL 2004b).

Onsite electrical generating capability for the power pool is limited by the aforementioned TA-3 Co-generation Complex, which is capable of producing up to 20 megawatts of electric power that is shared by the Power Pool under contractual arrangement. Generally, onsite electricity production is used to fill the difference between peak loads and the electric power import capability (LANL 2004b). An environmental assessment was prepared and a Finding of No Significant Impact was issued in December 2002 for a project to install two new (20 megawatt), gas-fired combustion turbine generators and to upgrade the existing steam turbines. Refurbishment of this facility, which includes upgrades to the #3 steam turbine and to the steam path and cooling tower, began in 2003. When complete in Fiscal Year (FY) 2005, these improvements should increase the output of the facility to more than 20 megawatts in the short term. Installation of the first new combustion turbine generator at the TA-3 Co-generation Complex is scheduled to occur during the FY 2004 – FY 2005 timeframe (LANL 2004b).

Operations at several of the large LANL load centers changed during 2003. For example, operations at the Strategic Computing Complex resulted in load increases of about 4 megawatts in FY 2003 (LANL 2004b). Electrical energy availability from the Pool is estimated at 963,600 megawatt-hours (reflecting the lower thermal rating of 110 megawatts for 8,760 hours per year on the existing transmission system). In FY 2003, LANL used 382,849 megawatt-hours of electricity. Other Los Alamos County users consumed an additional 109,822 megawatt-hours, for a Power Pool total electric energy consumption of 492,671 megawatt hours. The FY 2003 peak load usage was about 71 megawatts for LANL and about 17 megawatts for the rest of the county (LANL 2004b). The estimated peak load capacity is 110 megawatts (see Table 3–21). TA-55 uses approximately 14,500 megawatt-hours of electricity annually (LANL 2003).

3.3.2.3 Natural Gas

Natural gas is the primary fuel used in Los Alamos County and at LANL. The natural gas system includes a high-pressure main and distribution system to Los Alamos County and pressure-reducing stations at LANL buildings. In August 1999, DOE sold the 209-kilometer-long (130-mile-long) main gas supply line and associated metering stations for Los Alamos and vicinity to the Public Service Company of New Mexico. The county and LANL both have delivery points where gas is monitored and measured. LANL burns natural gas to generate steam to heat buildings. The natural gas delivery system servicing the Los Alamos area has a contractually-limited capacity of about 229 million cubic meters (8.07 billion cubic feet) per year (DOE 2003d). In FY 2003, LANL used approximately 34.5 million cubic meters (1.22 billion cubic feet) of natural gas (see Table 3–21). Some 97 percent of the natural gas used at LANL is for heating, and the remainder for electricity generation to meet peak demands (LANL 2004b). The rest of the service area, including Los Alamos County, is estimated to use an average of 29.5 million cubic meters (1.04 billion cubic feet) of natural gas annually. Relatively small quantities of fuel oil are also stored at LANL as a backup fuel source and use is therefore negligible. TA-55 uses natural gas to fire boilers and for other facility uses and is estimated to use approximately 1.3 million cubic meters (45 million cubic feet) annually (DOE 2003d).

3.3.2.4 Water

The Los Alamos water supply system consists of 14 deep wells, 246 kilometers (153 miles) of main distribution lines, pump stations, and storage tanks. The system supplies potable water to all of the county, LANL, and Bandelier National Monument (DOE 2003d).

On September 5, 2001, DOE completed the transfer of ownership of the water production system to Los Alamos County, along with 70 percent (4,785 million liters [3,879 acre feet or 1,264 million gallons] per year) of its water rights. The remaining 30 percent (2,050 million liters [1,662 acre feet or 542 million gallons] per year) of the water rights are leased by DOE to the county for 10 years, with the option to renew the lease for four additional 10-year terms (DOE 2003d). The county is also pursuing the use of San Juan-Chama water as a means of preserving those water rights. Los Alamos County has completed a preliminary engineering study and is currently negotiating a contract to acquire this allocation (LANL 2004b).

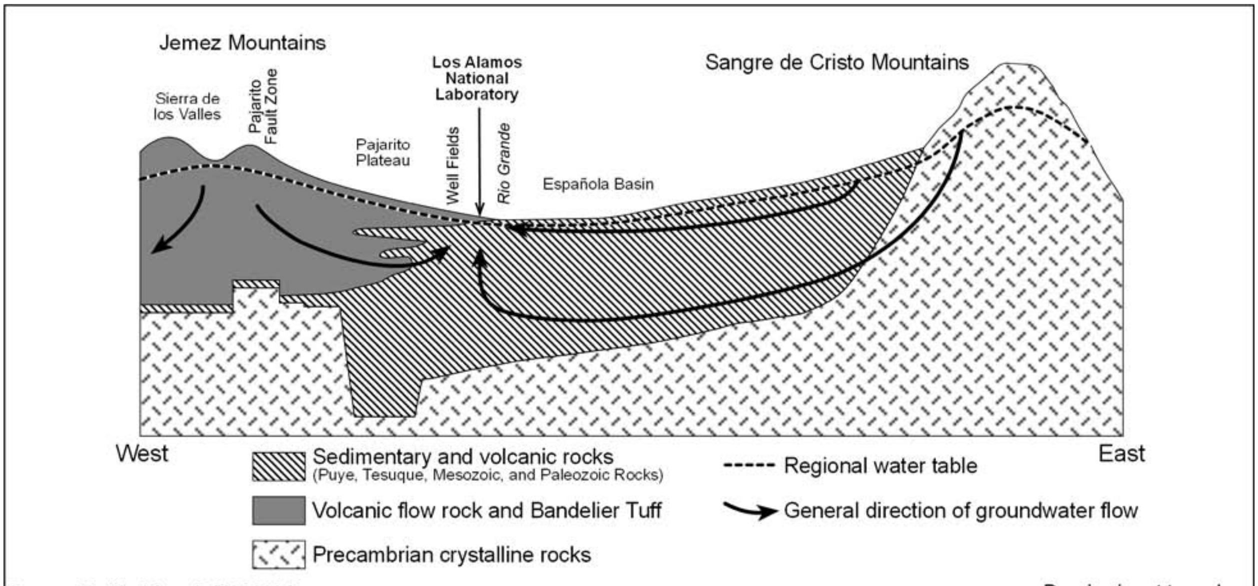
In FY 2003, LANL used approximately 1,430 million liters (378 million gallons) of water (LANL 2004b) (see Table 3–21). Water use for TA-55 is not currently available.

3.3.3 Geology and Soils

3.3.3.1 Geology

LANL is located on the Pajarito Plateau within the Southern Rocky Mountains Physiographic Province. The Pajarito Plateau lies between the Sierra de Los Valles and the Jemez Mountains to the west and the Rio Grande to the east (see **Figure 3–13**). The surface of the Pajarito Plateau is divided into multiple narrow, east-southeast trending mesas separated by deep parallel canyons that extend from the Jemez Mountains to the Rio Grande. The major tectonic feature in the region is the Rio Grande Rift, which begins in northern Mexico, trends northward across central New Mexico, and ends in central Colorado. The rift is a complex system of north-trending basins that have formed from down-faulted blocks of the Earth's crust. In the Los Alamos area, the Rio Grande Rift is about 56 kilometers (35 miles) wide and encompasses the Española Basin. The Sangre de Cristo Mountains border the Rio Grande Rift on the east, and the Jemez Mountains lie west of the Rift and the Pajarito Fault system (DOE 2003d).

Bedrock outcrops typically occur on greater than 50 percent of the surface of LANL. Forming the Pajarito Plateau, the Bandelier Tuff consists of volcanic material that was violently erupted about 1.2 and 1.6 million years ago from the Valles and Toledo Calderas. In the LANL area, the Bandelier Tuff attains a thickness of more than 200 meters (700 feet) and consists of multiple ash-flow deposits of rhyolitic tuff and pumice. In particular, the Tshirege Member of the Bandelier Tuff consists of multiple cooling units that create nearly horizontal light- and dark-colored strata on canyon walls throughout the LANL area. The dark-colored units are harder and more resistant to erosion; they form steep cliffs and cap the mesas. Beneath the Bandelier Tuff, the Puye Formation is a complex deposit consisting predominantly of poorly sorted coarse sands to boulders resulting from erosion of the Jemez Mountains. This formation also includes ash and pumice falls from Jemez Mountain volcanism, inter-bedded basalt flows (the Cerros del Rio Basalt) and debris from the Cerros del Rio volcanic field (2 to 3 million years old), localized deposits of well-rounded cobbles and boulders of crystalline rocks from the ancestral Rio Grande, and fine-grained lake deposits in the eastern portions of the fan. The underlying Tschicoma Formation (2 to 7 million years old) consists of intermediate composition volcanic rocks and forms the bulk of the Jemez Mountains. The Santa Fe Group (4 to 21 million years old) is the thickest and most extensive group of sedimentary deposits in the upper Española Basin. In the vicinity of the Pajarito Plateau, the Santa Fe Group consists of two formations (Tesuque and overlying Chamita Formation) of slightly consolidated



Source: Modified from DOE 2003d.

Drawing is not to scale

Figure 3–13 Geology and Hydrogeology of the Española Portion of the Northern Rio Grande Basin

sedimentary rocks derived from fluvial erosion of the Sangre de Cristo Mountains to the east. The Santa Fe Group also contains older volcanic tuff deposits and basalt flows, and overlies Precambrian Age (greater than 570 million years old) crystalline basement rock.

The Pajarito Fault system defines the western boundary of the Rio Grande Rift. In Los Alamos County, the Pajarito Fault system consists of the Pajarito, Rendija Canyon, and Guaje Mountain Fault zones (see **Figure 3–14**). Of these three fault zones, the Pajarito is the largest and delineates the boundary between the Pajarito Plateau and Jemez Mountains. The Rendija Canyon Fault changes from a single-trace in the northern part of Los Alamos County to a broad zone of smaller faults within LANL property. Locally, the Pajarito and Rendija Canyon Fault zones define a down-faulted block of the Bandelier Tuff that lies beneath the western part of the Los Alamos townsite and TA-3 (DOE 2003d). The three major faults in Los Alamos County are considered active and capable per the U.S. Nuclear Regulatory Commission definition of the term as used for seismic safety (DOE 2003d). A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100).

Although LANL is located within an intracontinental rift zone, the region exhibits generally low seismicity overall. A historical catalog has been compiled of earthquakes that occurred in the LANL area from 1873 to 1991. Only six of these have had estimated magnitudes of 5 or greater on the Richter Scale. The May 1918 Cerrillos Earthquake was the most significant seismic event in this period. This earthquake had an estimated Richter magnitude of 5.5 and was centered approximately 50 kilometers (31 miles) southeast of LANL. This event had a reported MMI of VII at its epicenter (DOE 2002c, DOE 2003d). Since 1973, six earthquakes have been recorded within 100 kilometers (62 miles) of north-central LANL ranging in magnitude from 1.6 to a magnitude 4.5 event in March 1973. This 1973 earthquake was the closest to LANL at 27 kilometers (17 miles) to the northeast. The most recent was a magnitude 2.8 earthquake that occurred in December 1998 at a distance of 88 kilometers (55 miles) (USGS 2005c).

Earthquake-produced ground motion is expressed in units of "g" (force of acceleration relative to that of the earth's gravity). Two differing measures of this motion are peak (ground) acceleration and response spectral acceleration. For north-central LANL facilities, the calculated maximum considered earthquake ground motion ranges from approximately 0.49g for a 0.2-second spectral response acceleration to 0.16g for a 1.0-second spectral response acceleration. The calculated peak ground acceleration for the given probability of exceedance at the site is approximately 0.20g (USGS 2005b). These are representative of MMI VII earthquake damage (BSSC 2004). Table B–7 in Appendix B of this EIS shows the approximate correlation between MMI, earthquake magnitude, and peak ground acceleration.

Seismic hazard analysis demonstrates that the highest seismic hazard at LANL would be to a site built atop a trace of the Pajarito Fault. Along the Pajarito Fault system, an earthquake with a magnitude greater than or equal to 6 is estimated to have an annual probability of occurrence of once every 4,000 years. An earthquake with a magnitude greater than or equal to 7 is estimated to have an annual probability of occurrence of once every 100,000 years (DOE 2003d). Maintenance and refurbishment activities at LANL are specifically intended to upgrade the seismic performance of older structures. As stated in DOE Order 420.1A, DOE requires that nuclear or nonnuclear facilities be designed, constructed, and operated so that the public, the workers, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Volcanism in the Jemez Mountains volcanic field, west of LANL, has a 13-million-year history. The Bandelier Tuff is the material upon which most LANL facilities are constructed. The Bandelier Tuff is generally thickest to the west of LANL near its source, and thins eastward across the Pajarito Plateau, due to increasing distance from the source and erosion. Volcanic eruptions continued up to about 520,000 years ago, followed by a 460,000-year period of dormancy. The most recent volcanic activity produced several rock units, including the El Cajete Pumice, which is a minor unit in the LANL area that overlays the Bandelier Tuff. The El Cajete Pumice dates at 50,000 to 60,000 years old (DOE 2002d). Several independent lines of evidence indicate that future volcanic activity in the Jemez Mountains is likely, but recurrence intervals have not been firmly established.

During seismic events, facilities near a cliff edge or in a canyon bottom below 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. As for other geologic hazards due to seismic activity, the potential for land subsidence and soil liquefaction at LANL are considered low and negligible, respectively (DOE 2003d).

3.3.3.2 Soils

Several distinct soils have developed in Los Alamos County as a result of interactions between the bedrock, topography, and local climate. Most soils developed from acidic volcanic rock and range in texture from clay and clay loam to gravel. Soils that formed on mesa tops are well drained and range from 0 to 102 centimeters (0 to 40 inches) deep, with the greatest depth to the underlying Bandelier Tuff being 102 centimeters (40 inches). Soil erosion rates vary considerably on the mesa tops at LANL, with the highest rates occurring in drainage channels, where roads and structures concentrate runoff, and in areas of steep slopes, and the lowest rates occurring on gently sloping portions of the mesa tops away from the channels. High erosion rates appear to be relatively recent, most likely resulting from loss of vegetative cover, decreased precipitation, past logging practices, and past livestock grazing. Site soils are acceptable for standard construction techniques. No prime farmland soils have been designated in Los Alamos County (DOE 2002d, DOE 2003d).

The May 2000 Cerro Grande Fire burned the east-facing slope of the Jemez Mountains immediately upslope of LANL. The fire also burned significant areas within the western and central portions of the site. The loss of ground cover vegetation due to the fire increased the potential for soil erosion in these areas. Following the fire, the U.S. Forest Service Burn Area Emergency Rehabilitation Team found no significant areas of hydrophobic (water repellent) soil conditions within LANL. Regardless, due to exposed soils in the Jemez Mountains upslope of LANL, prevention of possible flooding of high-risk LANL facilities during intense precipitation events became a high priority. The possibility for enhanced erosion will likely persist for some 3 to 5 years (DOE 2003d).

TA-55 is located just to the southwest of the southern terminus of the Rendija Canyon Fault, which is located approximately 1.3 kilometers (0.8 miles) northwest of the facility. The Guaye Mountain Fault Zone dies out within the Los Alamos townsite approximately 3.2 kilometers (2 miles) north-northeast of TA-55; it has not been identified within LANL. TA-55 is located within an area of relatively simple structure where virtually no fault deformation can be documented. Detailed mapping has shown that the closest fault (not shown on Figure 3–14) is located 0.28 miles (0.45 kilometers) west of the Plutonium Facility at TA-55 (DOE 2003d). Typical subsurface stratigraphy at LANL and TA-55 consists of welded and poorly welded volcanic tuffs that comprise the Tshirege Member of the Bandelier Tuff Formation. The Tshirege Member attains a thickness of about 122 meters (400 feet). Site-specific investigations in Pajarito Canyon near TA-18 have found the tuff to be highly weathered and unwelded, with the upper 3 to 4.5 meters (10 to 15 feet) of the material classified as clayey sand or sandy clay. The canyon tuff is overlain by up to 4.5 meters (15 feet) of sandy and silty alluvium. Soils derived from these deposits are typically sandy loams (DOE 2002e).

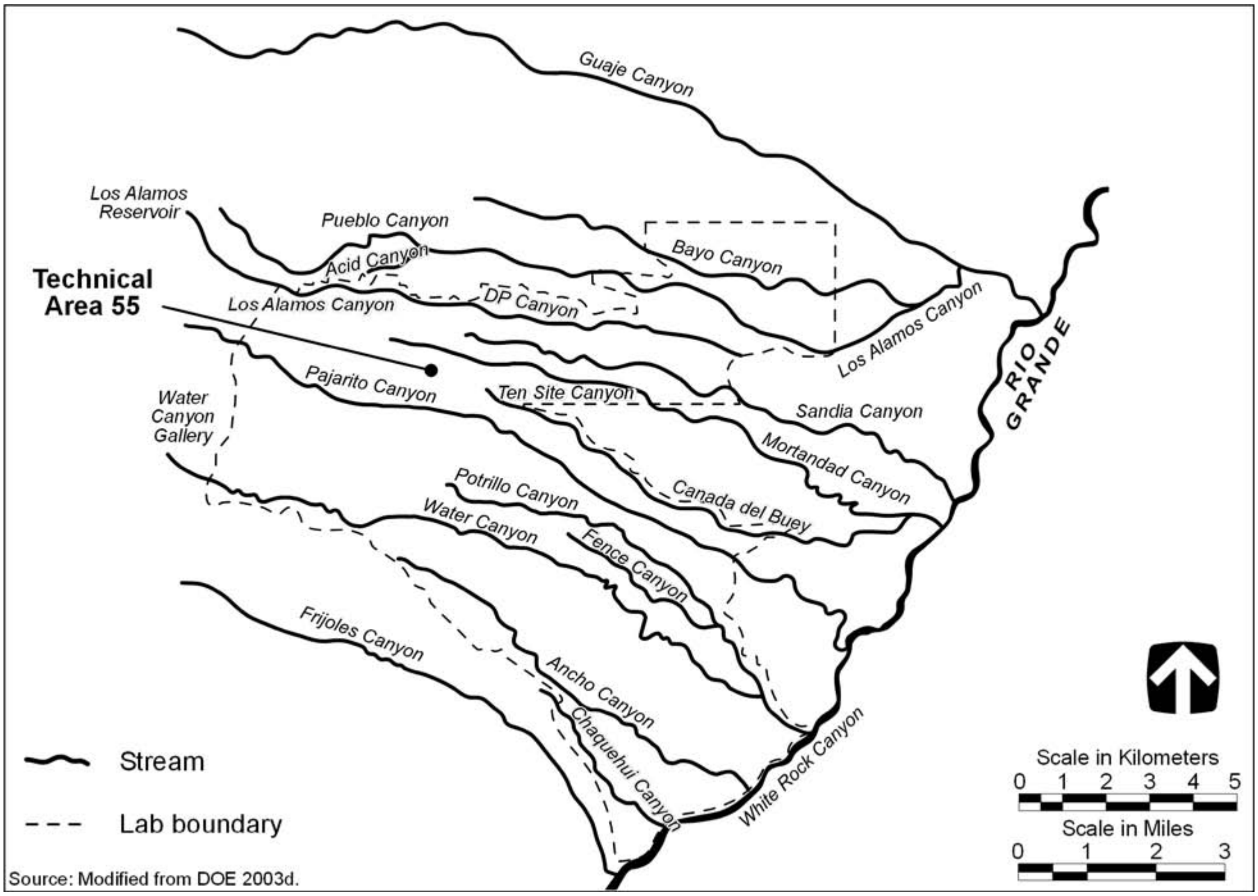
3.3.4 Water Resources

3.3.4.1 Surface Water

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams (i.e., arroyos). Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the LANL site before they are depleted by evaporation, transpiration, and infiltration. Runoff from heavy thunderstorms or snowmelt reaches the Rio Grande, the major river in north-central New Mexico, several times a year in some drainages. Effluent from sanitary sewage, industrial water treatment plants, and cooling-tower blowdown enter some canyons at rates sufficient to maintain surface flows for varying distances. Major watersheds in the LANL region are shown in **Figure 3–15**. All of these watersheds are tributaries to an 18-kilometer (11-mile) segment of the Rio Grande (DOE 2003d).

The Pajarito Plateau Canyons, which serve as collection points for the regional watersheds, originate either along the eastern rim of the Sierra de Los Valles or on the Pajarito Plateau. Within LANL boundaries, only Los Alamos, Pajarito, Water, Ancho, Sandia, Pueblo, and Chaquehui Canyons contain reaches or streams with sections that have continuous flow. Intermittent streams within LANL property are not classified, but are protected by the state of New Mexico for livestock watering and wildlife habitat use (New Mexico Administrative Code 20.6.4.10). Surface water within LANL boundaries is not a source of municipal, industrial, or irrigation water, but is used by wildlife that lives within, or migrates through, the region (DOE 2003d).

Most of LANL effluent is discharged into normally dry arroyos, and LANL is required to meet effluent limitations under the NPDES permit program that requires routine effluents monitoring. Therefore, the water quality of the intermittent streams is more characteristic of the quality of these discharges than of natural runoff, as reflected in the results of 2003 surface water and runoff monitoring. LANL's current individual NPDES permit (No. NM0028355), which was reissued with an effective date of February 1, 2001, covers all onsite industrial and sanitary effluent discharges, and DOE/NNSA and the



Source: Modified from DOE 2003d.

Figure 3–15 Surface Water Features at Los Alamos National Laboratory

University of California are co-permittees. As a result of an ongoing outfall reduction program that includes removing process flows at industrial outfalls, LANL's current industrial point-source NPDES permit now contains 21 permitted outfalls that include 1 sanitary outfall and 20 industrial outfalls.

The NPDES Industrial Storm Water Permit Program regulates storm water discharges from identified industrial activities. The University of California and DOE are also co-permittees under the NPDES Storm Water Multi-Sector General Permit 2000 (published in 2000) for LANL. The permit regulates storm water discharges from LANL industrial activities. The permit also requires the development and implementation of an SWPP Plan. Currently, LANL maintains and implements 17 SWPP Plans for its industrial activities. LANL also conducts stream monitoring and storm water monitoring at the confluence of major canyons, in certain segments of these canyons, and at a number of site-specific facilities. In addition, LANL conducts voluntary monitoring in major canyons that enter and leave LANL property (LANL 2004c).

LANL monitors surface waters and channel sediments from regional and Pajarito Plateau stations to evaluate the environmental effects of facility operations. Historical activities and resulting effluent discharges have affected water courses and associated sediments particularly in Pueblo, Los Alamos, Sandia, and Mortandad Canyons and, consequently, continue to affect surface water and runoff quality in these areas. The overall quality of most surface water in the Los Alamos area is very good, with very low levels of dissolved solutes. Of the more than 100 analytes tested for in sediment and surface water within the Laboratory, most are within normal ranges or at concentrations far below regulatory standards or risk-based advisory levels. However, nearly every major watershed shows indications of some effect from

LANL operations. At monitoring locations below other industrial or residential areas, particularly in the Los Alamos and Pueblo Canyon watersheds, above background contaminant levels reflect contributions from non-Laboratory sources, such as urban runoff.

The University of California at LANL has delineated all 100-year floodplains within LANL boundaries, which are generally associated with canyon drainages. Overall, most laboratory development is on mesa tops, and development within canyons is light. Nevertheless, for practical purposes the Cerro Grande Fire has increased the extent of all delineated floodplains in and below burned watershed areas (i.e., predominantly Los Alamos, Sandia, Mortandad, Pajarito, and Water Canyons) due to vegetation loss. More storm water runoff reaches the canyon bottoms and could subject LANL facilities located within or near the prefire delineated floodplain areas to increased erosion or sediment and debris deposition (DOE 2003d).

TA-55 is located on a narrow mesa (Mesita del Buey) about 1 mile (1.6 kilometers) southeast of TA-3. The mesa is flanked by Mortandad Canyon to the north and Twomile Canyon to the south. The site is largely comprised of a heavily developed facility complex with surface drainage primarily occurring as sheet flow runoff from the impervious surfaces within the complex. No developed portions of the complex are located within a delineated floodplain. One TA-55 facility discharges cooling tower blowdown directly to Mortandad Canyon (via NPDES Outfall 03A181). The Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50, specifically receives and treats plutonium processing and other wastes from TA-55 facilities with effluent discharged via NPDES Outfall 051 to Mortandad Canyon (DOE 2003d, NMED 2004).

3.3.4.2 Groundwater

Groundwater in the Los Alamos area occurs as perched groundwater near the surface in shallow canyon bottom alluvium and at deeper levels in the main (regional) aquifer. All groundwater underlying LANL and the vicinity having a total dissolved solids concentration of 10,000 milligrams per liter or less is considered a potential source of water supply for domestic or other beneficial use (New Mexico Administrative Code 20.6.2.3000).

The locations and extent of perched groundwater bodies have not been fully characterized at LANL, but investigations are continuing, and unidentified perched aquifers may exist. The depth to perched groundwater from the surface ranges from approximately 27 meters (90 feet) in the middle of Pueblo Canyon to about 150 to 200 meters (500 to 700 feet) in Mortandad Canyon. The regional aquifer exists in the sedimentary and volcanic rocks of the Española Basin, with a lateral extent from the Jemez Mountains in the west to the Sangre de Cristo Mountains in the east (see Figure 3–13). The hydrostratigraphic (water-bearing) units comprising the regional aquifer include the interconnected Puye Formation and the Tesuque Formation of the Santa Fe Group, with the top of the aquifer originating in the Cerros del Rio basalt, rather than in the Puye Formation, in some locations. Groundwater flow paths are conceptually illustrated in Figure 3–13. Groundwater flow is generally to the east across LANL toward the Rio Grande (DOE 2003d). Flow rates in the regional aquifer vary spatially but are typically 9 meters (30 feet) per year (LANL 2004c).

The regional aquifer is hydraulically separated for practical purposes from the overlying alluvial and intermediate perched groundwater bodies by unsaturated volcanic tuff and sedimentary strata, with the regional water table surface lying at a depth below land surface that varies from approximately 366 meters (1,200 feet) along the western boundary of the Pajarito Plateau to approximately 183 meters (600 feet) along its eastern edge. Thus, these hydrogeologic conditions tend to insulate the regional aquifer from near-surface waste management activities. Water in the regional aquifer is under confined, artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande (DOE 2003d).

Short-term effects of the Cerro Grande Fire on LANL groundwater resources include a potential increase in the prevalence of perched groundwater and springs. Also, the liberation of organic nitrogen from burned soils could impact shallow groundwater in the perched and alluvial zones, although the effects on deeper groundwater resources are not known (DOE 2003d).

Groundwater monitoring is conducted within and near LANL and encompasses the perched alluvial zone, intermediate perched groundwater zone, regional aquifer, and springs. However, although largely insulated from effects resulting from surface activities by hydrogeologic conditions, resource management and protection efforts are focused on the regional aquifer, which is the source for the Los Alamos public water supply. The groundwater monitoring network for perched alluvial groundwater consists of shallow observation wells located in Mortandad, Los Alamos, Pueblo, and Pajarito Canyons and in Cañada del Buey. The monitoring network for the regional aquifer includes monitoring (test) wells, 12 deep supply wells that produce water for all of LANL and the surrounding communities, and numerous springs, including those in White Rock Canyon along the Rio Grande. Los Alamos County owns and operates LANL's water supply wells and is responsible for demonstrating that the supply system meets Safe Drinking Water Act requirements (LANL 2004c).

As previously indicated, liquid effluent disposal at the Laboratory has significantly affected the quality of alluvial groundwater in some canyons. These effluents have affected deeper intermediate perched groundwater and the regional aquifer to a lesser degree. Drainages that received liquid radioactive effluents include Mortandad Canyon, Pueblo Canyon from its tributary Acid Canyon, and Los Alamos Canyon from its tributary DP Canyon. Water Canyon and its tributary Cañon de Valle have received effluents produced by high explosive processing and experimentation. Most notably, Mortandad Canyon presently receives radioactive effluents from the TA-50 RLWTF from its tributary Effluent Canyon. The radionuclide constituents in the RLWTF effluent have often exceeded the DOE Derived Concentration Guides for public dose from drinking water. The effluent also contains nitrate and fluoride that formerly caused perched alluvial groundwater concentrations to exceed the New Mexico groundwater standards of 10 milligrams per liter and 1.6 milligrams per liter, respectively. The nitrate source is nitric acid from plutonium processing at TA-55 that enters the TA-50 waste stream (DOE 2003d, LANL 2004c). Across the site, elevated perched alluvial groundwater concentrations of strontium-90, plutonium, americium, tritium, nitrate, perchlorate, high-explosives, barium, and molybdenum have approached or exceeded drinking water standards or risk-based drinking water levels in recent years in a few locations and over a limited area. Further, intermediate perched groundwater concentrations of high explosives, chlorinated solvents, tritium, perchlorate, and nitrate exceed or approach drinking water standards or risk-based drinking water levels in a few locations onsite. The regional aquifer shows traces of tritium and nitrate that are below drinking water risk levels. However, significant improvements in the water quality of most liquid effluent discharges from LANL facilities have with some exceptions (such as strontium-90) resulted in rapid improvement in the quality of shallow groundwater (LANL 2004c).

A reverse osmosis and ultrafiltration treatment system that removes additional radionuclides and nitrate from the effluent began operation in April 1999. As a result, effluent discharges from the RLWTF now meet the DOE Derived Concentration Guides for public dose and New Mexico standards for nitrate and fluoride; the RLWTF effluent has met DOE Derived Concentration Guides continuously since December 10, 1999. Also, at the end of 2000, the RLWTF adopted a voluntary goal of tritium activity below 20,000 picocuries per liter in its effluent (LANL 2004c). Detailed information on groundwater monitoring, including analytical results, is presented in the annual site environmental report.

The main aquifer is the only body of groundwater in the region that is sufficiently saturated and permeable to transmit economic quantities of water to wells for public use. All drinking water for Los Alamos County, LANL, and Bandelier National Monument comes from the main aquifer. Water use is detailed in Section 3.3.2.4.

The depth to groundwater beneath TA-55 is approximately 390 meters (1,280 feet) and the flow direction is inferred as east and southeast. As discussed above, radioactive effluents from TA-3 and TA-55 are conveyed through RLWTF at the TA-50 wastewater treatment facility and then discharged to Mortandad Canyon (DOE 2003d). Effluent discharge from the RLWTF into Mortandad Canyon had created a localized area of alluvial groundwater with plutonium-238, -239, -240, and americium-241 measured above the 4-millirem DOE Derived Concentration Guide for drinking water.

3.3.5 Air Quality and Noise

3.3.5.1 Air Quality

Los Alamos has a semiarid, temperate mountain climate. This climate is characterized by seasonable, variable rainfall with precipitation ranging from 25 to 51 centimeters (10 to 20 inches) per year. The climate of the Los Alamos townsite is not as arid (dry) as the portions of LANL near the Rio Grande, which is arid continental. Meteorological conditions within Los Alamos are influenced by the elevation of the Pajarito Plateau. Climatological averages presented for atmospheric variables such as temperature, pressure, winds, and precipitation are based on observations made at the official Los Alamos meteorological weather station from 1971 to 2000. Normal (30-year mean) minimum and maximum temperatures for the community of Los Alamos range from a mean low of -8.1 °C (17.4 °F) in January to a mean high of 27 °C (80.6 °F) in July. Normal (30-year mean) minimum and maximum temperatures for the community of White Rock range from a mean low of -9.7 °C (14.6 °F) in January to a mean high of 29.8 °C (85.6 °F) in July. Temperatures in Los Alamos vary with altitude, averaging 3 °C (5 °F) higher in and near the Rio Grande Valley, which is 1,981 meters (6,500 feet) above sea level, and 3 to 5.5 °C (5 to 10 °F) lower in the Jemez Mountains, which are 2,600 to 3,050 meters (8,500 to 10,000 feet) above sea level. Los Alamos townsite temperatures have dropped as low as -28 °C (-18 °F) and have reached as high as 35 °C (95 °F). The normal annual precipitation for Los Alamos is approximately 48 centimeters (19 inches). Annual precipitation rates within the county decline toward the Rio Grande Valley, with the normal precipitation for White Rock at approximately 34 centimeters (14 inches). The Jemez Mountains receive over 64 centimeters (25 inches) of precipitation annually. The lowest recorded annual precipitation in Los Alamos townsite was 17 centimeters (7 inches) and the highest was 76 centimeters (30 inches).

Thirty-six percent of the annual precipitation for Los Alamos County and LANL results from thundershowers that occur in July and August. Winter precipitation falls primarily as snow. Average annual snowfall is approximately 150 centimeters (59 inches), but can vary considerably from year to year. Annual snowfall ranges from a minimum of 24 centimeters (9 inches) to a maximum of 389 centimeters (153 inches).

Los Alamos County winds average 3 meters per second (7 miles per hour). Wind speeds vary throughout the year, with the lowest wind speeds occurring in December and January. The highest winds occur in the spring (March through June), due to intense storms and cold fronts. The highest recorded wind in Los Alamos County was 34 meters per second (77 miles per hour). Surface winds often vary dramatically with the time of day, location, and elevation, due to Los Alamos' complex terrain.

In addition to seasonal changes in wind conditions, surface winds often vary with the time of day. An up-slope air flow often develops over the Pajarito Plateau in the morning hours. By noon, winds from the south usually prevail over the entire plateau. The prevalent nighttime flow ranges from the west-southwest to northwest over the western portion of the plateau. These nighttime winds result from cold air drainage off the Jemez Mountains and the Pajarito Plateau. Analyses of Los Alamos Canyon wind data indicate a difference between the atmospheric flow in the canyon and the atmospheric flow over the Pajarito Plateau. Cold air drainage flow is observed about 75 percent of the time during the night and continues for an hour or two after sunrise until an up-canyon flow forms. Wind conditions are discussed further in the *LANL SWEIS* (DOE 1999a).

Thunderstorms are common in Los Alamos County, with an average of 60 thunderstorms occurring in a year. Lightning can be frequent and intense. The average number of lightning-caused fires in the 1,104 hectares (2,727 acres) of Bandelier National Monument for the years 1990 through 1994 was 12 per year. There are no recorded instances of large-scale flooding in Los Alamos County. However, flash floods from heavy thunderstorms are possible in areas such as arroyos, canyons, and low-lying areas. No tornadoes are known to have touched the ground in the Los Alamos area.

Nonradiological Releases

LANL operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. LANL is 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 (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) (40 CFR 81.332).

In addition to the NAAQS established by the EPA, the state of New Mexico has established ambient air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates, hydrogen sulfide, and total reduced sulfur. Additionally, New Mexico established permitting requirements for new or modified sources of regulated air pollutants. Air quality permits have been obtained from the State Air Quality Bureau for beryllium operations, a rock crusher, and LANL's power plant that were modified or constructed after August 31, 1972. In accordance with Title V of the Clean Air Act, as amended, and New Mexico Administrative Code 202.72.402, the University of California and DOE submitted a sitewide operating permit application to the New Mexico Environment Department (NMED) in December 1995. In 2002, the University of California and DOE submitted a revised operating permit application as requested by NMED. NMED issued a Notice of Completeness for both applications and issued Operating Permit P100 in April 2004.

Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers, emergency generators, and motor vehicles. **Table 3–22** presents information regarding the primary existing sources. Toxic air pollutant emissions from LANL activities are released primarily from laboratory, maintenance, and waste management operations. Unlike a production facility with well-defined operational processes and schedules, LANL is a research and development facility with great fluctuations in both the types of chemicals emitted and their emission rates. DOE has a program to review new operations for their potential to emit air pollutants.

Only limited monitoring of the ambient air has been performed for nonradiological air pollutants within the LANL region. The NMED operated a DOE-owned ambient air quality monitoring station adjacent to Bandelier National Monument between 1990 and 1994 to record sulfur dioxide, nitrogen dioxide, ozone, and particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) levels (see **Table 3–23**). LANL and the NMED discontinued operation of this station in FY 1995 because recorded values were well below applicable standards. Beryllium monitoring performed in 1999 at 9 onsite stations, 10 perimeter stations, and 6 regional stations showed that beryllium levels were low. The New Mexico beryllium ambient standard has been repealed.

Table 3–22 Air Pollutant Emissions at Los Alamos National Laboratory in 1999

Pollutant	*LANL Sources other than TA-55 (metric tons per year)* [a]	*TA-55 Sources (metric tons per year)*
Carbon monoxide	24.6	4.44
Nitrogen dioxide	73.5	5.97
PM_{10}	3.66	0.402
Sulfur dioxide	0.474	0.021

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] Emissions from the following were included: TA-3 Steam Plant, TA-21 Steam Plant, TA-16 Boilers, TA-48 Boiler, TA-53 Boiler, TA-59 Boiler, paper shredder, TA-3 Asphalt Plant, and TA-54 Water Pump. The inventory did not include various small sources such as residential-size boilers and standby emergency generators.

Note: To convert from metric tons to (short) tons, multiply by 1.1023.

Sources: DOE 2002d.

Table 3–23 Nonradiological Ambient Air Monitoring Results

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*Ambient Concentration* [b] *(micrograms per cubic meter)*
Sulfur dioxide	Annual 24 hours 3 hours	41 [c] 205 [c] 1,030 [d]	2 18 Not applicable
Nitrogen dioxide	Annual 24 hours	73.7 [c] 147 [c]	4 9
Ozone	1 hour	185 [d]	138
PM_{10}	Annual 24 hours	50 [d] 150 [d]	8 29

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] The most stringent of the state and Federal standards are shown.

[b] 1994 ambient concentrations from monitoring site near Bandelier National Monument at TA-49.

[c] State standard.

[d] Federal standard (NAAQS).

Source: DOE 2002d.

Criteria pollutant concentrations attributable to existing LANL activities were estimated for the *LANL SWEIS* and are presented in **Table 3–24**.

For toxic air pollutants, a bounding analysis was performed for the *LANL SWEIS*, which indicated that the pollutants of concern for exceeding the guideline values at LANL were emissions from the High Explosives Firing Site operations and emissions that contributed to additive risk from all TAs on receptors near the Los Alamos Medical Center. These combined cancer risks were dominated by the chloroform emissions from the Health Research Laboratory. It was shown that pollutants released under the No Action Alternative in the *LANL SWEIS* are not expected to cause air quality impacts that would affect human health and the environment (DOE 2002d).

In accordance with the Clean Air Act, as amended, and New Mexico regulations, the Bandelier National Monument and Wilderness Area has been designated as a Class I area (i.e., wilderness areas that exceed 4,047 hectares [10,000 acres]), where visibility is considered to be an important value (40 CFR 81 and 20 New Mexico Administrative Code 2.74) and requires protection. Visibility is measured according to a standard visual range, i.e., how far an image is transmitted through the atmosphere to an observer some distance away. Visibility has been officially monitored by the National Park Service at the Bandelier National Monument since 1988. The view distance at Bandelier National Monument has been recorded from approximately 127 to 182 kilometers (79 to 113 miles). The visual range has not deteriorated during the period for which data are available.

Table 3–24 Modeled Ambient Air Concentrations from Los Alamos National Laboratory Sources

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*Maximum Estimated Concentration* [b] *(micrograms per cubic meter)*
Criteria Pollutants			
Carbon monoxide	8 hours 1 hour	7,800 11,700	1,440 2,710
Lead	Calendar quarter	1.5	0.00007
Nitrogen dioxide	Annual 24 hours	73.7 147	9 90
PM_{10}	Annual 24 hours	50 150	1 9
Sulfur dioxide	Annual 24 hours 3 hours	41 205 1,030	18 130 254
Other regulated pollutants			
Total suspended particulates	Annual 24 hours	60 150	2 18

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million (ppm). These values have been converted to micrograms per cubic meter with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 2,135 meters [7,005 feet], following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] Based on the Expanded Operations Alternative in the *LANL SWEIS*. The annual concentrations were analyzed at locations to which the public has access – the site boundary or nearby sensitive areas. Short-term concentrations were analyzed at the site boundary and at the fence line of certain TAs to which the public has short access.

Source: DOE 2002d.

Radiological Releases

Radiological air emissions in 2003 from all LANL TAs combined are presented in **Table 3–25**. Radiological air emissions from TA-55 are also shown in the table.

3.3.5.2 Noise

Existing LANL-related publicly detectable noise levels are generated by a variety of sources, including truck and automobile movements to and from the LANL TAs, high explosives testing, and security guards' firearms practice activities. Noise levels within Los Alamos County unrelated to LANL are generated predominately by traffic movements and, to a much lesser degree, other residential-, commercial-, and industrial-related activities within local communities and the surrounding areas. Limited data currently exist on the levels of routine background ambient noise levels, air blasts, or ground vibrations produced by LANL operations that include explosives detonations.

Background noise levels were found to range from 31 to 35 dBA at the vicinity of the entrance to Bandelier National Monument and New Mexico Route 4 (NM 4). At White Rock, background noise levels range from 38 to 51 dBA (1-hour equivalent sound level); this is slightly higher than was found near Bandelier National Monument, probably due to higher levels of traffic and the presence of a residential neighborhood, as well as the different physical setting. The detonation of high explosives represents the peak noise level generated by LANL operations. The results of these detonations are air blasts and ground vibrations.

Table 3–25 Airborne Radioactive Emissions from Los Alamos National Laboratory in 2003

Radionuclide	*TA-55 (curies)*	*Other Areas (curies)*	*Total (curies)*
Tritium [a]	6.02×10^{1}	1.32×10^{3}	1.38×10^{3}
Americium-241 [b]	5.85×10^{-7}	3.12×10^{-7}	8.97×10^{-7}
Plutonium [b]	1.55×10^{-6}	3.32×10^{-6}	4.87×10^{-6}
Uranium [c]	–	7.09×10^{-6}	7.09×10^{-6}
Thorium [d]	3.90×10^{-8}	6.98×10^{-7}	7.37×10^{-7}
P/VAP [e]	–	6.04×10^{0}	6.04×10^{0}
G/Map [f]	–	7.39×10^{2}	7.39×10^{2}
Strontium-90	5.62×10^{-8}	2.14×10^{-7}	2.70×10^{-7}

[a] Includes both gaseous and oxide forms of tritium.
[b] Includes plutonium-238, -239, and -240.
[c] Includes uranium-234, -235, and -238.
[d] Includes thorium-228, -230, and -232.
[e] Particular/vapor activation products.
[f] Gaseous/mixed activation products.
Note: Dashed lines indicate virtually no releases.
Source: LANL 2004c.

The primary source of these detonation activities is the high explosives experiments conducted at the LANL Pulsed High-Energy Radiation Machine Emitting X-Rays Facility and surrounding TAs with active firing sites. In July 1999, with the appropriate DOE authorization, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Project Office initiated DARHT facility operations on the DARHT first axis. Testing has continued since the late fall of 2000, when the first major hydrotest using the DARHT first axis was completed. As part of the *DARHT Mitigation Action Plan*, LANL has undertaken a long-term monitoring program at the ancestral Pueblo of Nake'muu to assess the impact of these LANL mission activities on cultural resources. Nake'muu is the only Pueblo at the Laboratory that still contains its original standing walls. It dates from circa A.D. 1200 to 1325 and contains 55 rooms with walls standing up to 6 feet high. Over the 6-year monitoring program, the site has witnessed a 0.6 percent displacement rate of chinking stones and 0.2 percent displacement of masonry blocks. The annual loss rate ranges from 0.5 to 2.0 percent for chinking stones and 0.05 to 1.3 percent for the masonry blocks. Statistical analyses indicate that these displacement rates are significantly correlated with annual snowfall, but not with annual rainfall or shots from the DARHT facility (LANL 2004a).

Air blasts consist of higher-frequency, audible air pressure waves that accompany an explosives detonation. This noise 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 workers. Air blasts and most LANL-generated ground vibrations result from testing activities involving aboveground explosives research. The effects of vibration from existing activities at LANL are discussed further in the *LANL SWEIS*.

The forested condition of much of LANL (especially where explosives testing areas are located), the prevailing area atmospheric conditions, and the regional topography that consists of widely varied elevations and rock formations all influence how noise and vibrations can be both attenuated (lessened) and channeled away from receptors. These regional features are jointly responsible for mitigating environmental noise pollution and ground vibration concerns in the area resulting from LANL operations.

Loss of large forest areas from the Cerro Grande Fire in 2000 has had an adverse effect on the ability of the surrounding environment to absorb noise. However, types of noise and noise levels associated with

LANL and from activities in surrounding communities have not changed significantly as a result of the fire (DOE 2000d).

Noise generated by LANL operations, together with the audible portions of explosives air blasts, is regulated by county ordinance and worker protection standards. The standard unit used to report sound pressure levels is the decibel (dB); the A-weighted frequency scale (dBA) is an expression of adjusted pressure levels by frequency that accounts for human perception of loudness. Los Alamos County has 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.). Between 7 a.m. and 9 p.m., 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.

The vigor and well being of area wildlife and sensitive, federally-protected bird populations suggest that noise levels are within an acceptable tolerance range for most wildlife species and sensitive nesting birds found along the Pajarito Plateau.

3.3.6 Ecological Resources

3.3.6.1 Terrestrial Resources

LANL lies within the Colorado Plateau Province. Ecosystems within the laboratory site itself are quite diverse, due partly to the 1,525-meter (5,000-foot) elevational gradient from the Rio Grande on the southeastern boundary to the Jemez Mountains, 20 kilometers (12.4 miles) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at LANL has been developed, and only 5 percent of the site is estimated to be unavailable to most wildlife (because of security fencing). The remaining land has been classified into four major vegetation zones, which are defined by the dominant plants present and occur within specific elevational zones. These include mixed conifer forest, ponderosa pine forest, piñon-juniper woodland, and juniper savannah (see **Figure 3–16**). The vegetative communities on and near LANL are very diverse, with over 900 species of vascular plants identified in the area. As noted in Section 3.3.1.1, the 405-hectare (1,000-acre) White Rock Canyon Wildlife Reserve, located in the southeast perimeter of LANL, was dedicated in 1999 because of its ecological and cultural resources and research potential (DOE 2002d).

Terrestrial animals associated with vegetation zones in the LANL area include 57 species of mammals, 200 species of birds, 28 species of reptiles, and 9 species of amphibians. Common animals found on LANL include the collared lizard (*Crotaphytus collaris*), eastern fence lizard (*Sceloporus undulates*), black-headed grosbeak (*Pheucticus melanocephalus*), western bluebird (*Sialia mexicana*), elk, and raccoon (*Procyon lotor*). The most important and prevalent big game species at LANL are mule deer and elk. Elk populations have increased in the area from 86 introduced animals in 1948 and 1964 to an estimated population of over 10,000 animals. Hunting is not permitted onsite. Numerous raptors, such as the red-tailed hawk (*Buteo jamaicensis*) and great-horned owl (*Bubo virginianus*), and carnivores, such as the black bear (*Ursus americanus*) and bobcat (*Lynx rufus*), and great-horned owl, are also found on LANL. A variety of migratory birds have been recorded at the site (DOE 2002d).

In 2000, the Cerro Grande Fire burned approximately 17,400 hectares (43,000 acres), including about 3,035 hectares (7,500 acres) on LANL (LANL 2004a). Direct impacts on terrestrial resources included reduction in the habitat and loss of wildlife (DOE 2000d). Fire mitigation work, such as flood retention facilities, affected about 20 hectares (50 acres) of undeveloped land (LANL 2004b). Additionally, 2,947 hectares (7,283 acres) of forest have been thinned to reduce future wildfire potential (LANL 2005). Thinning also creates a forest that appears more park-like, with an increase in the diversity of shrubs, herbs, and grasses in the understory (LANL 2001b).

Within 2 years of the Cerro Grande Fire, a bark beetle outbreak occurred that resulted in 14 to 97 percent mortality in pine trees on 3,619 hectares (8,943 acres) of forest land. The infestation could result in an increase in runoff, herbaceous growth, and the potential for wildfire. It would also be expected to impact wildlife populations. While at least partially the result of the fire, the bark beetle outbreak appears to be more a consequence of stress resulting from current drought conditions (LANL 2005).

As noted in Section 3.3.1.1, 894 hectares (2,209 acres) have been conveyed to Los Alamos County or transferred to the Pueblo of San Ildefonso (LANL 2004a). Much of this land is in a natural state and falls within the piñon-juniper woodland and ponderosa pine forest zones. To date, none of this land has been developed, although development in the future could result in both direct and indirect impacts to terrestrial habitats and species.

TA-55 is located in the ponderosa pine forest vegetation zone; however, 43 percent of the site is developed. Animal species likely to be present in the area include the prairie lizard (*Sceloporus undulates*), white-breasted nuthatch (*Sitta carolinensis*), Audubon’s warbler (*Dendroica coronata*), deer mouse (*Peromyscus maniculatus*), and raccoon. Due to the presence of security fencing, no large animals would be found within developed portions of TA-55 (DOE 2002d).

3.3.6.2 Wetlands

A total of 20 hectares (50 acres) of wetlands have been identified within LANL boundaries. Ninety-five percent of these are located in Sandia, Mortandad, Pajarito, and Water Canyon watersheds. The majority of the wetlands in the LANL region are associated with canyon stream channels or are present on mountains or mesas as isolated meadows containing ponds or marshes, often in association with springs or seeps. Cochiti Lake and the area near the LANL Fenton Hill site (TA-57) support lake associated wetlands. There are also some springs within White Rock Canyon. Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates, and potentially contribute to the overall habitat requirements of a number of protected and sensitive species (LANL 2004a, DOE 1999a).

Prior to 1999, 38 LANL NPDES outfalls supported 5.3 hectares (13 acres) of wetlands. The reduction in NPDES-permitted outfalls from 38 to 21 from 1999 to 2003 reduced this acreage. As a bounding case, it is estimated that 2.8 hectares (6.8 acres) of wetlands could be impacted; however, the actual reduction has not been verified (LANL 2003, 2005).

During the Cerro Grande Fire, 6.5 hectares (16 acres) of the wetlands on LANL were burned at a low or moderate intensity. No wetlands within LANL were severely burned. Some riparian areas along the drainages also burned during the fire; however, these are not wetlands and are not included in the total acres of wetland. In addition to direct impacts from the fire, wetlands could receive increased sediment from runoff. While small amounts of sediment from the burned areas would enhance wetland growth, large amounts of deposited sediment could permanently alter the condition of existing wetlands and destroy them. The effects of the Cerro Grande Fire on LANL wetlands have not yet been fully assessed (DOE 2000f).

To date, all or portions of seven tracts have been conveyed or transferred to Los Alamos County and the Pueblo of San Ildefonso. These tracts contain a total of about 3.6 hectares (9 acres) of wetlands, including linear features (i.e., streams within canyons). Although these wetlands are no longer under the control of DOE, they are still protected by state and Federal regulations, and any potential impacts to them from the Proposed Action and alternatives are addressed in this *Consolidation EIS*. To date, there has been no change in the status of these wetlands since development has not taken place; however, future development could result in direct loss of wetland structure and function with a potential increase in downstream and offsite sedimentation (DOE 1999f).

There are three wetlands located within TA-55. These wetlands result from natural sources and are characterized by riparian vegetation. Wetland plant species present include rush (*Juncus spp.*), willow, and broad-leafed cattail (*Typha latifolia*). Animals observed using this wetland include the many-lined skink (*Eumeces multivigratus*), western chorus frog (*Pseudacris triseriata*), red-winged blackbird (*Agelaius phoeniceus*), violet-green swallow (*Tachycineta thalassiana*), long-tailed vole (*Microtus longicaudus*), and vagrant shrew (*Sorex vagrans*) (DOE 2002d).

3.3.6.3 Aquatic Resources

The watersheds draining the Jemez Mountains and the Pajarito Plateau are tributary to the Rio Grande, the fifth largest watershed in North America. Approximately 18 kilometers (11 miles) of LANL's eastern boundary borders on the rim of White Rock Canyon or descends to the Rio Grande. The riverine, lake, and canyon environment of the Rio Grande, as it flows through White Rock Canyon, makes a major contribution to the biological resources and significantly influences ecological processes of the LANL region. The relatively recent construction of Cochiti Dam at the mouth of White Rock Canyon for flood and sediment control, recreation, and fish and wildlife purposes has significantly changed the features of White Rock Canyon and introduced new ecological components and processes. Twelve species of fish (primarily found in the Rio Grande, Cochiti Lake, and the Rito de los Frijoles) have been identified in the LANL region (DOE 1999a, LANL 2004a).

While the Rio Grande and Rito de los Frijoles in Bandelier National Monument are the only truly perennial streams in the region, many canyon floors contain reaches of perennial surface water, such as the streams draining LANL property from lower Pajarito and Ancho Canyons to the Rio Grande. No fish species have been found within LANL boundaries (DOE 1999a, LANL 2004a).

There are no aquatic resources located within TA-55.

3.3.6.4 Threatened and Endangered Species

A number of threatened, endangered, and other special status species have been documented on LANL (**Table 3-26**). Federally-listed wildlife includes 2 endangered species, 2 threatened species, 1 candidate, and 8 species of concern. New Mexico protected and sensitive plants and animals include 3 endangered species, 7 threatened species, 2 species of concern, and 14 sensitive species. Additionally, 18 species of birds are listed as birds of conservation concern. DOE and LANL coordinate with the New Mexico Department of Game and Fish and the USFWS to locate and conserve protected and sensitive species (DOE 1999a).

Habitat that is either occupied by federally-protected species or that is potentially suitable for future use by these species has been delineated within LANL. The *Los Alamos Threatened and Endangered Species Habitat Management Plan*, implemented in 1998, identifies areas of environmental interest (AEI) for various federally-listed threatened or endangered species. In general, an AEI consists of a core area that contains important breeding or wintering habitat for a specific species and a buffer area around the core area. The buffer protects the core area from disturbances that would degrade its value. AEIs have been established for the Mexican spotted owl (S*trix occidentalis lucida*), bald eagle, and southwestern willow flycatcher (LANL 1998). They have not been established for the black-footed ferret (*Mustella nigripes*) since suitable habitat for this species does not occur at LANL (DOE 2003d).

Table 3–26 Protected and Sensitive Species of Los Alamos National Laboratory

Common Name	***Scientific Name***	***Status***	
		Federal	***State***
Plants			
Sapello Canyon larkspur	*Delphinium sapellonis*		Species of Concern
Springer's blazing star	*Mentzelia springeri*		Species of Concern
Wood lily (mountain lily)	*Lilium philadelphicum L. var. anadinum* (Nutt.) Ker		Endangered
Yellow lady's slipper orchid	*Cyprepedium calceolus L. var. pubescens* (Willd.) Correll		Endangered
Insects			
New Mexico silverspot butterfly	*Speyeria nokomis nitocris*	Species of Concern	
Fish			
Rio Grande chub	*Gila Pandora*		Sensitive
Amphibians			
Jemez Mountain salamander	*Plethodon neomexicanus*	Species of Concern	Threatened
Birds			
American peregrine falcon	*Falco peregrinus anatum*	Species of Concern, Conservation Concern	Threatened
Arctic peregrine falcon	*Falco peregrinus tundrius*	Species of Concern, Conservation Concern	Threatened
Bald eagle		Threatened	Threatened
Bendire's thrasher	*Toxostoma bendirei*	Conservation Concern	
Black-throated gray warbler	*Dendroica nigrescens*	Conservation Concern	
Crissal thrasher	*Toxostoma crissale*	Conservation Concern	
Feruginous hawk	*Buteo regalis*	Conservation Concern	
Flammulated owl	*Otus flammeolus*	Conservation Concern	
Graces's warbler	*Dendroica graciae*	Conservation Concern	
Golden eagle	*Aquila chrysaetos*	Conservation Concern	
Gray vireo	*Vireo vicinior*	Conservation Concern	Threatened
Lewis's woodpecker	*Melanerpes lewis*	Conservation Concern	
Loggerhead shrike	*Lanius ludovicianus*		Sensitive
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Sensitive
Northern goshawk	*Accipiter gentiles*	Species of Concern	Sensitive
Northern harrier	*Circus cyaneus*	Conservation Concern	
Piñon jay	*Gymnorhinus cyanocephalus*	Conservation Concern	
Prairie falcon	*Falco mexicanus*	Conservation Concern	
Sage sparrow	*Amphispiza belli*	Conservation Concern	
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered
Virginia's warbler	*Vermivora virginiae*	Conservation Concern	
Williamson's sapsucker	*Sphyrapicus thyroideus*	Conservation Concern	
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate, Conservation Concern	Sensitive
Mammals			
Big free-tailed bat	*Nyctinomops macrotis*		Sensitive

Common Name	***Scientific Name***	***Status***	
		Federal	***State***
Black-footed ferret	*Mustella nigripes*	Endangered	
Fringed myotis	*Myotis thysanodes*		Sensitive
Goat Peak pika	*Ochotona princeps nigrescens*	Species of Concern	Sensitive
Long-eared myotis	*Myotis evotis*		Sensitive
Long-legged myotis	*Myotis volans*		Sensitive
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Species of Concern	Threatened
Ringtail	*Bassariscus astutus*		Sensitive
Spotted bat	*Euderma maculatum*		Threatened
Townsend's big-eared bat	*Plecotus townsendii*	Species of Concern	Sensitive
Western small-footed myotis	*Myotis ciliolabrum*		Sensitive
Yuma myotis	*Myotis yumanensis*		Sensitive

Federal:

Candidate: substantial information exists in USFWS files on biological vulnerability to support proposals to list as endangered or threatened.

Conservation Concern: migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act.

Endangered: in danger of extinction throughout all or a significant portion of its range.

Species of Concern: conservation standing is of concern, but status information is still needed; they do not receive recognition under the Endangered Species Act.

Threatened: likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

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 Mexico.

Sensitive: those taxa that, in the opinion of a qualified New Mexico Department of Game and Fish biologist, deserve special consideration in management and planning, and are not listed as threatened or endangered by the state of New Mexico.

Species of Concern: a New Mexico plant species, which should be protected from land use impacts when possible because it is a unique and limited component of the regional floral.

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.

Sources: LANL 2004a, NMNHP 2004, NMSF 2004, NMDGF 2004a, 2004b, USFWS 2002, 2004a, 2004b, NMAC 919.21.2.

The Cerro Grande Fire did not severely burn any of the AEIs on LANL, although many of the Mexican spotted owl AEIs received moderate- and low-severity burns. Habitat within the southwestern willow flycatcher AEI and bald eagle AEI did not burn (DOE 2000f). There is no evidence that the fire caused a long-term change to the overall number of federally-listed threatened or endangered species inhabiting the region. LANL's species of greatest concern, the Mexican spotted owl, resumed normal breeding activities in 2001 and 2002. Some state-listed species, including the Jemez Mountain salamander, are likely to have been less fortunate (DOE 2003d).

As noted in Section 3.3.1.1, 894 hectares (2,209 acres) have been conveyed to Los Alamos County and transferred to the Pueblo of San Ildefonso. Some of the areas that have been turned over to these two entities have AEIs for both the Mexican spotted owl and peregrine falcon. However, the *LANL Threatened and Endangered Species Habitat Management Plan*, under which the AEIs are designated, is no longer in effect on conveyed or transferred land. Although none of the land has been developed to date, future development could result in the modification of habitat for protected and sensitive species (DOE 1999f).

There are three wetland locations within TA-55. Threatened and endangered species and species of concern associated with this type of wetland and which may be found in the vicinity include the Northern goshawk which is listed as a species of concern, the federally-threatened Mexican spotted owl, the state-threatened spotted bat, and the federally-endangered southwestern willow flycatcher (DOE 2002d). In addition, TA-55 contains core and buffer AEIs for the Mexican spotted owl.

3.3.7 Cultural Resources

3.3.7.1 Prehistoric Resources

Prehistoric resources at LANL refer to any material remains and items used or modified by people before the establishment of a European presence in the upper Rio Grande Valley in the early seventeenth century. Archaeological surveys have been conducted of approximately 90 percent of the land within LANL (with 85 percent of the area surveyed receiving 100 percent coverage) to identify the cultural resources. The majority of these surveys emphasized prehistoric American Indian archaeological sites, including pueblos, rock shelters, rock art, water control features, trails, and game traps. A total of 1,777 prehistoric sites have been recorded at LANL, of which 439 have been assessed for potential nomination to the National Register of Historic Places. Of these, 379 sites were determined to be eligible, 60 sites ineligible, and 2 of undetermined status. The remaining 1,338 sites, which have not been assessed for nomination to the National Register of Historic Places, are assumed to be eligible until assessed. Three areas in the vicinity of LANL have been established as National Register of Historic Places sites or districts: Bandelier National Monument, Puye Cliffs Historic Ruins, and the Los Alamos Scientific Laboratory National Historic District. The latter is the location of former TA-1 in downtown Los Alamos, which includes Fuller Lodge, the Bathtub Row Houses, and the Ice House Monument at Ashley Pond.

The Cerro Grande Fire directly impacted 215 prehistoric sites. Effects on cultural resource sites included those originating from burned-out tree root systems forming conduits for modern debris and water to mix with subsurface archaeological deposits and for entry by burrowing animals. Also, snags or dead or dying trees have fallen and uprooted artifacts (DOE 2000d). Additionally, the leveling of a staging area in TA-49 during the fire destroyed one and damaged two other prehistoric sites. Areas at LANL burned by the Cerro Grande Fire have been surveyed for impacts, and mitigation measures have been implemented.

A single paleontological artifact has been discovered at a site within LANL boundaries; 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.

TA-55 contains no prehistoric or paleontological sites. Within TA-48, a short distance from the TA-55 boundary (about 100 meters [300 feet]), there is a prehistoric site eligible for listing on the National Register of Historic Places (DOE 2003d).

3.3.7.2 Historic Resources

In April 2000, the DOE entered into a programmatic agreement with the New Mexico State Historic Preservation Office concerning the management of LANL's historic properties (MOU DE-GM32-00AL77152). Historic resources present within LANL boundaries and on the Pajarito Plateau can be attributed to nine locally defined Periods: U.S. Territorial, Statehood, Homestead, Post Homestead, Historic Pueblo, Undetermined Historic, Manhattan Project, Early Cold War, and Late Cold War. The number of sites identified from each period are as follows: 1 from the U.S. Territorial Period, 9 from the Statehood Period, 71 from the Homestead Period, 5 from the Post Homestead Period, 1 from the Historic Pueblo Period, 36 from the Undetermined Historic Period, 56 from the Manhattan Project Period, and 527 from the Early and Late Cold War Periods. Thus, a total of 706 historic sites have been identified at LANL (DOE 2003d).

The Cerro Grande Fire directly impacted 11 historic buildings and 56 historic sites. Structures and artifacts from the Homestead Period, Manhattan Project Period, and Cold War Period were adversely affected. The fire destroyed virtually all-wooden buildings associated with the Homestead Period, and the burned properties were largely reduced to rubble. V-Site, one of the last vestiges of the Manhattan Project Period remaining at Los Alamos, was the location where work was conducted on the Trinity device. This important historical site was partially destroyed by the fire. Also, a historic structure and building at TA-2 were adversely impacted by post-fire activities (DOE 2000d).

TA-55 contains 11 historic resources. The New Mexico State Historic Preservation Office has concurred with the determination that 1 is eligible for the National Register of Historic Places, and 2 have been determined to be not eligible. The remaining eight have yet to be assessed (DOE 2003d).

3.3.7.3 Traditional Cultural Properties

Consultations to identify traditional cultural properties were conducted with 19 American Indian tribes in connection with the preparation of the *LANL SWEIS*. Two Hispanic communities were also contacted. These consultations identified 15 ceremonial and archaeological sites, 14 natural features, 10 ethnobotanical sites, 7 artisan material sites, and 8 subsistence features. In addition to physical cultural entities, concern has been expressed that “spiritual,” “unseen,” “undocumentable,” or “beingness” aspects can be present at LANL that are an important part of American Indian culture and may be adversely impacted by LANL’s presence and operation. Additional consultations regarding traditional cultural properties are ongoing for LANL and other nearby DOE-administered properties (DOE 2003d).

3.3.8 Socioeconomics

Statistics for population, housing, and local transportation are presented in this section for the region of influence, a three-county area in New Mexico in which 89.2 percent of all LANL employees reside (see **Table 3–27**). In 2003, LANL employed 12,975 persons in New Mexico (LANL 2004a).

Table 3–27 Distribution of Employees by Place of Residence in the Los Alamos National Laboratory Region of Influence in 2003

County	*Number of Employees*	*Total Site Employment (percent)*
Los Alamos	5,800	44.7
Rio Arriba	2,898	22.3
Santa Fe	2,876	22.2
Region of influence total	11,574	89.2

Source: LANL 2004a.

3.3.8.1 Regional Economic Characteristics

Between 2000 and 2003, the average annual civilian labor force in the Tri-County area increased 7.1 percent to the 2003 level of 104,124. In 2003, the annual average unemployment rate in the region of influence was 4.4 percent, which was less than the annual unemployment average of 6.4 percent for New Mexico (NM DOL 2004).

In 2003, Government represented the largest sector of employment in the Tri-County area (29.8 percent). This was followed by trade, utilities, and transportation activities (15.4 percent) and leisure and hospitality (12.8 percent) (NM DOL 2005). The totals for these employment categories in New Mexico were 23.4 percent, 18.0 percent, and 11.0 percent, respectively (BBER 2004).

3.3.8.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 3–28**. Persons self-designated as minority individuals comprise 57.9 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian residents. The Pueblos of San Ildefonso, Santa Clara, San Juan, Nambe, Pojoaque, Tesuque, and part of the Jicarilla Apache Indian Reservation are included in the region of influence.

Table 3–28 Demographic Profile of the Population in the Los Alamos National Laboratory Region of Influence

	Los Alamos County	*Rio Arriba County*	*Santa Fe County*	*Region of Influence*
Population				
2000 population	18,343	41,190	129,292	188,825
1990 population	18,115	34,365	98,928	151,408
Percent change from 1990 to 2000	1.3	19.9	30.7	24.7
Race (2000) (percent of total population)				
White	90.3	56.6	73.5	71.5
Black or African American	0.4	0.3	0.6	0.5
American Indian and Alaska Native	0.6	13.9	3.1	5.2
Asian	3.8	0.1	0.9	1.0
Native Hawaiian and Other Pacific Islander	0.0	0.1	0.1	0.1
Some other race	2.7	25.6	17.7	18.0
Two or more races	2.3	3.3	4.1	3.7
Percent minority	17.9	86.4	54.5	57.9
Ethnicity (2000)				
Hispanic or Latino	2,155	30,025	63,405	95,585
Percent of total population	11.7	72.9	49.0	50.6

Source: DOC 2005.

Income information for the LANL region of influence is included in **Table 3–29**. There are significant differences in the income levels among the three counties, especially between Rio Arriba County at the low end with a median household income of $29,429 and Los Alamos County at the upper end with a medial household income of $78,993. The median household income in Los Alamos County is over twice that of the New Mexico state average. In 2000, only 2.9 percent of the population in Los Alamos County was below the official poverty level compared with 20.3 percent of the population of Rio Arriba County.

Table 3–29 Income Information for the Los Alamos National Laboratory Region of Influence

	Los Alamos County	*Rio Arriba County*	*Santa Fe County*	*New Mexico*
Median household income 2000 (dollars)	78,993	29,429	42,207	34,133
Percent of persons below poverty line (2000)	2.9	20.3	12.0	18.4

Source: DOC 2005.

3.3.8.3 Housing

Table 3–30 lists the total number of occupied housing units and vacancy rates in the region of influence. In 2000, there were a total of 83,654 housing units in the Tri-County area, with 89.7 percent occupied and 10.3 percent vacant. The median value of owner-occupied homes in Los Alamos County ($238,300) was the greatest of the three counties, and over twice the median value of owner occupied homes in Rio Arriba County ($107,500). The vacancy rate was the smallest in Los Alamos County (5.5 percent) and highest in Rio Arriba County (16.5 percent). During the Cerro Grande Fire, approximately 230 housing units were destroyed or damaged in the northern portions of Los Alamos County (DOE 2000d) and, as a result, vacancy rates have decreased.

Table 3–30 Housing in the Los Alamos National Laboratory Region of Influence

	Los Alamos County	*Rio Arriba County*	*Santa Fe County*	*Region of Influence*
Housing (2000)				
Total units	7,937	18,016	57,701	83,654
Occupied housing units	7,497	15,044	52,482	75,023
Vacant units	440	2,972	5,219	8,631
Vacancy Rate (percent)	5.5	16.5	9.0	10.3
Median value (dollars)	228,300	107,500	189,400	175,067

Source: DOC 2005.

3.3.8.4 Local Transportation

Motor vehicles are the primary means of transportation to LANL. Regional transportation route(s) connecting LANL to Albuquerque and Santa Fe are I–25 to U.S. 84/285 to NM 502; to Española are NM 30 to NM 502; and to Jemez Springs and western communities is NM 4. Hazardous and radioactive material shipments leave or enter LANL from East Jemez Road to NM 4 to NM 502 (see Figures 3–10 and 3–11). Only two major roads, NM 502 and NM 4, access Los Alamos County. Los Alamos County traffic volume on these two segments of highway is primarily associated with LANL activities.

A public bus service located in Los Alamos operates within Los Alamos County. The Los Alamos bus system consists of seven buses that operate five days a week. The nearest commercial bus terminal is located in Santa Fe, New Mexico. The nearest commercial rail connection is at Lamy, New Mexico, 83 kilometers (52 miles) southeast of LANL. LANL does not currently use rail for commercial shipments. The primary commercial international airport in New Mexico is located in Albuquerque. The small Los Alamos County Airport is owned by the Federal Government, and operations and maintenance are performed by Los Alamos County. The airport is located parallel to East Road at the southern edge of the Los Alamos community. Until January 1996, the airport provided regular passenger and cargo service through specialized contract carriers such as Ross Aviation, which were under contract with DOE to provide passenger and cargo air service to Los Alamos County and LANL. DOE continues to negotiate with various companies to provide for service to the Los Alamos Airport.

3.3.9 Human Health Risk

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

3.3.9.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of LANL are shown in **Table 3–31**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to LANL operations.

Table 3–31 Sources of Radiation Exposure to Individuals in the Los Alamos National Laboratory Vicinity Unrelated to Los Alamos National Laboratory Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Total external (cosmic and terrestrial) [a]	120
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	425

[a] LANL 2000b.
[b] NCRP 1987.
[c] An average for the United States.

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 in 2003 are listed in *Environmental Surveillance at Los Alamos During 2003* (LANL 2004c). The releases are summarized in Section 3.3.5.1 of this EIS. The doses to the public resulting from these releases are presented in **Table 3–32**. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation.

Using a risk estimator of 6.0×10^{-4} LCF per rem (see Appendix C of this EIS), the fatal cancer risk to the maximally exposed offsite member of the public due to radiological releases from LANL operations is estimated to be 3.75×10^{-7}. The estimated probability of this maximally exposed person dying of cancer at some point in the future from radiation exposure associated with 1 year of LANL operations is less than one in 2.7 million (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

Table 3–32 Radiation Doses to the Public from Normal Los Alamos National Laboratory Operations in 2003 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed offsite individual (millirem)	10	0.625	4	~0	100	0.625
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.88	None	~0	100	0.88
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	0.0031	None	~0	None	0.0031

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem-per-year limit from airborne emissions is required by the Clean Air Act (40 CFR 61) and the 4-millirem-per-year limit is required by the Safe Drinking Water Act (40 CFR 141). For this *Consolidation EIS*, the 4-millirem-per-year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, *Radiation Protection of the Public and the Environment: Proposed Rule,* as published in 58 FR 16268. If the potential total dose exceeds the 100-person-rem value, the contractor operating the facility would be required to notify DOE.

[b] About 280,000 based on county population estimates for 2003.

[c] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.

Source: LANL 2004c.

According to the same risk estimator, 3.75×10^{-4} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of LANL from normal operations in 2003. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 2003 from all causes in the population of 280,000 living within 80 kilometers (50 miles) of LANL would be 560. This expected number of fatal cancers is much higher than the fatal cancers estimated from LANL operations in 2003.

LANL workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at LANL from operations in 2003 are presented in **Table 3–33**. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of 6.0×10^{-4} LCF per person-rem (see Appendix C of this EIS), the number of projected fatal cancers among LANL workers from normal operations in 2003 is 0.14.

Table 3–33 Radiation Doses to Workers from Normal Los Alamos National Laboratory Operations in 2003 (total effective dose equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average radiation worker (millirem)	None [b]	117
Total workers [c] (person-rem)	None	240

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999f); the site must make reasonable attempts to maintain individual worker doses below this level.

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

[c] There were 2,047 workers with measurable doses in 2003.

Source: DOE 2003e.

3.3.9.2 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 (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to 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 to the public may occur during normal operations at LANL via inhalation of air containing hazardous chemicals released to the atmosphere by LANL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 3.3.5.1. 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 may 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.

3.3.9.3 Health Effects Studies

Numerous epidemiological studies have been conducted in the LANL area. One study conducted by the New Mexico Department of Health reported elevations in brain cancer incidence during the mid- to late-1980s, compared to state and national reference populations, but random fluctuation could not be ruled out. Breast cancer incidence rates in Los Alamos from 1970 to 1990 remained level, but higher than New Mexico rates. Reproductive and demographic factors known to increase the risk of breast cancer have been prevalent in Los Alamos County. Ovarian cancer incidence in the county from 1986 to 1990 was approximately twofold greater than that observed in a New Mexico State reference population. In the mid- to late-1980s, a twofold excess risk of melanoma was observed in Los Alamos County compared with a New Mexico State reference population. A more recent study observed a fourfold increase in thyroid cancer incidence during the late 1980s and early 1990s compared with the State as a whole, but the rate began to decline in 1994 and 1995. No statistically significant excess cancers were reported for male workers exposed to plutonium. However, statistically significant excesses in kidney cancer and lymphomatic leukemia were observed in male workers exposed to external radiation. For more detailed descriptions of studies reviewed and the findings, refer to Appendix D, Section D.1.2 of the *LANL SWEIS* (DOE 1999a) and to Appendix E, Section E.4.6 of the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS),* DOE/EIS-0236 (DOE 1996c).

3.3.9.4 Accident History

Degradation of a radioactive material container occurred on August 5, 2003, at TA-55. A package containing residues from plutonium-238 operations breached while being handled by two workers performing a pre-inventory check. The pressurized release of materials from the package gave the workers uptake doses of two or three rem cumulative effective dose equivalents (LCF of 0.0012 to 0.0018).

On February 15, 2001, plutonium-238 was released into the air from a glovebox when the hot nuclear material caused a crack in a technician's uninsulated glove. The accident was partially a result of a failure to follow procedures for safely handling plutonium-238. DOE investigated allegations concerning this incident along with radiological incident reports from 1999 and 2000 at TA-55. As a result, recommendations were made, accepted by LANL and instituted in corrective actions at TA-55 (DOE 2003f).

In March 2000, a radiological release of plutonium-238 occurred near a glovebox in the Plutonium Facility at TA-55. Seven workers had confirmed intakes of plutonium-238. The source of the release was a compression fitting in a contaminated vacuum line serving the glovebox. After an investigation was completed, lessons learned from this incident were documented by DOE. As a result, LANL performed a check of over 50,000 mechanical fittings at TA-55 and corrected any leak problems (DOE 2000g).

None of the aforementioned plutonium-238 accidents resulted in any measurable radiological impacts to the public.

On May 4, 2000, the National Park Service at Bandelier National Monument set a prescribed fire that subsequently burned out of control. This Cerro Grande Fire damaged or destroyed more than 100 LANL structures and about 230 residential structures in the Los Alamos townsite. By the time it was contained, it had burned approximately 3,035 hectares (7,500 acres) within the boundaries of LANL. LANL is conducting an extensive environmental monitoring and sampling program to evaluate the effects of that fire at the laboratory and especially to evaluate if public and worker health and the environment were adversely impacted by the fire on Laboratory land. The program will identify changes from prefire baseline conditions that will aid in evaluating potential future impacts, especially those from any contaminants that may have been transported offsite (LANL 2000b).

3.3.9.5 Emergency Preparedness and Security

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, training, preparedness, and response. The LANL emergency management program was activated on May 5, 2000, to coordinate emergency management operations during the Cerro Grande Fire.

DOE maintains equipment and procedures to respond to situations where human health or the environment is threatened. These include specialized training and equipment for the local fire department, local hospitals, state public safety organizations, and other government entities that may participate in response actions, as well as specialized assistance teams (DOE Order 151.1, *Comprehensive Emergency Management System*). These programs also provide for notification of local governments whose constituencies may be threatened. 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 responses to an accidental explosion at the Hanford Site in May 1997.

3.3.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. Minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income.

Figure 3–17 shows the relationship of TA-55 to surrounding Indian Reservations and the region of potential radiological impact. As shown in the figure, areas potentially at radiological risk from the current missions performed at TA-55 include the city of Santa Fe and several Pueblos and the Jicarilla Apache Reservation in North Central New Mexico. Eight counties are included or partially included in the potentially affected area (see **Figure 3–18)**: Bernalillo, Los Alamos, Mora, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Taos. **Table 3–34** provides the total minority composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, a majority of these county residents designated themselves as members of a minority (54 percent of the total population of these counties). Hispanics and American Indians/Alaska Natives comprised over 91 percent of the minority population. As a percentage of the total resident population in 2000, New Mexico had the largest percentage minority population (55 percent) among the contiguous states and the second largest percentage minority population among all of the states (only Hawaii had a larger percentage minority population [77 percent]).

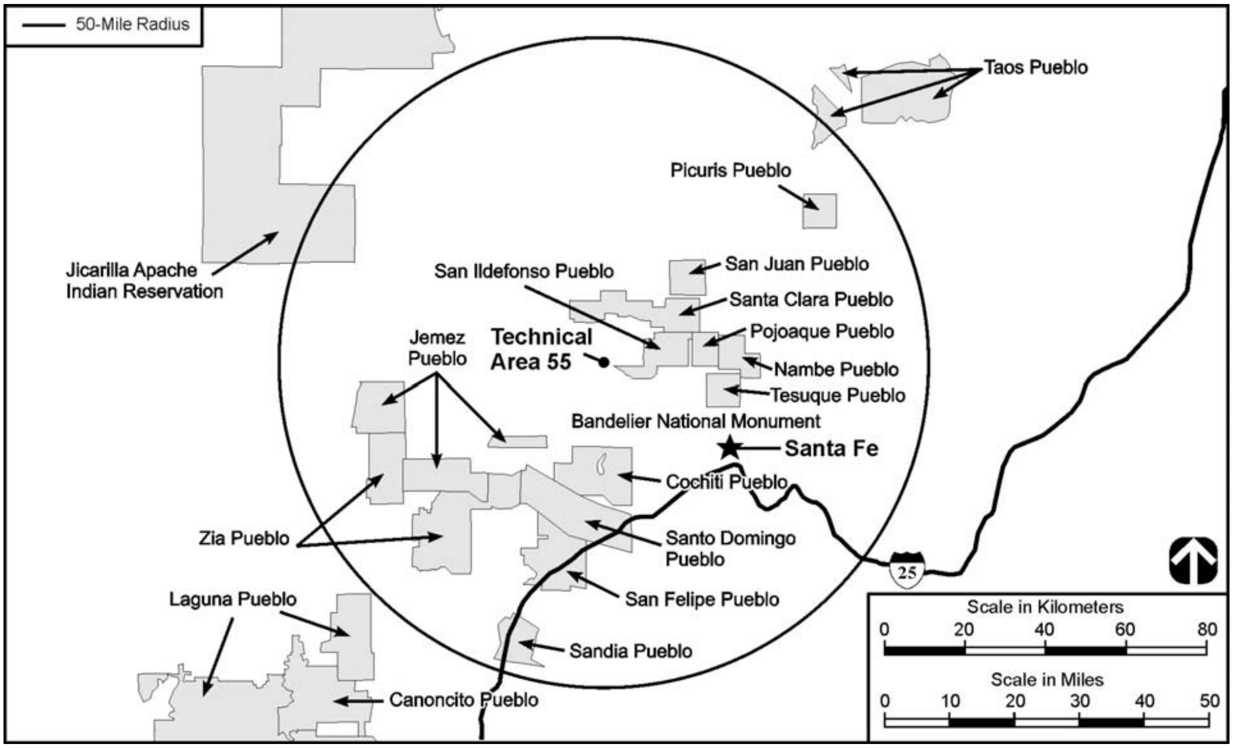


Figure 3–17 Location of Technical Area 55 and Indian Reservations Surrounding Los Alamos National Laboratory

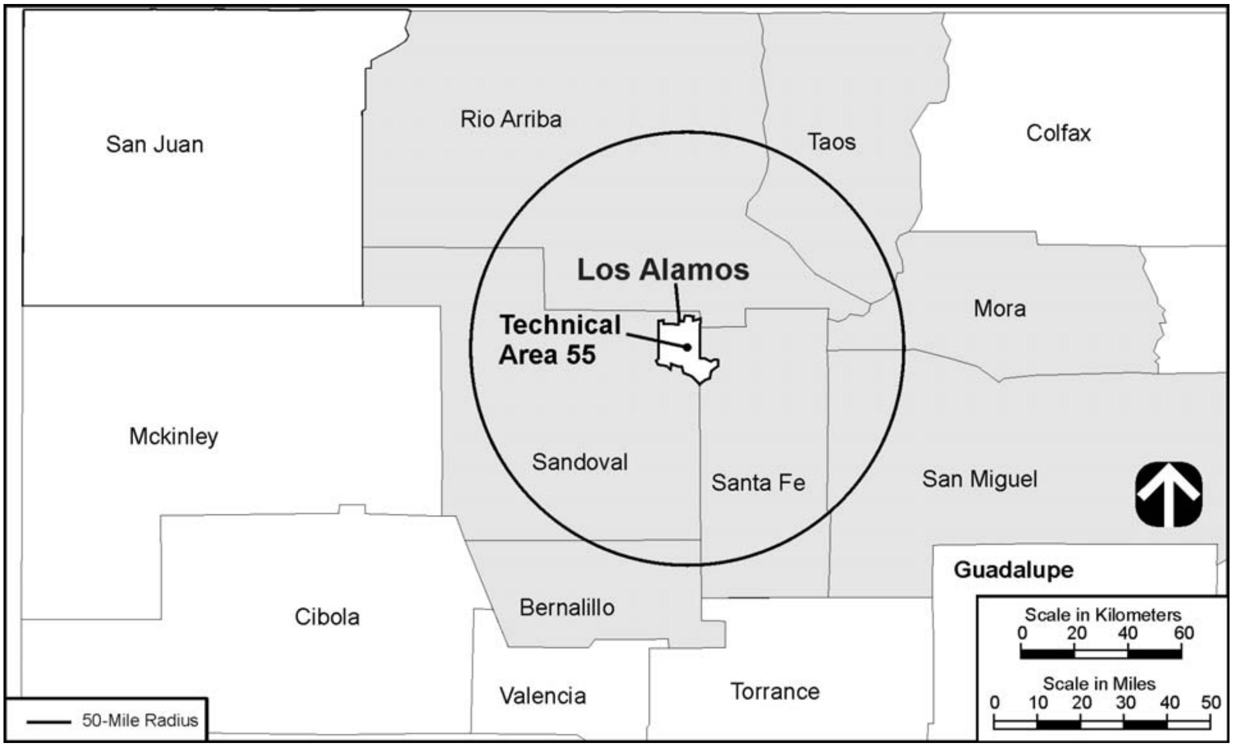


Figure 3–18 Potentially Affected Counties Surrounding Los Alamos National Laboratory

Table 3–34 Populations in Potentially Affected Counties Surrounding Los Alamos National Laboratory in 2000

Population Group	*Population*	*Percentage of Total*
Minority	490,172	54.4
Hispanic	400,725	44.5
Black or African American	15,945	1.8
American Indian and Alaska Native	44,468	4.9
Asian	12,188	1.4
Native Hawaiian and Pacific Islander	527	0.1
Two or more races	14,859	1.6
Some other race	1,460	0.2
White	410,524	45.6
Total	900,696	100.0

Source: DOC 2005.

The percentage of population for whom poverty status was determined in potentially affected counties in 2000 was approximately 13 percent. In 2000, nearly 18 percent of the total population of New Mexico reported incomes less than the poverty threshold. In terms of percentages, minority populations and low-income resident populations in 2000 in potentially impacted counties were lower than the state percentage.

3.3.11 Waste Management and Pollution Prevention

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

3.3.11.1 Waste Inventories and Activities

LANL manages the following types of waste: transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Waste generation rates and the inventory of stored waste from activities at LANL are provided in **Table 3–35**. Selected waste management facilities at LANL are summarized in **Table 3–36**.

Table 3–35 2003 Selected Waste Generation Rates and Inventories at Los Alamos National Laboratory

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
Transuranic	560 [a]	12,120
Low-level radioactive	5,625	Not applicable [b]
Mixed low-level radioactive	36	25 [c]
Hazardous (in metric tons)	689 [d]	Not applicable [b]
Nonhazardous		
Liquid	794,253	Not applicable [b]
Solid (in metric tons)	10,280 [e]	Not applicable [b]

[a] Includes 157 cubic meters of mixed transuranic waste.
[b] Generally, low-level radioactive, hazardous, and nonhazardous waste are not held in long-term storage.
[c] Inventory as of September 2004.
[d] This waste type also includes biomedical waste.
[e] 8,100 metric tons is recycled.

Notes: The generation rates are attributed to facility operations and do not include the waste generated from environmental restoration actions.
To convert from cubic meters to cubic yards, multiply by 1.3079.

Source: DOE 2002d, 2003d; LANL 2004b, 2005; SNL 2004.

3.3.11.2 Transuranic Waste

All projects generating transuranic waste at LANL are required to implement waste minimization procedures (64 FR 50797). As part of the implementation of the ROD for “Transuranic Waste Treatment and Storage,” part of the *Waste Management PEIS* (DOE 1997b), LANL will treat transuranic waste onsite to reduce volume as much as possible and to meet waste acceptance criteria for disposal at WIPP.

3.3.11.3 Low-Level Radioactive Waste

Solid low-level radioactive waste generated by LANL’s operating divisions is characterized and packaged for disposal at the onsite low-level radioactive waste disposal facility at TA-54, Area G. Low-level radioactive waste minimization strategies are intended to reduce the environmental impacts associated with low-level radioactive waste operations and waste disposal by reducing the amount of low-level radioactive waste generated and/or minimizing the volume of low-level radioactive waste that will require storage or disposal onsite (LANL 2000a).

Table 3–36 Selected Waste Management Facilities at Los Alamos National Laboratory

Facility Name/Description	*Capacity*	*Status*	*Applicable Waste Type* *TRU*	*Low-Level Radioactive Waste*	*Mixed Low-Level Radioactive Waste*	*Hazardous*	*Non-hazardous*
Treatment Facility (cubic meters per year)							
TRU waste volume reduction	1,080	Online	X				
RAMROD and RANT Facilities	1,050	Online	X				
Low-level radioactive waste compaction	342	Online		X			
Sanitary wastewater treatment	1,060,063	Online					X
Radioactive Liquid Waste Treatment Facility	35,000,000 [a] liters	Online		X			
Storage Facility (cubic meters)							
TRU waste storage	14,090	Online	X				
Mixed low-level radioactive waste storage	1,515	Online			X		
Hazardous waste storage	260	Online				X	
Disposal Facility							
TA-54, Area G low-level radioactive waste disposal (cubic meters)	252,500 [b]	Online		X			
Sanitary tile fields (cubic meters per year)	567,750	Online					X

TRU = transuranic waste, RAMROD = Radioactive Materials Research, Operations, and Demonstration; RANT = Radioactive Assay and Nondestructive Test.

[a] Amount of radioactive liquid waste projected to be treated under the *LANL SWEIS* Expanded Operations Alternative.

[b] Current inventory of 250,000 cubic meters. Capacity will be expanded as part of implementation of the *LANL SWEIS* ROD.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079.

Source: DOE 2002d, 2003d; LANL 2005.

A 1998 analysis of the low-level radioactive waste landfill at TA-54, Area G, indicated that at previously planned rates of disposal, the disposal capacity would be exhausted in a few years. Reduction in low-level radioactive waste generation has extended this time to approximately 5 years; however, potentially large volumes of waste from planned construction upgrades could rapidly fill the remaining capacity (LANL 2000a).

As part of the implementation of the ROD in the *LANL SWEIS*, DOE will continue onsite disposal of LANL-generated low-level radioactive waste using the existing footprint at the Area G low-level waste disposal area and will expand disposal capacity into Zones 4 and 6 at Area G. This expansion would cover up to 29 hectares (72 acres). Additional sites for low-level radioactive waste disposal at Area G would provide onsite disposal for an additional 50 to 100 years (64 FR 50797, LANL 2000a).

Liquid low-level radioactive waste is transferred through a system of pipes and by tanker trucks to the RLWTF at TA-50, Building 1. The radioactive components are removed and disposed of as solid low-level radioactive waste at TA-54, Area G. The remaining liquid is discharged to a permitted outfall (LANL 2000a).

3.3.11.4 Mixed Low-Level Radioactive Waste

There are seven major mixed low-level radioactive waste streams at LANL: circuit boards, gloveboxes, lead parts, research and development chemicals, personal protective equipment, fluorescent tubes, and waste generated from spills and spill cleanup. Typically, mixed low-level radioactive waste is transferred to a satellite storage area once generated. Whenever possible, mixed low-level materials are surveyed to confirm the radiological contamination levels, and if decontamination will eliminate either the radiological or the hazardous component, materials are decontaminated and removed from the mixed low-level radioactive waste category (LANL 2000a).

Proper waste management and DOT documentation are provided for solid waste operations at TA-54, Area G or Area L, to process remaining mixed low-level radioactive waste for storage, bulking, and transportation. From TA-54, mixed low-level radioactive waste is sent to commercial and DOE treatment and disposal facilities. The waste is treated/disposed of by various processes (e.g., segregation of hazardous components, macroencapsulation, or incineration) (LANL 2000a).

In October 1995, the state of New Mexico issued a Federal Facility Compliance Order to both DOE and LANL requiring compliance with the site treatment plan. That plan documents the development of treatment capacities and technologies or use of offsite facilities for treating mixed waste generated at LANL that is stored beyond the 1-year timeframe (LANL 2000b).

3.3.11.5 Hazardous Waste

Most LANL activities generate some amount of hazardous waste. Hazardous waste commonly generated at LANL includes many types of laboratory research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous waste. This may include equipment, containers, structures, and other items intended for disposal and contaminated with hazardous waste (e.g., compressed gas cylinders). After the hazardous waste is collected, it is sorted and segregated. Some materials are reused within LANL, and others are decontaminated for reuse. Those materials that cannot be decontaminated or recycled are packaged and shipped to offsite RCRA-permitted treatment and disposal facilities (LANL 2000a).

3.3.11.6 Nonhazardous Waste

Both LANL and Los Alamos County use the same landfill located within LANL boundaries. The landfill is operated under a special permit by Los Alamos County. The Los Alamos County Landfill received about 20 million kilograms (22,013 tons) of solid waste from all sources during the period July 1995 through June 1996, with LANL contributing about 22 percent of the solid waste. Since the Cerro Grande Fire, the generation of wastes from community and LANL cleanup activities has increased several fold. The Los Alamos County Landfill is scheduled for closure in 2006. A replacement facility, which would be located offsite, would then be used by LANL for nonhazardous waste disposal. It is currently anticipated that the replacement facility would be located within 160 kilometers (100 miles) of LANL. Both LANL and Los Alamos County would need to transport their wastes to the new facility.

Sanitary liquid waste is delivered by dedicated pipelines to the Sanitary Wastewater Systems Consolidation Plant at TA-46. The plant has a design capacity of 2.27 million liters (600,000 gallons) per day, and in 2000 processed a maximum of about 950,000 liters (250,000 gallons) per day. Some septic tank pumpings are delivered periodically to the plant for treatment via tanker truck. Sanitary waste is treated by an aerobic digestion process. After treatment, the liquid from this process is recycled to the TA-3 power plant for use in cooling towers or is discharged to Sandia Canyon adjacent to the power plant under an NPDES permit and groundwater discharge plan. Under normal operating conditions, the solids from this process are dried in beds at the Sanitary Wastewater Systems Consolidation Plant and are applied as fertilizer as authorized by the existing NPDES permit.

3.3.11.7 Waste Minimization

LANL's Environmental Stewardship Office manages LANL's pollution prevention program. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. Achievements and progress are updated at least annually. Implementing pollution prevention projects reduced the total amount of waste generated at LANL in 1999 by approximately 2,459 cubic meters (3,216 cubic yards). Examples of pollution prevention projects completed in 1999 at LANL include reduction of low-level radioactive waste and mixed low-level radioactive waste by 116 cubic meters (152 cubic yards) by decontaminating waste metal and reduction of transuranic waste by 3 cubic meters (4 cubic yards) by using improved nondestructive assay instrumentation, which enabled the measurement and characterization of waste as either transuranic or low-level radioactive waste (DOE 2000f).

3.3.11.8 *Waste Management PEIS* Records of Decision

The *Waste Management PEIS* RODs affecting LANL are shown in **Table 3–37**. Decisions on the various waste types were announced in a series of RODs published on the *Waste Management PEIS* (DOE 1997b). The initial transuranic waste ROD was issued on January 20, 1998 (63 FR 3629) with several subsequent amendments, the hazardous waste ROD was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste ROD was published on February 18, 2000 (65 FR 10061). The transuranic waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare transuranic waste for disposal at WIPP. Each DOE site that has or will generate transuranic waste will, as needed, prepare and store its transuranic waste onsite until the waste is shipped to WIPP. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own nonwastewater hazardous waste onsite in existing facilities, where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste ROD states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites, and disposal will continue, to the extent practicable, onsite at INL, LANL, ORR, and SRS. In addition, the Hanford Site and NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at the Hanford Site, INL, ORR, and SRS and disposed of at the Hanford Site and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at LANL is presented in the hazardous waste and the low-level radioactive and mixed low-level radioactive waste RODs.

3.3.12 Environmental Restoration Program

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at LANL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

Table 3–37 Waste Management Programmatic Environmental Impact Statement Records of Decision Affecting Los Alamos National Laboratory

Waste Type	*Preferred Action*
Transuranic	Dispose at WIPP.
Low-level radioactive	DOE has decided to treat LANL low-level radioactive waste onsite and continue onsite disposal. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at the Hanford Site, INL, ORR, and SRS. DOE has decided to ship LANL mixed low-level radioactive waste to either the Hanford Site or NTS for disposal. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of most of LANL nonwastewater hazardous waste. [b]

[a] From the ROD for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the ROD for hazardous waste (63 FR 41810).
Source: 65 FR 10061, 63 FR 41810.

Although not listed on the National Priorities List, LANL adheres to CERCLA guidelines for environmental restoration projects that involve certain hazardous substances not covered by RCRA. LANL's environmental restoration program originally consisted of approximately 2,100 potential release sites (DOE 2002d). At the end of 1999, there remained 1,206 potential release sites requiring investigation or remediation and 118 buildings awaiting decontamination and decommissioning. Based on a review by LANL's Environmental Restoration Project, the boundary of Potential Release Site 48-001 overlaps a small area at TA-55. This area of overlap involves possible surface soil contamination from TA-48 stack emissions. Further investigation and any necessary remediation of this site will be completed under LANL's environmental restoration program (DOE 2002d) and in accordance with LANL's Hazardous Waste Facility Permit. More information on regulatory requirements for waste disposal is provided in Chapter 5 of this EIS.

3.4 Oak Ridge National Laboratory

ORNL is located within the ORR. ORR was established in 1943 as one of the three original Manhattan Project sites, is located on 13,949 hectares (34,424 acres) in Oak Ridge, Tennessee, and includes ORNL, the Y-12 Plant (Y-12), and the East Tennessee Technology Park (ETTP). It extends over parts of Anderson and Roane Counties. The primary focus of ORNL is to conduct basic and applied scientific research and technology development. Y-12 engages in national security activities and manufacturing outreach to U.S. industries. The mission of the ETTP is to maintain the infrastructure until decommissioning activities have been completed. ORNL is one of the locations where RPS nuclear production infrastructure is planned as described in the *NI PEIS* ROD. The Radiochemical Engineering Development Center (REDC) and High Flux Isotope Reactor (HFIR), which could be used for RPS nuclear production, are both located within ORNL (see **Figure 3–19**). ORNL's primary mission is to perform leading-edge nonweapons research and development in energy, health, and the environment. Other missions include production of radioactive and stable isotopes not available from other production sources, fundamental and applied research and development in sciences and materials development, research involving hazardous and radioactive materials, environmental research, and radioactive waste disposal.

3.4.1 Land Resources

3.4.1.1 Land Use

Lands bordering ORNL and ORR are predominantly rural and are used primarily for residences, small farms, forest land, and pasture land. The city of Oak Ridge, Tennessee, has a typical urban mix of residential, public, commercial, and industrial land uses. It also includes almost all of ORR. There are four residential areas along the northern boundary of ORR, several of which have houses located within 30 meters (98 feet) of the site boundary.

Land uses at ORR are shown in **Figure 3–20**. Land uses at the site include industrial, mixed industrial, institutional/research, institutional/environmental laboratory, and mixed research/future initiatives. Industrial and mixed industrial areas of the site include ORNL, Y-12, and the ETTP. The institutional/research category applies to land occupied by central research facilities at ORNL and the Natural and Accelerated Bioremediation Field Research Center in Bear Creek Valley near Y-12. The institutional/environmental laboratory category includes the Oak Ridge Institute for Science and Education. Land within the mixed research/future initiative category includes land that is used or available for use in field research and land reserved for future DOE initiatives. Most mixed research and future initiatives areas are forested. Undeveloped forested lands on ORR are managed for multiple use and sustained yield of quality timber products. Although soils that would be identified as prime farmland occur on the site, that designation is waived because they are within the city of Oak Ridge (DOE 2000f). Only a small fraction of ORR has been disturbed by Federal activities, including the construction and operation of facilities, roadways, or other structures.

A large number of reservation-wide land uses overlay the primary land use categories and are officially designated as mixed uses. The largest mixed use is biological and ecological research in the Oak Ridge National Environmental Research Park, which is on 8,090 hectares (20,000 acres). The National Environmental Research Park, established in 1980, is used by the Nation's scientific community as an outdoor laboratory for environmental science research on the impact of human activities on the eastern deciduous forest ecosystem. Recently, the Three Bend Scenic and Wildlife Management Refuge Area, on 1,215 hectares (3,000 acres), was set aside by DOE as a conservation and wildlife management area. The area is located in the ORR buffer zone, on Freels, Gallaher, and Solway Bends on the north shore of Melton Hill Lake (DOE 2000f). Additional details on land use plans at the site are provided in the *Oak Ridge National Laboratory Land and Facilities Plan* (ORNL 2002).

ORNL is primarily located within Bethel Valley between Haw and Chestnut Ridges, and covers 1,720 hectares (4,250 acres) of land. The site is classified as an industrial area that encompasses a number of facilities dedicated to energy research. REDC and HFIR are located in ORNL along a low ridge in Melton Valley just to the southwest of Haw Ridge. The nearest public access to these facilities, Bethel Valley Road, is located about 1,500 meters (4,920 feet) to the north, and the nearest residential area is about 4,100 meters (13,450 feet) to the southwest. Land surrounding ORNL is largely forested and is classified as mixed research/future initiatives (DOE 2000f).

3.4.1.2 Visual Resources

The landscape at ORNL and ORR is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The vegetation is dominated by deciduous forest mixed with some coniferous forest. Most of the original open field areas on the site have been planted in shortleaf and loblolly pine, although smaller areas have been planted in a variety of deciduous and coniferous trees. The DOE facilities are brightly lit at night, making them especially visible. The developed areas of ORNL are consistent with the Bureau of Land Management's Visual Resource Contrast Class IV rating in which management activities dominate the view and are the focus of viewer attention (DOI 1986). The remainder ranges from a Visual Resource Contrast Class II to Class III rating. Management activities within these classes may be seen, but should not dominate the view.

The viewshed consists mainly of rural land. Sensitive viewpoints affected by DOE facilities are primarily associated with Interstate 40, State Highways 58, 62, and 95, and Bethel Valley and Bear Creek Roads. The Clinch River/Melton Hill Lake, and the bluffs on the opposite side of the Clinch River also have views of ORR, but views of most of the existing DOE facilities are blocked by terrain and/or vegetation. Although only a small portion of State Highway 62 crosses ORR, it is a major route for traffic to and from Knoxville and other communities. The hilly terrain, heavy vegetation, and generally hazy atmospheric conditions limit views.

ORNL is one of several highly developed areas of ORR. As noted above, such areas are consistent with the Bureau of Land Management Visual Resource Contrast Class IV rating. While a large part of ORNL is visible from Bethel Valley Road, it is not visible to persons in offsite locations because of the presence of the Haw and Chestnut Ridges. REDC and HFIR, located to the south of the main ORNL complex, are not visible from any public area.

3.4.2 Site Infrastructure

Characteristics of ORNL's utility and ground transportation infrastructure are summarized in **Table 3–38**. Section 3.4.8.4 further discusses local transportation infrastructure, and Section 3.4.11 describes the site's waste management infrastructure.

3.4.2.1 Site Ground Transportation

Within the ORR Site, ORNL contains 290 kilometers (180 miles) of improved roadways, including 40 kilometers (25 miles) of paved roads. Within ORR, several routes are used to transfer traffic from the State Routes to the main plant areas including ORNL (ORNL 2002). Bear Creek Road, north of Y-12, flows in an east-west direction and connects Scarboro Road on the east end of the plant with State Road 95 and State Road 58. Bear Creek Road has restricted access around Y-12, and is not a public thoroughfare. Bethel Valley Road, a public roadway, provides access to ORNL, and extends from the east end of ORR at State Road 62 to the west end at State Route 95. Access to REDC and HFIR is provided by secondary roads with controlled access including First Street, which runs north-south from Bethel Valley Road, and Melton Valley Road, which runs east-west and passes the entry road (DOE 2000f).

Two main branches provide rail service for ORR. The CSX Transportation line at Elza (just east of Oak Ridge) serves Y-12 and the Office of Science and Technological Information in east Oak Ridge. The Norfolk and Southern main line from Blair provides easy access to the ETTP (DOE 2000b). No rail spur runs to the ORNL site.

Table 3–38 Oak Ridge National Laboratory Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	180 [a]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity		
Energy (megawatt-hours per year)	175,200	350,400
Peak load (megawatts)	24	40
Fuel		
Natural gas (cubic meters per year)	25,900,000	15,500,000 [b]
Fuel oil (heating) (liters per year)	866,500	Not limited [c]
Water (liters per year) [d]	6,910,000,000	9,670,000,000

[a] Includes paved and unpaved roads.

[b] Contractual limit, actual capacity is greater.

[c] Capacity is only limited by the ability to ship resource to the site.

[d] Reflects peak usage and capacity of the ORNL water supply system.

Note: To convert kilometers to miles, multiply by 0.621; liters to gallons, multiply by 0.264; and cubic meters to cubic feet, multiply by 35.315.

Sources: ORNL 2002 and 2005.

3.4.2.2 Electricity

Electrical power is supplied to ORNL and ORR by the Tennessee Valley Authority. The Power Operations Group located in the Y-12 Facilities Maintenance Organization has responsibility for coordinating operations and activities on the distribution grid and for operating and maintaining the main substations serving each individual site. Two transmission lines supply ORNL and vicinity: (1) a 13-kilometer- (8-mile-) long line that extends from the K-27 substation at the ETTP, and (2) a 10-kilometer- (6-mile-) long line that feeds from the Elza Substation located at the Y-12 Site. Each line is rated at 161 kilovolts, with each having a load capacity of approximately 110 megawatts. Transformers at the main substation reduce the voltage from these lines to 13.8 kilovolts for distribution within ORNL. Eight 13.8-kilovolt feeders further distribute power within ORNL, including a 13.8-kilovolt feeder that extends to the HFIR Substation. Five secondary 2.4-kilovolt substations, a 2.4-kilovolt distribution system consisting of 51 kilometers (32 miles) of aboveground and 6.4 kilometers (4 miles) of underground distribution lines, and over 200 facility transformers complete the primary electrical distribution system that provides power to ORNL facilities. The oldest sections of the electrical power system were built in the early-to-mid-l940s, and a number of projects have been undertaken to upgrade key components. Gasoline- or diesel-powered generators are also in place to provide power to key operations and facilities in the event of a power outage (ORNL 2002).

Total electrical energy availability to ORR from the Tennessee Valley Authority grid is 13,880,000 megawatt-hours per year. Total electrical energy consumption across ORR is about 726,000 megawatt-hours annually (DOE 2000f). This consumption reflects an average load demand of about 83 megawatts. As described above, the ORNL electric power distribution system has a maximum capacity of 80 megawatts, but is practically limited to approximately 40 megawatts (reflecting an electrical energy availability of 350,400 megawatt-hours per year). The electrical load demand at ORNL averages less than 20 megawatts for much of the year (ORNL 2002). This load demand reflects annual energy consumption of not more than about 175,200 megawatt-hours. The peak load demand for ORNL is estimated at 24 megawatts (see Table 3–38).

3.4.2.3 Fuel

The Duke Energy Company supplies natural gas to ORNL. Natural gas is used in the ORNL Central Steam Plant to heat ORNL facilities, and fuel oil is used as a backup and switching fuel. This company owns, operates, and maintains the main line and the three pressure-reducing stations that make up the supply system to the ORNL. The Power Operations Department at the Y-12 National Security Complex also has managerial responsibility for this utility. The ORNL natural gas tap is located at Metering Station B, north of Bethel Valley Road at the Melton Valley Access Road intersection. ORNL can demand up to about 15.5 million cubic meters (547.5 million cubic feet) of natural gas annually under current contract limits without incurring a penalty charge (ORNL 2002).

In 2004, ORNL consumed approximately 25.9 million cubic meters (914 million cubic feet) of natural gas. Total ORNL fuel oil consumption was about 866,500 liters (228,900 gallons) in 2004 (ORNL 2005) (see Table 3–38). No current supply limitations impact ORNL operations, as the system is designed with more capacity than is now demanded (ORNL 2002).

3.4.2.4 Water

Water for ORNL is obtained from the Clinch River south of the eastern end of the Y-12 National Security Complex and pumped to the water treatment plant located on the ridge northeast of Y-12. The treatment plant (formerly the DOE treatment facility) is owned and operated by the city of Oak Ridge. The water treatment plant can deliver water to two water storage reservoirs at a potential rate of 91 million liters (24 million gallons) per day. Water from the two reservoirs is distributed to the Y-12 Plant, ORNL, and the city of Oak Ridge. A 61-centimeter (24-inch) water line extends from the water treatment plant approximately 12 kilometers (7.5 miles) across Chestnut Ridge into ORNL. This supply line feeds the ORNL reservoir system. This system consists of one concrete reservoir with a capacity of 11.4 million liters (3 million gallons) and a new (completed in 2001) 5.7-million liter (1.5-million gallon) capacity steel reservoir on the south slope of Chestnut Ridge. Also comprising this system are two 5.7-million liter (1.5-million gallon) capacity steel reservoir tanks located on Haw Ridge that supply water to ORNL. The Haw Ridge tanks specifically provide reserve capacity for REDC, HFIR, and other facilities in Melton Valley. From these storage facilities, water flows by gravity into the distribution system for potable, sanitary, fire protection, and process uses (ORNL 2002).

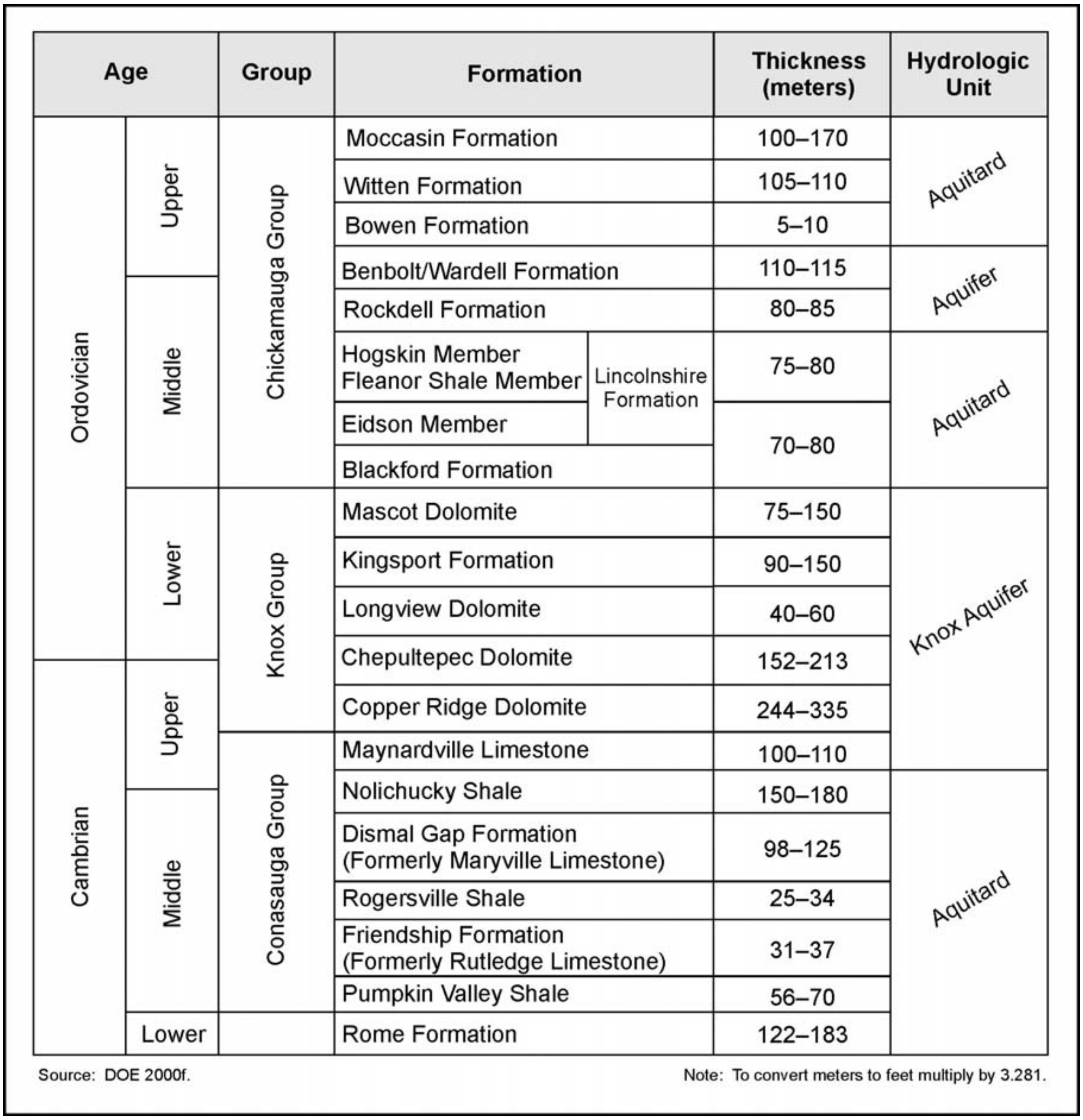
Total ORNL water use ranges from about approximately 9.5 million liters (2.5 million gallons) per day (3.45 billion liters [912.5 million gallons] annually) during the winter to around 15 million liters (4 million gallons) per day (5.53 billion liters [1.46 billion gallons] annually) during the summer, but can approach 19 million liters (5 million gallons) per day (6.91 billion liters [1.83 billion gallons] annually). A flow of 26.5 million liters (7 million gallons) per day (9.67 billion liters [2.55 billion gallons] annually) can be accommodated by the ORNL supply system under current operating conditions (see Table 3–38). Loss of the single supply line from the water plant, or any activity that would cause loss of the reserve capacity of one of the reservoirs, could impact ORNL operations within a short period of time (ORNL 2002).

Either of the two reservoirs is capable of supplying the normal 3,785 liters (1,000 gallons) per minute cooling water requirements of HFIR. The HFIR complex uses a total of approximately 6.1 million liters (1.6 million gallons) of water per day or about 2.23 billion liters (589 million gallons) annually. REDC uses approximately 294,000 liters (77,800 gallons) of water per day or 107 million liters (28.4 million gallons) per year (DOE 2000f).

3.4.3 Geology and Soils

3.4.3.1 Geology

ORNL is in the southwestern portion of the Valley and Ridge physiographic province in east-central Tennessee. The topography consists of alternating valleys and ridges that have a southwest-northeast trend, with most facilities occupying the valleys. The topography reflects the underlying geology, which consists of a sequence of sedimentary rocks deformed by a series of major southeast-dipping thrust faults (**Figures 3–21 and 3–22**). The ridges are underlain by relatively erosion-resistant rocks, while weaker rock strata underlie the valleys. The ORNL main site is located in Bethel Valley between Haw and Chestnut Ridges. REDC and HFIR are located on a low ridge in Melton Valley, south of Haw Ridge (DOE 2000f).

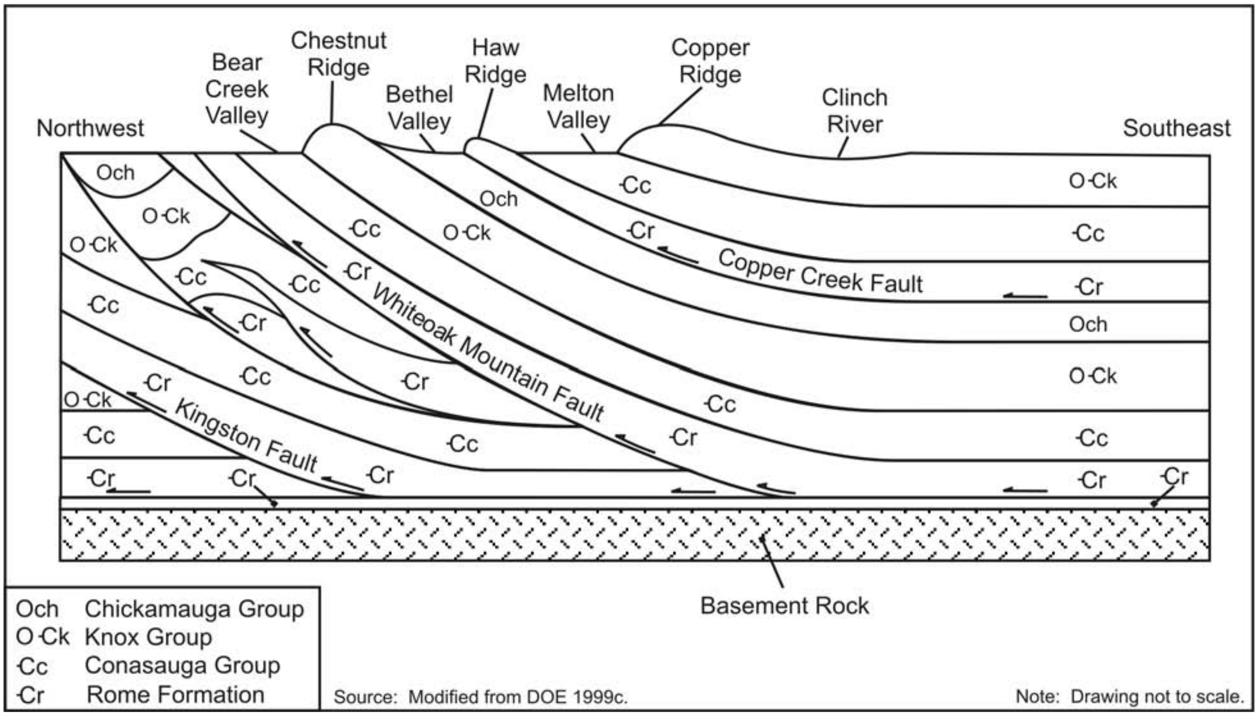


Age		Group	Formation		Thickness (meters)	Hydrologic Unit
Ordovician	Upper	Chickamauga Group	Moccasin Formation		100–170	Aquitard
			Witten Formation		105–110	
			Bowen Formation		5–10	
	Middle		Benbolt/Wardell Formation		110–115	Aquifer
			Rockdell Formation		80–85	
			Hogskin Member Fleanor Shale Member	Lincolnshire Formation	75–80	Aquitard
			Eidson Member		70–80	
			Blackford Formation			
	Lower	Knox Group	Mascot Dolomite		75–150	Knox Aquifer
			Kingsport Formation		90–150	
			Longview Dolomite		40–60	
			Chepultepec Dolomite		152–213	
Cambrian	Upper		Copper Ridge Dolomite		244–335	
		Conasauga Group	Maynardville Limestone		100–110	
	Middle		Nolichucky Shale		150–180	Aquitard
			Dismal Gap Formation (Formerly Maryville Limestone)		98–125	
			Rogersville Shale		25–34	
			Friendship Formation (Formerly Rutledge Limestone)		31–37	
			Pumpkin Valley Shale		56–70	
	Lower		Rome Formation		122–183	

Source: DOE 2000f.

Note: To convert meters to feet multiply by 3.281.

Figure 3–21 Stratigraphic Column for the Oak Ridge National Laboratory



Source: Modified from DOE 1999c.

Note: Drawing not to scale.

Figure 3–22 Geologic Cross Section of the Oak Ridge National Laboratory

Bedrock in the ORNL vicinity is of Early Cambrian (about 570 million years ago) to Ordovician Age (505 to 540 million years ago). The bedrock units encompass a wide variety of lithologies ranging from pure limestone to dolostone to fine sandstone. The total thickness of the stratigraphic section is about 2.6 kilometers (1.6 miles). Four primary geologic units occur in the area. These include (from oldest to youngest) the Rome Formation, Conasauga Group, Knox Group, and Chickamauga Group. The Conasauga Group, Knox Group, and Chickamauga Group are comprised of individual geologic formations that have been combined based on general lithology types and age. Because of their unique lithologies, the major stratigraphic units possesses different mechanical characteristics and have responded differently to the strains imparted on them through time. In general, the Maynardville Limestone of the Conasauga Group, the Knox Group, and most of the overlying Chickamauga Group act as brittle, but competent, units within the major thrust sheets in the vicinity of ORNL. The Rome Formation, all of the Conasauga Group below the Maynardville Limestone, and the Moccasin Formation of the Chickamauga Group (weak units) readily deform under stress; these units often contain fault planes along which movement has occurred. These faults have been largely inactive in recent geologic time. The Rome Formation and Knox Group are chemically resistant to weathering; thus, these units form the principal ridges. The Chickamauga Group and Conasauga Group formations underlie the valleys (DOE 2000b).

There is no evidence of active capable faults in the Valley and Ridge physiographic province or within the rocks comprising the Appalachian Basin structural feature where ORNL is located. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100, Appendix A). The nearest capable faults are approximately 480 kilometers (298 miles) northwest in the New Madrid (Reelfoot Rift) Fault Zone. Historical earthquakes occurring in the Valley and Ridge are not attributable to fault structures in underlying sedimentary rocks, but rather occur at depth in basement rock (DOE 2000f).

The historical seismicity of the southeastern United States relative to ORNL has been extensively reviewed in recent years. Since the New Madrid earthquakes of 1811 to 1812, at least 27 other earthquakes with an MMI of III to VI (see Appendix B of this EIS) have been felt in the Oak Ridge area. One of closest and most intense seismic events occurred in 1930, approximately 8 kilometers (5 miles) from ORR, and had an MMI of V at the site. The largest recent earthquake in eastern Tennessee registered 4.6 on the Richter scale and occurred on November 30, 1973, in Maryville, Tennessee, about 32 kilometers (20 miles) southeast of ORR. This earthquake produced an MMI of V to VI at ORNL (as estimated at HFIR) (DOE 2000f). The region has continued to be seismically active, with 49 earthquakes recorded within a radius of 100 kilometers (62 miles) of ORNL since 1973. The closest of those events occurred on June 17, 1998, with an epicenter within ORR near the ETTP, registering a magnitude 3.6 (USGS 2005d).

Earthquake-produced ground motion is expressed in units of “g” (force of acceleration relative to that of the earth’s gravity). Two differing measures of this motion are peak (ground) acceleration and response spectral acceleration. For ORNL facilities, the calculated maximum considered earthquake ground motion ranges from approximately 0.47g for an 0.2-second spectral response acceleration to 0.11g for a 1.0-second spectral response acceleration. The calculated peak ground acceleration for the given probability of exceedance at the site is approximately 0.28g (USGS 2005b). These are representative of MMI VII earthquake damage (BSSC 2004). Table B–7 in Appendix B of this EIS shows the approximate correlation between MMI, earthquake magnitude, and peak ground acceleration.

As stated in DOE Order 420.1A, DOE requires that nuclear or nonnuclear facilities be designed, constructed, and operated so that the public, the workers, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Based on historical observations, the maximum earthquake having an epicenter at ORNL would be an MMI VIII event. Numerous studies have been conducted as part of establishing the design-basis earthquake for evaluating and designing new ORR facilities. For this purpose, an earthquake producing an effective peak-ground acceleration of 0.15g has been established and calculated to have an annual probability of occurrence of about 1 in 1,000. For comparison, an earthquake with a peak acceleration of 0.32g has an annual probability of occurrence of 1 in 5,000 (DOE 2000f).

There is no volcanic hazard at ORNL. The area has not experienced volcanic activity within the last 230 million years (DOE 2000f).

3.4.3.2 Soils

The four soil map units identified at ORNL are the Fullerton-Claiborne-Bodine; Collegedale-Gladeville-Rock outcrop; Lehew-Armuchee-Muskingum; and Armuchee-Montevallo-Hamblen units. Soils of the Fullerton-Claiborne-Bodine unit may be described as deep, rolling-to-steep, well-drained cherty and noncherty soils underlain by dolomite. They occur on rolling ridgetops and on all aspects of steep side slopes. The Collegedale-Gladeville-Rock outcrop soil unit consists of deep and shallow, rolling and hilly well-drained soils that are underlain by limestone and have many outcrops of limestone. Soils of this group occur on uplands. Soils of the Lehew-Armuchee-Muskingum unit are moderately deep, steep, well-drained soils underlain by multicolored shale, siltstone, and sandstone. This unit is found on high winding ridges. The Armuchee-Montevallo-Hamblen soil unit is made up of shallow-to-deep, steep to nearly level, well-drained and moderately well-drained soils underlain by shale. This unit occurs on uplands and bottomlands. While there are soils that would be classified as prime farmland on ORR, that designation is waived within the ORR site boundary (DOE 2000f).

The ORNL main site is underlain primarily by calcareous siltstones and silty-to-clean limestone of the Chickamauga Group. Melton Valley is underlain by the interbedded limestones and shales of the Conasauga Group. Most of REDC at HFIR is underlain by the Maryville Limestone with the southern limits of the site bordering the Nolichucky Shale (Figures 3–21 and 3–22). In particular, the bedrock beneath the HFIR complex is described as a dark-gray, calcareous clay shale overlain by up to 6 meters (20 feet) of saprolite (weathered bedrock) with only a thin topsoil. Karst features are less developed in the Chickamauga Group than in the Knox Group. Cavities encountered are smaller and often clay-filled, and caves are sparse and typically small, with the same observation expected for the Conasauga Group. Soils of ORNL are highly disturbed and would be classified as Urban Land. Urban Land includes areas where more than 80 percent of the surface is covered with industrial plants, paved parking lots, and other impervious surfaces (DOE 2000f).

3.4.4 Water Resources

3.4.4.1 Surface Water

The major surface water feature in the immediate vicinity of ORNL is the Clinch River, which borders ORR to the south and west. There are four major subdrainage basins on ORR that flow into the Clinch River and are affected by site operations: Poplar Creek, East Fork Poplar Creek, Bear Creek, and White Oak Creek. Several smaller drainage basins, including Ish Creek, Grassy Creek, Bearden Creek, McCoy Branch, Kerr Hollow Branch, and Raccoon Creek, drain directly to the Clinch River (**Figure 3–23**). Each drainage basin takes the name of the major stream flowing through the area. The three major facilities at ORR each affect different basins of the Clinch River. Drainage from Y-12 enters both Bear Creek and East Fork Poplar Creek; the ETTP drains mainly into Poplar Creek; and ORNL drains into White Oak Creek (DOE 2000f).

The Clinch River and connected waterways supply raw water for ORNL. The Clinch River has an average flow rate of 132 cubic meters (4,647 cubic feet) per second, as measured at the downstream side of Melton Hill Dam. ORR uses 14,210 million liters (3,754 million gallons) per year. The ORR water supply system, which includes the city of Oak Ridge treatment facility (formerly the DOE treatment facility) and the ETTP treatment facility, has a capacity of 90.8 to 121.5 million liters (24 to 32.1 million gallons) per day (DOE 2000f). Water use is detailed in Section 3.4.2.4.

The Clinch River water levels in the vicinity of ORR are regulated by a system of dams operated by the Tennessee Valley Authority. Melton Hill Dam controls the flow of the Clinch River along the northeast and southeast sides of ORR. Watts Bar Dam on the Tennessee River near the lower end of the Clinch River controls the flow of the Clinch River along the southwest side of ORR (DOE 2000f).

The surface streams of Tennessee are classified by the Tennessee Department of Environmental Conservation according to the Use Classifications for Surface Waters. Classifications are based on water quality, beneficial uses, and resident aquatic biota. The Clinch River is the only surface water body near ORNL classified for domestic water supply. Unless otherwise specified in these rules, all streams in Tennessee are classified for use for fish and aquatic life, recreation, irrigation, and for livestock watering and wildlife. In addition, the Clinch River and a short segment of Poplar Creek from its confluence with the Clinch River are also classified for industrial water supply use. White Oak Creek and Melton Branch are the only streams not classified for irrigation. East Fork Poplar Creek is posted by the state of Tennessee with warnings against fishing and contact recreation (DOE 2000f).

Wastewater treatment facilities are located throughout ORR, including six treatment facilities at Y-12 that discharge to East Fork Poplar Creek, and three treatment facilities at ORNL that discharge into White Oak Creek Basin. These discharge points are included in existing NPDES permits (DOE 2000b, Hughes et al. 2004).

There are approximately 400 NPDES-permitted outfalls at ORR associated with the 3 major facilities (Y-12 Plant, ETTP, and ORNL); many of these are storm water outfalls. The current permit lists 164 point-source discharges that require compliance monitoring. Approximately 100 of these are storm drains, roof drains, and parking lot drains. The NPDES permit limit compliance rate for all discharge points for the three major facilities in 2003 was over 99 percent (Hughes et al. 2004).

At ORNL, water samples are collected and analyzed from 18 locations around the reservation to assess the impact of past and current DOE operations on the quality of local surface water. Sampling locations include streams, both upstream and downstream of ORNL waste sources, and public water intakes. Samples are collected and analyzed for general water quality parameters at all locations, and are screened for radioactivity and analyzed for specific radionuclides, when appropriate. White Oak Lake at White Oak Dam is also checked for volatile organic compounds, polychlorinated biphenyls, and metals. Radionuclides were detected above minimum detectable activity at all surface water locations in 2003. The levels of gross beta, total radioactive strontium, and tritium continue to be highest at Melton Branch (0.2 kilometers [0.1 miles] downstream from ORNL), White Oak Creek at White Oak Dam, and White Oak Creek (2.6 kilometers [1.6 miles] downstream from ORNL). These data are consistent with historical data and with the processes or legacy activities nearby or upstream from these locations. Volatile organic compounds were also detected at White Oak Creek at White Oak Dam in 2003, including chloroform and acetone, which are common laboratory contaminants. Two other locations, one on Northwest Tributary and one on Raccoon Creek also had elevated levels of gross beta and total radioactive strontium. Both of these locations are impacted by contaminated groundwater from Solid Waste Storage Area #3 (Hughes et al. 2004).

The Tennessee Valley Authority has conducted flood studies along the Clinch River, Bear Creek, and East Fork Poplar Creek, and has also performed probable maximum flood studies along the Clinch River. The probable maximum flood is that which could be expected from the most severe combination of critical hydrometeorological conditions that are reasonably possible over the entire watershed. The probable maximum flood level along the Clinch River at the mouth of Bearden Creek would occur at elevation 248.3 meters (814.7 feet), while the probable maximum flood level at the mouth of White Oak Creek would occur at elevation 237.5 meters (779.3 feet). Based on the studies, most of ORNL is above the probable maximum flood elevation along the Clinch River (DOE 2000f).

Sanitary wastewater from the REDC and HFIR is conveyed to the ORNL Sewage Treatment Plant, which provides primary, secondary, and tertiary sewage treatment. The Sewage Treatment Plant has a treatment capacity of 1.1 million liters (300,000 gallons) per day. Since 1997, treated flows have ranged from about 685,000 to 821,000 liters (181,000 to 217,000 gallons) per day. Specifically, the HFIR complex is estimated to generate about 7.3 million liters (1.93 million gallons) of sanitary wastewater per year, with REDC generating an additional 3.1 million liters (828,000 gallons) annually (DOE 2000f).

Process wastewater from REDC and HFIR is collected and conveyed to storage tanks prior to processing in the Process Waste Treatment Complex. All treated wastewater is ultimately discharged to White Oak Creek through a single NPDES-permitted outfall (Outfall X12). The flow rate from this outfall averages about 2.08 million liters (550,000 gallons) per day, of which approximately 66,245 liters (17,500 gallons) per day are attributable to process wastewater from REDC and HFIR. The treated effluent from Outfall X12 meets NPDES water quality-based limits for metals and organics and DOE Derived Concentration Guides (DOE Order 5400.5), and is not toxic to aquatic species based on NPDES-required toxicity testing. REDC and HFIR also discharge dechlorinated cooling water and cooling tower blowdown to Melton Branch through NPDES-permitted Outfalls 081 and 281. Discharge from Outfall 281, which is predominantly HFIR cooling tower blowdown, averages about 378,500 liters (100,000 gallons) per day in the warm months. The discharge rate from Outfall 081 averages approximately 265,000 liters (70,000 gallons) per day during the warm months and consists primarily of REDC cooling water

(DOE 2000f). Waste management activities and facilities are discussed in greater detail under Section 3.4.11.

Melton Branch, the primary stream in the immediate vicinity of REDC and HFIR, was analyzed to assess the potential for flooding from a locally intense storm, based on probable maximum precipitation events. The analysis determined that the relatively high elevation of the terrain and slope ensures that locally intense precipitation would not cause the Melton Branch to flood equipment at HFIR. Likewise, the occurrence of a probable maximum flood at the mouth of White Oak Creek or along Melton Branch due to probable maximum precipitation events would not inundate HFIR. Surface runoff and facility drainage flows to either of two headwater tributaries of Melton Branch on the east and west sides, respectively, of REDC and HFIR (DOE 2000f).

3.4.4.2 Groundwater

Groundwater in the vicinity of ORNL occurs both in the unsaturated zone as transient, shallow subsurface stormflow and within the deeper saturated zone. An unsaturated zone of variable thickness separates the stormflow zone and water table. Adjacent to surface water features or in valley floors, the water table is found at shallow depths, and the unsaturated zone is thin. Along the ridge tops or near other high topographic areas, the unsaturated zone is thick, and the water table often lies at considerable depth [15 to 50 meters (50 to 175 feet) deep]. In low-lying areas where the water table occurs near the surface, the stormflow zone and saturated zone are indistinguishable. It is estimated that in undisturbed, naturally vegetated areas at ORR, about 90 percent of the infiltrating precipitation does not reach the water table but travels through the 1- to 2-meter (3- to 7-feet) stormflow zone, which approximately corresponds to the root zone. This condition exists because of the permeability contrast between the shallow stormflow zone and the underlying unsaturated zone (Hughes et al. 2004).

Two broad hydrologic groupings have been characterized at ORR, each having fundamentally different characteristics. The Knox Group and the Maynardville Limestone of the Conasauga Group constitute the Knox Aquifer, in which flow is dominated by a combination of solution conduits and weathered permeable fractures. The less permeable ORR aquitard units constitute the second regime, in which flow is dominated by fractures alone. These hydrologic groupings and the geologic units comprising them are illustrated in Figure 3–21. The combination of fractures and solution conduits in the dolostones and limestones of the Knox Aquifer control flow over substantial areas, and rather large quantities of water may move relatively long distances. Active groundwater flow can occur at substantial depths in the Knox Aquifer (91.5 to 122 meters [300 to 400 feet] deep). The Knox Aquifer is the primary source of groundwater to many streams (base-flow), and most large springs on ORR receive discharge from the Knox Aquifer. Yields of some wells penetrating larger solution conduits are reported to exceed 3,785 liters (1,000 gallons) per minute (Hughes et al. 2004).

Units constituting the ORR aquitards include the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group, and consist mainly of siltstone, shale, sandstone, and thinly bedded limestone of low to very low permeability. The typical yield of a well in the aquitards is less than 3.8 liters (1 gallon) per minute, and the base flows of streams draining areas underlain by the aquitards are poorly sustained because of such low flow rates (DOE 2000f). Most water in the saturated zone in the ORR aquitards is transmitted through a 1- to 6-meter (3- to 20-feet) layer of closely spaced, well-connected fractures near the water table. Modeling by the U.S. Geological Survey indicates that 95 percent of all groundwater flow occurs in the upper 15 to 30 meters (50 to 100 feet) of the saturated zone in the ORR aquitards. As a result, flow paths in the active flow zones of the aquitards are relatively short, and nearly all groundwater discharges to local surface water drainages on the ORR (Hughes et al. 2004, DOE 2000f).

Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at ORNL. Only one water supply well exists; it provides a supplemental water supply to an ORNL aquatic biology laboratory during extended droughts (DOE 2000f). Industrial and drinking water supplies are primarily taken from surface water sources. However, single-family wells are common in adjacent rural areas not served by the public water supply system. Most of the residential wells in the immediate vicinity of ORNL are south of the Clinch River. Groundwater rights in the state of Tennessee are traditionally associated with the Reasonable Use Doctrine. Under this doctrine, landowners can withdraw groundwater as long as they exercise their rights reasonably in relation to the rights of others (DOE 2000f).

Background groundwater quality at ORR is generally good and of the calcium-magnesium-bicarbonate type in the near-surface saturated zone and the Knox Aquifer. It is poor in the deep saturated zone (particularly in the aquitards) at depths greater than 305 meters (1,000 feet), due to high total dissolved solids where the groundwater is of the sodium-chloride type (Hughes et al. 2004).

Groundwater near ORNL has been locally contaminated by hazardous chemicals and radionuclides from past process activities. The contaminated sites include past waste disposal sites, waste storage tanks, spill sites, and contaminated inactive facilities (DOE 2000f). The groundwater monitoring program at ORNL consists of a network of wells of two basic types and functions: (1) water quality monitoring wells built to RCRA specifications and used for site characterization and compliance purposes, and (2) piezometer wells used to characterize groundwater flow conditions. The groundwater surveillance monitoring program is managed by the University of Tennessee-Battelle for the DOE Office of Science. Monitoring wells have been established around the perimeter of the WAGs determined to have a potential for release of contaminants. The University of Tennessee-Battelle's WAG perimeter monitoring network and the ORNL plant perimeter groundwater surveillance program involved 49 wells in 2003. The ORNL exit pathway program is designated to monitor groundwater at locations that are thought to be likely exit pathways for groundwater affected by activities at ORNL. Four of the 10 wells that make up ORNL's exit pathway monitoring program are also part of the WAG perimeter monitoring program. In the current ORNL program, groundwater quality wells are sampled on an annual basis (Hughes et al. 2004).

Three radiological contaminant constituents exceeded their respective reference values in 2003: tritium, gross alpha activity, and gross beta activity. In particular, one monitoring well located downgradient of the HFIR complex indicates that a statistically significant upward trend continues to be observed for tritium. This is attributed to the tritium leak from the process waste drain line that occurred in 2000, and was repaired during the summer of 2001. Overall, most monitoring locations immediately downgradient of HFIR and the point of release continue to show a decrease in tritium with the results indicating that the tritium plume is moving downgradient away from HFIR toward eventual discharge into Melton Branch (Hughes et al. 2004). More complete information on groundwater monitoring and chemical analysis is presented in the annual site environmental report.

Groundwater is not used for drinking water at ORNL. In general, contaminant plumes in groundwater at ORNL are relatively small in areal extent, as contaminant sources are discretely located and flow paths to surface water outlets are short (Hughes et al. 2004).

3.4.5 Air Quality and Noise

3.4.5.1 Air Quality

The climate at ORNL may be classified as humid continental, but is moderated by the influence of the Cumberland and Great Smoky Mountains. Winters are mild and summers are warm, with no noticeable extremes in precipitation, temperature, or winds. The average annual temperature is 13.7 °C (56.6 °F);

average monthly temperatures range from a minimum of 2.2 °C (36 °F) in January to a maximum of 24.9 °C (76.8 °F) in July. The average annual precipitation is 138.5 centimeters (54.5 inches). Prevailing winds at ORNL generally follow the valley up the valley – from the southwest during the daytime, or down the valley from the northeast during the nighttime. The wind speed is less than 11.9 kilometers per hour (7.4 miles per hour) 75 percent of the time; tornadoes and winds exceeding 30 kilometers per hour (18 miles per hour) are rare (DOE 2000f).

Airborne discharges from ORNL facilities, both radioactive and nonradioactive, are subject to regulation by EPA and the Tennessee Department of Environment and Conservation (TDEC) Division of Air Pollution Control. Radioactive emissions are regulated by EPA under the National Emissions Standards for Hazardous Air Pollutants regulations in 40 CFR 61, Subpart H, and by the rules of the TDEC Division of Air Pollution Control, 1200-3-11.08.

ORNL is located in the Eastern Tennessee and Southwestern Virginia Interstate Air Quality Control Region #207. Air quality surrounding the Oak Ridge area is relatively good. However, Anderson County has been designated as a nonattainment area for the 8-hour ozone standard, as part of the larger Knoxville nonattainment area. Also, Anderson County and a portion of Roane County have been designated as nonattainment for the new, stricter Federal fine particulate matter ($PM_{2.5}$) air quality standard. For all other criteria pollutants for which EPA has made attainment designations, existing air quality in the greater Knoxville and Oak Ridge areas is in attainment with NAAQS (40 CFR 81.343). Applicable NAAQS and Tennessee State ambient air quality standards are presented in **Table 3–39**.

Nonradiological Releases

One Prevention of Significant Deterioration Class I area can be found in the vicinity of ORNL. A Class I area is one in which very little increase in pollution is allowed due to the pristine nature of the area. This area, the Great Smoky Mountains, is located 48.3 kilometers (30 miles) southeast of ORR. ORNL and its vicinity are classified as a Class II area, in which more moderate increases in pollution are allowed. Since the creation of the Prevention of Significant Deterioration program in 1977, no Prevention of Significant Deterioration permits have been issued for any emission source at ORR (DOE 2000f).

The TDEC Division of Air Pollution Control issues air permits for nonradiological and radiological airborne emissions for ORNL. Nine major sources of air emissions from ORNL operations are covered under a Title V Operating Permit (Permit Number 556850). In addition to this permit, ORNL also has a construction permit. The primary sources of nonradioactive emissions at ORNL include the steam plant (six boilers) on the main ORNL site and four small package-unit boilers located at the 7600 Area Complex and the Spallation Neutron Source. These sources account for approximately 75 percent of ORNL's allowable emissions. During 2003, TDEC inspected all permitted emission sources at ORNL, and all were found to be in compliance (Hughes et al. 2004).

The existing ambient air pollutant concentrations attributable to sources at ORNL are presented in **Table 3–40**. These concentrations are based on dispersion modeling, using emissions for the year 1998. Only those pollutants that would be emitted by any of the alternatives evaluated in this EIS are presented. As shown in Table 3–40, modeled concentrations associated with REDC and HFIR emission sources represent a small percentage of the ambient air quality standard.

The closest offsite monitors are operated by the TDEC in Anderson County and the city of Knoxville. In 1999, these monitors reported a maximum 8-hour average carbon monoxide concentration of 4,466 micrograms per cubic meter and maximum 1-hour average concentration of 12,712 micrograms per cubic meter. An annual average particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) concentration of 30.0 micrograms per cubic meter and a maximum 24-hour average concentration of 71 micrograms per cubic meter were reported. Annual, 24-hour, and 3-hour average sulfur dioxide maximum concentrations of 7.9 micrograms per cubic meter, 78.5 micrograms per cubic meter, and 293 micrograms per cubic meter, respectively, were also reported in 1999 (DOE 2000f).

Table 3–39 Comparison of Modeled Ambient Air Concentrations from Oak Ridge Reservation Sources with Most Stringent Applicable Standards or Guidelines, 1998

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline* [a] *(micrograms per cubic meters)*	*ORR Concentration (micrograms per cubic meters)*
Criteria pollutants			
Carbon monoxide	8 hours 1 hour	10,000 [b] 40,000 [b]	8.05 27.1
Nitrogen dioxide	Annual	100 [b]	1.58
Ozone	8 hours 1 hour	157 235 [c]	(d) (d)
PM_{10}	Annual 24 hours	50 [b] 150 [b]	1.6 12.7
$PM_{2.5}$	Annual 24 hours	15 [e] 65 [e]	1.6 [f] 12.7 [f]
Sulfur dioxide	Annual 24 hours 3 hours	80 [b] 365 [b] 1,300 [b]	4.86 35.7 112.0
Other regulated pollutants			
Total suspended particulates	24 hours	150 [g]	2 [h]

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 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 annual arithmetic mean particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] Federal and state standard.
[c] Federal 8-hour standard.
[d] Not directly emitted or monitored by the site.
[e] Federal standard.
[f] Assumed to be the same as PM_{10} because there are no specific data for $PM_{2.5}$.
[g] State standard.
[h] Based on stack emissions of particulate matter only.

Note: Emissions of hazardous air pollutants not listed here have been identified at ORR, but are not associated with any alternative evaluated in this EIS. EPA revised the ambient air quality standards for particulate matter and ozone in 1997 (62 FR 38856, 62 FR 38652).

Source: DOE 2000f.

Current nonradiological emissions from the REDC and HFIR are minimal, and result from wet chemistry and laboratory scale activities located at the facility. Additional nonradiological emissions result from maintenance activities inside the facility and in a small shop located adjacent to REDC and HFIR, and testing of emergency diesel generators. Current TDEC air pollution control rules do not require that these emissions be permitted or quantified (DOE 2000f). The existing ambient air pollutant concentrations attributable to sources at REDC and HFIR are presented in Table 3–40. These concentrations are estimated using SCREEN3 and are expected to overestimate the contribution to site boundary concentrations.

The primary sources of nonradiological air pollutants at ORNL include the facility steam plant and two small oil-fired boilers, which account for 98 percent of all allowable emissions. In 2003, ORNL had 11 operations air permits covering numerous air emission sources. All permitted sources were in compliance (DOE 2004g).

Table 3–40 Comparison of Modeled Ambient Air Concentrations from Sources at the Radiochemical Engineering Development Center and High Flux Isotope Reactor with Most Stringent Applicable Standards or Guidelines

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline* [a] *(micrograms per cubic meters)*	*REDC/HFIR Concentration (micrograms per cubic meters)*
Criteria pollutants			
Carbon monoxide	8 hours	10,000 [b]	31.5
	1 hour	40,000 [b]	45.1
Nitrogen dioxide	Annual	100 [b]	0.0072
Ozone	1 hour	235 [c]	(d)
PM_{10}	Annual	50 [b]	0.0005
	24 hours	150 [b]	5.96
Sulfur dioxide	Annual	80 [b]	0.0005
	24 hours	365 [b]	5.51
	3 hours	1,300 [b]	12.4
Other regulated pollutants			
Total suspended particulates	24 hours	150 [e]	5.96

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 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 annual arithmetic mean particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and state standard.

[c] Federal 8-hour standard is currently under litigation.

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

[e] State standard.

Source: DOE 2000f.

Radiological Releases

Radiological air emissions in 2003 from ORNL are presented in **Table 3–41**. The total curies and mass of isotopes discharged to the air can vary from year to year. The variations are attributable to changes in project activities and source process rates.

Radioactive airborne discharges at ORNL consist primarily of ventilation air from radioactively contaminated or potentially contaminated areas, vents from tanks and processes, and ventilation from reactor facilities. These airborne emissions are treated and then filtered with high-efficiency particulate air (HEPA) filters and/or charcoal filters before discharge. Radiological airborne emissions from ORNL consist of solid particulates; adsorbable gases (e.g., iodine), tritium, and nonadsorbable gases (i.e., noble gases). The major radiological emission point sources for ORNL consist of the following five stacks located in Bethel and Melton Valleys:

- High Radiation Level Analytical Laboratory;
- Radiochemical Processing Plant;
- Central off-gas and scrubber system, which includes cell ventilation system, isotope solid-state ventilation system, and central off-gas system;
- MSRE remediation; and
- Melton Valley Complex, which serves REDC and HFIR.

Table 3–41 Radiological Airborne Releases to the Environment at Oak Ridge National Laboratory in 2003 [a]

Emission Type	***Radionuclide***	***Curies***
Noble gases	Argon-41	2.31×10^{3}
	Krypton-85	8.58×10^{2}
	Krypton-85m	3.77×10^{1}
	Krypton-87	1.42×10^{2}
	Krypton-88	1.06×10^{2}
	Xenon-131m	1.64×10^{2}
	Xenon-133	1.64×10^{2}
	Xenon-133m	1.80×10^{1}
	Xenon-135	1.25×10^{2}
	Xenon-135m	7.17×10^{1}
	Xenon-138	4.04×10^{2}
Airborne particulates	Beryllium-7	1.06×10^{-5}
	Cobalt-60	9.67×10^{-6}
	Selenium-75	3.34×10^{-5}
	Strontium-90	2.79×10^{-3}
	Yttrium-90	1.57×10^{-3}
	Cesium-137	8.45×10^{-3}
	Cesium-138	2.81×10^{3}
	Barium-139	1.44×10^{0}
	Barium-140	2.93×10^{-4}
	Lanthanum-140	1.92×10^{-4}
	Osmium-191	3.10×10^{0}
	Lead-212	2.15×10^{0}
	Thorium-228	2.60×10^{-6}
	Thorium-230	1.71×10^{-6}
	Thorium-232	1.41×10^{-6}
	Uranium-234/235/238	1.32×10^{-4}
	Plutonium-238	1.27×10^{-4}
	Plutonium-239	2.39×10^{-4}
	Americium-241	2.31×10^{-4}
	Curium-242	1.13×10^{-4}
Nitrogens, oxygens, and iodine isotopes	Iodine-131	5.92×10^{-2}
	Iodine-132	6.98×10^{-1}
	Iodine-133	3.05×10^{-1}
	Iodine-134	9.26×10^{-1}
	Iodine-135	9.18×10^{-1}
Tritium and carbons	Tritium (hydrogen-3)	$1.03 \times 10^{+2}$

[a] Radionuclides with half-lives less than about 10 minutes are not included in the table (e.g., short-lived carbon, oxygen, and nitrogen isotopes). Also, not included are radionuclides for which less than 10^{-6} curies are released per year.

Source: Hughes et al. 2004.

In 2003, there were 24 minor point/group sources, and emission calculations/estimates were made for each of these sources.

The tritium emissions for 2002 totaled approximately 104 curies, which is an increase from 2002, but consistent with emissions from 1999 through 2000. The iodine-131 emission for 2003 decreased from that for 2002 to 0.06 curies. The major contributor to offsite doses at ORNL historically is argon-41, which is emitted as a nonadsorbable gas from the HFIR facility stack. However, due to a long maintenance period in 2001, cesium-138 emitted from the HFIR stack has remained the major contributor to the offsite dose since 2001. The cesium-138 emissions for 2003 were 2,810 curies (Hughes et al. 2004).

3.4.5.2 Noise

Major noise sources at ORNL and ORR include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Transportation noise sources are associated with moving vehicles that generally result in fluctuating noise levels above ambient noise levels for a short period of time. During peak hours, Bethel Valley Road traffic is a major contributor to traffic noise levels in the area. Most industrial facilities are a sufficient distance from the site boundary that noise levels at the boundary from these sources are not measurable, or are barely distinguishable from background noise levels (DOE 2000f).

Sound level measurements have been recorded at various locations within and near ORR in the process of testing sirens and preparing support documentation for the Atomic Vapor Laser Isotope Separation site. The acoustic environment along the ORR site boundary in rural areas and at nearby residences away from traffic noise is typical of a rural location, with average day-night sound levels in the range of 35 to 50 dBA. Areas within Oak Ridge are typical of a suburban area, with the average day-night sound levels in the range of 53 to 62 dBA. Traffic is the primary source of noise at the site boundary and at residences located near roads. During peak hours, plant traffic is a major contributor to traffic noise levels in the area (DOE 2000f).

The state of Tennessee has not established specific community noise standards applicable to ORNL and ORR. EPA guidelines for environmental noise protection recommend a day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). Land use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses (14 CFR Part 150). These guidelines further indicate that noise levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures. It is expected that for most residences near ORNL, the day-night average sound level is less than 65 dBA, and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

No distinguishing noise characteristics within ORNL have been identified. REDC and HFIR are 2.5 kilometers (1.6 miles) from the site boundary; thus, the noise levels at the site boundary from these sources are barely distinguishable from background noise levels (DOE 2000f).

3.4.6 Ecological Resources

3.4.6.1 Terrestrial Resources

Prior to Government acquisition of ORR as a security buffer for military activities, about 1,000 individual farmsteads consisting of forest, woodlots, open gazed woodlands, and fields were found on the site. Since acquisition by the Federal Government, much of the site has reverted back to a more natural state such that about 70 percent of ORR is in forest cover and about 20 percent is transitional, consisting of old fields, agricultural areas, cutover forest lands, roadsides, and utility corridors. Due to the highly diverse nature of both vegetative and animal communities on the site, portions of it have been designated as the Oak Ridge National Environmental Research Park Biosphere Reserve. Biosphere reserves are internationally recognized within the framework of the United Nations Educational, Scientific, and Cultural Organization Man and the Biosphere Program. Additionally, numerous Natural Areas and Reference Areas have been designated for the protection of rare plant and animal species and their habitat (ORNL 2002).

Plant communities at ORNL are characteristic of the intermountain regions of central and southern Appalachia; only a small fraction of ORR has been disturbed by Federal activities. The vegetation of ORR has been categorized into seven plant communities (**Figure 3–24**). Although outbreaks of southern pine beetles (*Dendroctonus frontalis*) killed over 445 hectares (1,100 acres) of pine forests in 1994 and 1999 to 2000, pine and pine-hardwood forest is the most extensive plant community on the site. Another abundant community is the oak-hickory forest, which is commonly found on ridges. Northern hardwood forest and hemlock-white pine-hardwood forest are the least common forest community types on the site. Forest resources are managed for multiple use and sustained yield of quality timber products; areas impacted by the pine beetle outbreak have been replanted or allowed to regenerate naturally. Over 1,100 vascular plants species are found on ORR (DOE 2000f, ORNL 2002).

Animal species found on ORR include 59 amphibians and reptiles, 260 birds, and 38 mammals. Animals commonly found on the site include the American toad (*Bufo americanus*), eastern garter snake (*Thamnophis sirtalis*), Carolina chickadee (*Parus carolinensis*), northern cardinal (*Cardinalis cardinalis*), white-footed mouse (*Peromyscus leucopus*), and raccoon. ORR has been designated a Tennessee Wildlife Management Area through an agreement with DOE and the Tennessee Wildlife Resources Agency. About 1,182 hectares (2,920 acres) of the Wildlife Management Area are specifically managed by the state as the Three Bends Scenic and Wildlife Management Refuge Area. The whitetail deer (*Odocoileus virginianus*) and wild turkey (*Meleagris gallopavo*) are the only species hunted onsite; however, other game animals are also present. Raptors, such as the northern harrier and great horned owl, and carnivores, such as the gray fox (*Urocyon cinereoargenteus*) and mink (*Mustela vison*), are ecologically important groups on ORR. A variety of migratory birds have been found at ORR and ORNL (DOE 2000f, ORNL 2002).

ORNL in Melton Valley contains a variety of ecosystems that range from those that are greatly disturbed to some that are relatively undisturbed. Where the valley has been heavily disturbed, the current vegetation cover is primarily grass and weeds. Vegetation of the rest of the valley is typical of forests found throughout ORR. Relatively undisturbed second-growth forests of mixed oak-hickory occur on the ridges and dry slopes, while pine and pine-hardwood on the lower slopes and valleys are typical of abandoned, eroded farmland (DOE 1996a). Vegetative communities in the vicinity of REDC and HFIR include pine, pine-hardwood forests, cedar, cedar-pine, cedar-hardwood, and oak-hickory forests (Figure 3–23) (DOE 2000f). Fauna of Melton Valley are typical of ORR and include the rat snake (*Elaphe obsolete*), black racer (*Coluber constrictor*), red-eyed vireo (*Vireo olivaceus*), scarlet tanager (*Piranga olivacea*), red-tailed hawk, red-shouldered hawk (*Buteo lineatus*), yellow-billed cuckoo (*Coccyzus americanus*), coyote, deer mouse, eastern gray squirrel (*Sciurus carolinensis*), southern flying squirrel (*Glaucomys volans*), and whitetail deer.

3.4.6.2 Wetlands

Approximately 235 hectares (580 acres) of wetlands occur on ORR, ranging in size from several square meters to about 10 hectares (25 acres) (ORNL 2002). Wetlands include emergent, scrub and shrub, and forested acres associated with bays (embayments) of the Melton Hill and Watts Bar Lake, areas bordering major streams and their tributaries (riparian), old farm ponds, and groundwater seeps. Well-developed communities of emergent wetland plants in the shallow embayments of the two reservoirs typically intergrade into forested wetland plant communities, which extend upstream through riparian areas associated with streams and their tributaries. Old farm ponds on ORR vary in size and support diverse plant communities and fauna. Although most riparian wetlands on ORR are forested, areas within utility rights-of-way, such as those in Bear Creek and Melton Valley, support emergent wetland vegetation (DOE 2000f).

There are six wetlands at ORNL in the vicinity of REDC and HFIR, including one small unclassified wetland; however, none are within the developed area. These wetlands, which were identified using the criteria and methods set forth in the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987), are generally classified as palustrine forested broad-leaved deciduous wetlands, although one also includes areas of emergent vegetation. Not including the unclassified wetland, the size of these areas ranges from 0.14 hectare (0.3 acre) to 1.23 hectares (3.0 acres). Mowing routinely disturbs two of the six wetlands (DOE 2000b).

3.4.6.3 Aquatic Resources

Aquatic habitat on or adjacent to ORNL and ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas in ORR also include seasonal and intermittent streams and old farm ponds (DOE 2000f).

Sixty-three fish species have been collected on ORR. The minnow family has the largest number of species and is numerically dominant in most streams. Fish species representative of the Clinch River in the vicinity of ORR are shad, herring, common carp (*Cyprinus carpio*), catfish, bluegill (*Lepomis macrochirus*), crappie (*Pomoxis* spp.), and freshwater drum (*Aplodinouts grunniens*). The most important fish species taken commercially in the ORR area are common carp and catfish. Commercial fishing is permitted on the Clinch River downstream from Melton Hill Dam. Area recreational species consist of crappie, largemouth bass (*Micropterus salmoides*), sauger (*Stizostedion canadense*), sunfish (*Lepomis* spp.), and catfish. Sport fishing is not permitted within ORR (DOE 2000f).

ORNL is drained by White Oak Creek. The upper portion of the creek is similar to the upper reaches of other streams originating on Chestnut Ridge. These streams typically have alternating riffle and pool habitats. The stoneroller (*Campostoma* spp.) and blacknose dace (*Rhinichethys atratulus*) are the fish species most commonly collected; 24 taxa of macroinvertebrates are present. Historically, operations at ORNL have had an adverse ecological effect on White Oak Creek. For example, the influence of ORNL is reflected in the fact that benthic macroinvertebrate populations are less diverse downstream of the site than upstream (DOE 2000f).

There are three Aquatic Reference Areas and one Reference Area in the ORNL area: Aquatic Reference Areas 3, 4, and 5, and Reference Area 28. Reference Areas are areas that are representative of the communities of the southern Appalachian region or that possess unique biotic features. Aquatic Reference Area 3, Northwest Tributary, is a second-order, frequently intermittent stream that flows along the wooded base of Haw Ridge, but with mowed fields, parking lots, and experimental ponds on the opposite bank. Aquatic Reference Area 4, First Creek, and Aquatic Reference Area 5, Fifth Creek, are first-order, spring-fed streams that flow out of Chestnut Ridge. Each area has rich benthic fauna, but is somewhat more limited with regard to the number of fish species present. Reference Area 28, Spring Pond, is a small spring-fed pond with unusually clear water for ponds on ORR; it is dominated by Nutall’s waterweed (*Elodea nuttallii*) (DOE 2000f).

3.4.6.4 Threatened and Endangered Species

Forty-two federal and state-listed threatened, endangered, and other special status species have been found on ORR (**Table 3–42**); additional species that occur near the site may also be present (ORNL 2004). The gray bat (*Myotic grisencens*) (endangered) and bald eagle (threatened, but proposed to be delisted) are the only federally-listed threatened or endangered species observed on or near ORR and ORNL. The bald eagle has been seen on Melton Hill and Watts Bar Lakes. A dead gray bat was found several years ago at Y-12. The Indiana bat (endangered) has not been reported on the site (DOE 2000f). State-listed threatened or endangered species observed on ORR include 12 plant species, the peregrine falcon, and gray bat.

Table 3–42 Endangered, Threatened, and Special Status Species of the Oak Ridge Reservation

Common Name	***Scientific Name***	***Status* [a]**	
		Federal	***State***
Plants			
American ginseng	*Panax quinquefolius*		Special Concern-CE
Appalachian bugbane	*Cimicifuga rubifolia*	Special Concern [b]	Threatened
Branching whitlow-grass	*Draba ramosissima*		Special Concern
Butternut	*Juglans cinerea*	Special Concern [b]	Threatened
Canada lily	*Lilium canadense*		Threatened
Fen orchid	*Liparis loeselii*		Endangered
Goldenseal	*Hydrastis canadensis*		Special Concern-CE
Hairy sharp-scaled sedge [c]	*Carex oxylepis var. pubescens*		Special Concern
Heavy sedge	*Carex gravida*		Special Concern
Large-tooth aspen	*Populus grandidentata*		Special Concern
Michigan lily [d]	*Lilium michiganense*		Threatened
Mountain witch-alder	*Fothergilla major*		Threatened
Northern bush-honeysuckle	*Dievilla lonicera*		Threatened
Northern white cedar	*Thuja occidentalis*		Special Concern
Nuttall's waterweed	*Elodea nuttallii*		Special Concern
Pink lady's-slipper	*Cypripedium acaule*		Endangered-CE
Pursh's wild-petunia	*Ruellia purshiana*		Special Concern
River bulrush	*Scirpus fluviatilis*		Special Concern
Shining ladies'-tresses	*Spiranthes lucida*		Threatened
Small-headed rush	*Juncus brachycephalus*		Special Concern
Spreading false-foxglove	*Aureolaria patula*	Special Concern [b]	Threatened
Tall larkspur	*Delphinium exaltatum*	Special Concern [b]	Endangered
Three-parted violet	*Viola tripartita var. tripartita*		Special Concern
Tubercled rein-orchid	*Platanthera flava var. herbiola*		Threatened
Fish			
Tennessee dace	*Phoxinus tennesseensis*		In Need of Management
Amphibians			
Four-toed salamander	*Hemidactylium scutatum*		In Need of Management
Birds			
Anhinga	*Anhinga anhinga*		In Need of Management
Bald eagle [e]	*Haliaeetus leucochphalus*	Threatened	In Need of Management
Cerulean warbler	*Dendroica cerulean*		In Need of Management
Golden-winged warbler	*Vermivora chrysophtea*		In Need of Management
Great egret	*Casmerodius alba*		In Need of Management
Little blue heron	*Egretta caerulea*		In Need of Management
Loggerhead shrike	*Lanius ludovicianus*		In Need of Management

Common Name	***Scientific Name***	***Status*** [a]	
		Federal	***State***
Northern harrier	*Circus cyaneus*		In Need of Management
Olive-sided flycatcher	*Contopus borealis*		In Need of Management
Peregrine falcon	*Falco peregrinus*		Endangered
Sharp-shinned hawk	*Accipiter striatus*		In Need of Management
Snowy egret	*Egretta thula*		In Need of Management
Yellow-bellied sapsucker	*Sphyrapicus varius*		In Need of Management
Mammals			
Gray bat	*Myotic grisenscens*	Endangered	Endangered
Southeastern shrew	*Sorex longirostris*		In Need of Management

[a] Status: CE = Status due to commercial exploitation.
[b] Special Concern was listed under the formerly used Federal C2 candidate designation. More information needed to determine status.
[c] Has not been relocated during recent surveys.
[d] Believed to have been extirpated from ORR by the impoundment at Melton Hill.
[e] Proposed for delisting.
Source: ORNL 2004.

No federally-listed endangered or threatened species (or critical habitat) are known to regularly occur in Melton Valley in the vicinity of ORNL. However, the bald eagle (federally-threatened) and the peregrine falcon (state endangered) are uncommon visitors to the vicinity. While some State-listed endangered or threatened species of wildlife may occasionally visit the vicinity, no suitable breeding habitat is present, and no such animal species are known to regularly occur there. Of species listed by the state as in need of management, the southeastern shrew (*Sorex longirostris*), sharp-shinned hawk (*Accipiter striatus*), and the yellow-bellied sapsucker (*Sphyrapicus varius*) are known to be present in Melton Valley. Other animal species listed by the state as in need of management that may be found in wetlands in Melton Valley are the northern harrier, the little blue heron (*Egretta caerulea*), the great egret, and the snowy egret (*Egretta thula*) (DOE 1996a).

Some state-listed plants are known to occur in Melton Valley. The Pink lady's slipper (*Cypripedium acaule*) (state endangered) and ginseng (special concern) grow in the valley. A small population of Canada lily (*Lilium canadense*) (state threatened) is also found in the area. River bulrush (*Scirpus fluviatilis*) (state special concern) has also been reported from Melton Valley (DOE 1996a).

No threatened, endangered, or sensitive plant or animal species have been recorded at or in the vicinity of REDC and HFIR. Further, there is no potential habitat for such species confirmed in close proximity to the area (DOE 2000f).

3.4.7 Cultural Resources

3.4.7.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written record. More than 20 cultural resources surveys have been conducted at ORR. About 90 percent of ORR has received at least some preliminary walkover or archival-level study, but less than 5 percent has been intensively surveyed. Most cultural resource studies have occurred along the Clinch River and adjacent tributaries. Prehistoric sites recorded at ORR include villages, potential burial mounds, camps, quarries, a chipping station, limited activity locations, and shell scatters. More than 45 prehistoric sites have been recorded at ORR to date. At least 13 prehistoric sites are considered potentially eligible for the National Registry of Historic Places, but most of these sites have not yet been evaluated. Additional prehistoric sites may be anticipated in the unsurveyed portions of ORR. In 1994, a Programmatic Agreement concerning the management of historic and cultural properties at ORR was executed among the DOE Oak Ridge Operations Office, the Tennessee State Historic Preservation Officer, and the Advisory Council on Historic Preservation. This agreement was executed to satisfy DOE's responsibilities regarding Sections 106 and 110 of the National Historic Preservation Act, and resulted in DOE preparing a *Cultural Resources Management Plan* for ORR. No prehistoric properties have been located within or immediately adjacent to ORNL's REDC and HFIR (DOE 2000f).

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age. Paleontological remains consist of fossils and their associated geological information. The majority of geological units with surface exposures at ORR contain paleontological materials. Paleontological materials consist primarily of invertebrate remains, and these have relatively low research potential. Paleontological resources at ORNL would not be expected to differ from those found elsewhere on ORR.

3.4.7.2 Historic Resources

Several historic resource surveys have been conducted at ORR. Historic resources identified at ORR include both archaeological remains and standing structures. Documented log, wood frame, or fieldstone structures include cabins, barns, churches, gravehouses, springhouses, storage sheds, smokehouses, log cribs, privies, henhouses, and garages. Archaeological remains consist primarily of foundations, roads, and trash scatters. A total of 32 cemeteries are located within the present boundaries of ORR. More than 240 historic resources have been recorded at ORR, and 38 of those sites may be considered potentially eligible for listing on the National Registry of Historic Places. Freel's Cabin and two church structures, George Jones Memorial Baptist Church and the New Bethel Baptist Church, are listed on the National Registry. These structures date from before the establishment of the Manhattan Project. National Registry sites associated with the Manhattan Project include the Graphite Reactor at ORNL, listed on the National Registry of Historic Places as a National Historic Landmark, and three traffic checkpoints, Bear Creek Road, Bethel Valley Road, and Oak Ridge Turnpike Checking Stations. Many other buildings and facilities at ORR are associated with the Manhattan Project and are eligible for the National Registry. Historic building surveys have been completed for ORNL (DOE 2000f).

A survey was conducted in 1993 to identify properties at ORNL that are included or are eligible for inclusion in the National Register of Historic Places. Eligible properties include the ORNL Historic District in the ORNL East Support Area, the Molten Salt Reactor Experiment Facility, (previously known as the Aircraft Reactor Experiment Building), the Tower Shielding Facility, and White Oak Lake and Dam. Of these structures, the Molten Salt Reactor Experiment Facility is the closest eligible property to REDC and HFIR. It is located about 0.4 kilometers (0.25 miles) to the north (DOE 2000f).

3.4.7.3 Traditional Cultural Properties

Resources that may be sensitive to American Indian groups include remains of prehistoric and historic villages, ceremonial lodges, cemeteries, burials, and traditional plant gathering areas. Apart from prehistoric archaeological sites, to date no American Indian resources have been identified at ORR. No American Indian sacred sites or cultural items have been found within or immediately adjacent to REDC and HFIR (DOE 2000f).

3.4.8 Socioeconomics

Statistics for employment, the regional economy, population, housing, and local transportation are presented for the region of influence, a 4-county area in which 87.7 percent of all ORR employees reside (**Table 3–43**). In 2003, ORR employed 12,856 persons.

Table 3–43 Distribution of Employees by Place of Residence in the Oak Ridge Reservation Region of Influence, 2003

County	*Number of Employees*	*Total Site Employment (percent)*
Anderson	3,539	27.5
Knox	4,834	37.6
Loudon	684	5.3
Roane	2,215	17.2
Region of influence total	11,272	87.7

Source: DOE 2004e.

3.4.8.1 Regional Economic Characteristics

Between 2000 and 2003, the civilian labor force in the region of influence increased by 5.7 percent to the 2003 level of 296,890. In 2003, the unemployment rate in the ORR region of influence (4.4 percent) was slightly lower than the state of Tennessee unemployment rate of 5.8 percent (TN DOL and WD 2005).

In 2003, the trade, utilities, and transportation sector represented the largest portion (21 percent) of the socioeconomic region of influence labor force, followed by Government (15.3 percent), and professional and business services (15 percent). The totals for these employment sectors in Tennessee were 22.1 percent, 15.1 percent, and 11.1 percent, respectively (TN DOL and WD 2005).

3.4.8.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population and income information is included in **Table 3–44**. Of the 4 counties in the region of influence, Loudon County grew by the largest percentage (20 percent) over the last decade from 1990 to 2000. Anderson County experienced the smallest growth over the same period (4.3 percent). Persons self-designated as minority individuals comprise 10.0 percent of the total region of influence population. This minority population is composed largely of Black or African American residents (6.9 percent). People who self-designated as Hispanic represent 1.3 percent of the total region of influence population.

Income information for the ORR region of influence is included in **Table 3–45**. Loudon County has the highest median household income of the 4 counties in the region of influence ($40,401) and the lowest percent of persons (10.0 percent) living below the poverty line. Roane County has the lowest median household income ($33,226) and the largest number of individuals (13.9 percent) living below the poverty line. The average median household income in the four counties is comparable to the median household income of the state of Tennessee ($36,360) during this same time period.

3.4.8.3 Housing

Table 3–46 lists the total number of occupied housing units and vacancy rates in the region of influence. In 2000, of the total 244,536 housing units in the region of influence, 92 percent were occupied and 8 percent were vacant. Roane County had the greatest vacancy rate of the 4 counties at 9 percent and Loudoun County had the smallest vacancy rate at 8 percent. Home values were the most expensive in Knox County, with a median housing value of $98,500, and the least expensive in Roane County at $86,500.

Table 3–44 Demographic Profile of the Population in the Oak Ridge Reservation Region of Influence

	Anderson	*Knox*	*Loudon*	*Roane*	*Region of Influence*
Population					
2000 population	71,330	382,032	39,086	51,910	544,358
1990 population	68,250	335,749	31,255	47,227	482,481
Percent change from 1990 to 2000	+4.3	+12.1	+20.0	+9.0	+11.4
Race (2000) (percent of total population)					
White	93.4	88.1	95.9	95.2	90.0
Black or African American	3.9	8.6	1.1	2.7	6.9
American Indian and Alaska Native	0.3	0.3	0.3	0.2	0.3
Asian	0.8	1.3	0.2	0.4	1.1
Native Hawaiian & Other Pacific Islander	0.0	0.0	0.0	0.0	0.0
Some other race	0.4	0.5	1.4	0.2	0.5
Two or more races	1.2	1.2	1.0	1.2	1.2
Percent minority	6.6	11.9	4.1	4.8	10.0
Ethnicity (2000)					
Hispanic or Latino	787	4,803	894	359	6,843
Percent of total population	1.1	1.3	2.3	0.7	1.3

Source: DOC 2005.

Table 3–45 Income Information for the Oak Ridge Reservation Region of Influence

	Anderson	*Knox*	*Loudon*	*Roane*	*Tennessee*
Median household income 2000 (dollars)	35,483	37,454	40,401	33,226	36,360
Percent of persons below poverty line (2000)	13.1	12.6	10.0	13.9	13.5

Source: DOC 2005.

Table 3–46 Housing in the Oak Ridge Reservation Region of Influence

	Anderson	*Knox*	*Loudon*	*Roane*	*Region of Influence*
Housing (2000)					
Total units	32,451	171,439	17,277	23,369	244,536
Occupied housing units	29,780	157,872	15,944	21,200	224,796
Vacant units	2,671	13,567	1,333	2,169	19,740
Vacancy rate (percent)	8.2	7.9	7.7	9.3	8.1
Median value (dollars)	87,500	98,500	97,300	86,500	Not available

Source: DOC 2005.

3.4.8.4 Local Transportation

Vehicles access ORR via 3 State Routes. State Route 95 forms an interchange with Interstate 40 and enters the reservation from the south. State Route 58 enters the reservation from the west and passes just south of the ETTP. State Route 162 extends from Interstate 75 and Interstate 40 just west of Knoxville, and provides eastern access to ORR (Figure 3–20).

Within ORR, several routes are used to transfer traffic from the state routes to the main plant areas. Bear Creek Road, north of Y-12, flows in an east-west direction and connects Scarboro Road on the east end of the plant with State Road 95 and State Road 58. Bear Creek Road has restricted access around Y-12, and is not a public thoroughfare. Bethel Valley Road, a public roadway, provides access to ORNL, and extends from the east end of ORR at State Road 62 to the west end at State Route 95. Access to the REDC and HFIR is provided by secondary roads with controlled access: First Street, which runs north-south from Bethel Valley Road, and Melton Valley Road, which runs east-west and passes the entry road (DOE 2000f).

Two main branches provide rail service for ORR. The CSX Transportation line at Elza (just east of Oak Ridge) serves Y-12 and the Office of Science and Technological Information in east Oak Ridge. The Norfolk Southern main line from Blair provides easy access to the ETTP. The Clinch River has a barge facility located on the west end of ORR near the ETTP that is occasionally used to receive shipments that are too large or too heavy to be transported by rail or truck. McGhee Tyson Airport, 37 kilometers (23 miles) from ORR, is the nearest airport serving the region, with major carriers providing passenger and cargo service. A private airport, Atomic Airport, Inc., is the closest air transportation facility to Oak Ridge. Oak Ridge has a part-time public transportation system (DOE 2000f).

3.4.9 Human Health Risk

3.4.9.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of ORNL are shown in **Table 3–47**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to ORNL and ORR operations.

Table 3–47 Sources of Radiation Exposure to Individuals in the Oak Ridge National Laboratory Vicinity Unrelated to Oak Ridge National Laboratory and Oak Ridge Reservation Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural background radiation [a]	
Cosmic radiation	36
External terrestrial radiation	51
Internal terrestrial radiation	39
Radon in homes (inhaled)	200
Other background radiation [b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	Less than 1
Air travel	1
Consumer and industrial products	10
Total	390

[a] DOE 2000f.
[b] NCRP 1987.
Note: Value of radon is an average for the United States.

Releases of radionuclides to the environment from ORR operations provide another source of radiation exposure to individuals in the vicinity of ORNL. Types and quantities of radionuclides released from ORR during normal operations in 2003 are listed in the *Oak Ridge Reservation Annual Site Environmental Report* for 2003 (Hughes et al. 2004). The doses to the public resulting from these releases are presented in **Table 3–48**. These doses fall within radiological limits per DOE Order 5400.5, and are much lower than those of background radiation.

Table 3–48 Radiation Doses to the Public from Oak Ridge Reservation Normal Operations in 2003 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed individual (millirem)	10	0.24	4	2 [b]	100	2.24 [c]
Population within 80 kilometers (50 miles) (person-rem) [d]	None	10.8	None	20	100	30.8
Average individual within 80 kilometers (50 miles) (millirem) [e]	None	0.01	None	0.02	None	0.03

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem-per-year limit from airborne emissions is required by the Clean Air Act, and the 4-millirem-per-year limit is required by the Safe Drinking Water Act. For this EIS, the 4-millirem-per-year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR Part 834, as published in 58 FR 16268. If the potential total dose exceeds the 100-person-rem value, it is required that the contractor operating the facility notify DOE.

[b] These doses are mainly from drinking water (approximately 0.35 millirem) and eating fish from the Clinch River section of Poplar Creek.

[c] This total dose includes a conservative value of 1 millirem per year from direct radiation exposure to a cesium field near the Clinch River.

[d] Based on a population of about 1,040,041 in 2003.

[e] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.

Source: Hughes et al. 2004.

Using a risk estimator of 6.0×10^{-4} LCF per rem (Appendix C of this EIS), the risk of an LCF to the maximally exposed member of the public due to radiological releases from ORR operations in 2003 is estimated to be 1.34×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of ORR operations is approximately one in 746,000, as it takes several to many years from the time of radiation exposure for a cancer to manifest itself.

According to the same risk estimator, 1.74×10^{-5} excess LCFs are projected in the population living within 80 kilometers (50 miles) of ORR from normal operations in 2003. To place this number in perspective, it may be compared with the number of cancer fatalities expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of cancer fatalities expected during 2003 from all causes in the population living within 80 kilometers (50 miles) of ORR would be 2,080, which is much higher than the LCFs estimated from ORR operations in 2003.

ORR workers receive the same doses as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at ORR from operations in 2003 are presented in **Table 3–49**. These doses fall within the radiological regulatory limits of 10 CFR Part 835. According to a risk estimator 6.0×10^{-4} LCF per person-rem among workers (Appendix C of this EIS), the number of projected LCFs among ORR workers from normal operations in 2003 is 0.07.

Table 3–49 Radiation Doses to Workers from Oak Ridge National Laboratory Normal Operations in 2003 (total effective dose equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average radiation worker (millirem)	None [b]	48.5
Total workers (person-rem) [c]	None	116

[a] The radiological limit for an individual worker is 5,000 millirem per year. However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established the Administrative Control Level of 2,000 millirem per year; the site must make reasonable attempts to maintain individual worker doses below this level.

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

[c] Based on a worker population of 2,389 with measurable doses in 2003.

Source: DOE 2003e.

A more detailed presentation on the radiation environment, including background exposures and radiological releases and doses, is presented in the *Oak Ridge Reservation Annual Site Environmental Report for 2003* (Hughes et al. 2004). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and offsite) are also presented in the report.

3.4.9.2 Chemical Environment

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

Carcinogenic Effects—Health effects in this case are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen. This could be incremental or excess individual lifetime cancer risk.

Noncarcinogenic Effects—Health effects in this case are determined by the ratio between the calculated or measured concentration of the chemical in the air and the reference concentration or dose. This ratio is known as the Hazard Quotient. Hazard Quotients for noncarcinogens are summed to obtain the Hazard Index. If the Hazard Index is less than 1, no adverse health effects would be expected.

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

Baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed from normal operations at ORNL. These concentrations are in compliance with applicable guidelines and regulations. Information on estimating the health impacts of hazardous chemicals is presented in Appendix C of this EIS.

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

3.4.9.3 Health Effects Studies

Two epidemiologic studies were conducted to determine whether ORR and ORNL contributed to any excess cancers in communities surrounding the facility. One study found no excess cancer mortality in the population living in counties surrounding ORR and ORNL, when compared to the control populations in other nearby counties and elsewhere in the United States. The other study found slight excess cancer incidences of several types in the counties near ORR and ORNL, but less than the number of expected cancers incidences for other types of cancers. Excess cancer mortalities have been reported and linked to specific job categories, age, and length of employment, as well as to the levels of exposure to radiation (DOE 2000f).

A pilot study on mercury contamination conducted by the Tennessee Department of Health and Environment showed no difference in urine or hair mercury levels between individuals with potentially high mercury exposures compared to those with little potential for exposure. However, soil analysis showed that the mercury in soil is inorganic, which decreases the likelihood of a toxic accumulation in living tissue (bioaccumulation) and adverse health effects. Studies are continuing on the long-term effects of exposure to mercury and other hazardous chemicals.

For a more detailed description of the epidemiologic studies, refer to Appendix M.4.6 of the *Storage and Disposition PEIS* (DOE 1996d).

3.4.9.4 Accident History

There have been no safety-related accidents causing significant injury or harm to workers, or posing any sort of harm to the offsite public, at HFIR or REDC during their operational lifetimes (DOE 2000f).

In addition, there have been no accidents with a measurable impact on offsite population during nearly 50 years of Y-12 operations at ORR. The most noteworthy accident in Y-12's history was a 1958 criticality accident, which resulted in temporary radiation sickness for a few ORR employees. In 1989, there was a one-time accidental release of xylene into the ORR sewer system with no offsite impacts. Accidental releases of anhydrous hydrogen fluoride occurred in 1986, 1988, and 1992, with little onsite and negligible offsite impact. The hydrogen fluoride system where these accidents occurred is being modified to reduce the probability of future releases and to minimize the potential consequences if a release should occur.

3.4.9.5 Emergency Preparedness and Security

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

DOE has overall responsibility for emergency planning and operations at ORR. However, DOE has delegated primary authority for event response to the operating contractor. Although the contractor's primary response responsibility is onsite, the contractor does provide offsite assistance, if requested, under the terms of existing mutual aid agreements. If a hazardous materials event with offsite impacts occurs at a DOE facility, elected officials and local governments are responsible for the State's response efforts. The Tennessee Emergency Management Agency is the established agency responsible for coordinating State emergency services. When a hazardous materials event occurring at DOE facilities is beyond the capability of local government and assistance is requested, the Tennessee Emergency Management Agency Director may direct State agencies to provide assistance to the local governments. To accomplish this task and ensure prompt initiation of emergency response actions, the Director may cause the state Emergency Operations Center and Field Coordination Center to be activated. City or county officials may activate local Emergency Operations Centers in accordance with existing emergency plans.

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 May 1997.

3.4.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. As discussed in Appendix B of this EIS, minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income. In the case of ORNL, the potentially affected area includes parts of Tennessee, North Carolina, and Kentucky.

Figure 3–25 shows ORNL, REDC, HFIR, and the region of potential radiological impact. As shown in the figure, areas potentially at radiological risk from the current missions performed at HFIR and REDC include the cities of Knoxville, Oak Ridge, and Sarboro in eastern Tennessee. Thirty counties are included or partially included in the potentially affected area, including 25 counties in Tennessee (see **Figure 3–26**): Anderson, Bledsoe, Blount, Bradley, Campbell, Claiborne, Cumberland, Fentress, Grainger, Jefferson, Knox, Loudon, McMinn, Meigs, Monroe, Morgan, Overton, Pickett, Polk, Putnam, Rhea, Roane, Scott, Sevier, and Union. The remaining five counties, partially included in the potentially affected area, include two counties in Kentucky and three counties in North Carolina: McCreary and Whitley, and Cherokee, Graham and Swain, respectively. **Table 3–50** provides the total minority composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, approximately 7.3 percent of the county residents identified themselves as members of a minority group. Black or African American and Hispanics comprised more than 68 percent of the minority population. The percentage of minority populations residing in the States of Tennessee, North Carolina, and Kentucky were 20.8 percent, 29.8 percent, and 10.7 percent, respectively.

Table 3–50 Populations in Potentially Affected Counties Surrounding Oak Ridge National Laboratory in 2000

Population Group	*Population*	*Percentage of Total*
Minority	102,482	7.3
Hispanic	17,198	1.2
Black or African American	52,396	3.7
American Indian and Alaska Native	8,060	0.6
Asian	8,639	0.6
Native Hawaiian and Pacific Islander	172	0.0
Two or more races	15,216	1.1
Some other race	801	0.1
White	1,305,083	92.7
Total	1,407,565	100.0

Source: DOC 2005.

The percentage of population for whom poverty status was determined in potentially affected counties in 2000 was approximately 16.2 percent. In 2000, nearly 13.5 percent of the total population of Tennessee reported incomes less than the poverty threshold. The percent of population for whom poverty status was determined reporting incomes below the poverty threshold in Kentucky and North Carolina were 15.8 percent and 12.3 percent, respectively. In terms of percentages in 2000, minority populations in the 30 potentially impacted counties were lower than either of the Kentucky, North Carolina, and Tennessee State percentages, while low-income resident populations in potentially impacted counties were higher than the state percentages.

3.4.11 Waste Management and Pollution Prevention

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all Federal and state statutes and DOE Orders. Disposal and management of previously generated ORR waste, known as legacy waste, is the responsibility of DOE's environmental management contractor, which is working to repackage, remove, and dispose of the existing legacy waste and newly generated wastes. The strategy is to dispose of current inventories of all waste types and close many of the existing storage facilities. The long-range strategy is to rely on a combination of onsite and offsite facilities to dispose of newly generated waste.

3.4.11.1 Waste Inventories and Activities

ORR manages the following types of waste: transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Waste generation rates and the inventory of stored waste from activities at ORR are provided in **Table 3–51**. Waste generation rates specifically for HFIR and REDC activities are provided in **Table 3–52**. ORR waste management capabilities are summarized in **Table 3–53**. More detailed descriptions of the waste management system capabilities at ORR are included in the *Storage and Disposition PEIS* (DOE 1996d).

Table 3–51 2003 Waste Generation Rates and Inventories at Oak Ridge Reservation and Oak Ridge National Laboratory

Waste Type	*Generation Rates (cubic meters per year)*		*Inventory (cubic meters)*	
	ORR [a]	*ORNL*	*ORR* [a]	*ORNL*
Transuranic	3	3	2,450	2,450
Low-level radioactive	2,028	64	20,000 [b]	5,214
Mixed low-level radioactive [c]	154	1	26,000	3,000
Hazardous	36,000 kilograms per year	20,000 kilograms per year	1,689	–
Nonhazardous				
Liquid	269,000	60,600	Not applicable [d]	Not applicable [d]
Solid	3,661 metric tons per year	1,039 metric tons per year	Not applicable [d]	Not applicable [d]

ORR = Oak Ridge Reservation, ORNL = Oak Ridge National Laboratory.

[a] Represents entire waste generated or managed at ORR, including ORNL.

[b] Excludes waste from DOE environmental restoration activities.

[c] Mixed liquid low-level radioactive waste is reported as low-level radioactive waste. Certain contents are mixed-permit-by-rule.

[d] Generally, this waste is not held in long-term storage.

Note: To convert from cubic meters to cubic yards, multiply by 1.308. To convert from kilograms to pounds, multiply by 2.2. To convert from metric tons to kilograms multiply by 1,000.

Source: DOE 2004d, 2000f.

Table 3–52 Waste Generation Rates at the Radiochemical Engineering Development Center and High Flux Isotope Reactor

Waste Type	*REDC (cubic meters per year)*	*HFIR (cubic meters per year)*
Transuranic		
Contact-handled	16	0
Remotely handled	9	0
Low-level radioactive		
Liquid	52	0
Solid	65	48
Process waste	0	19,700
Mixed low-level radioactive	less than 1	0
Hazardous	13,200 kilograms	0
Nonhazardous		
Liquid	96,700	138,200
Sanitary wastewater	3,130	7,310
Solid	294	0

REDC = Radiochemcial Engineering Development Center, HFIR = High Flux Isotope Reactor.

Note: To convert from cubic meters to cubic yards, multiply by 1.308. To convert from kilograms to pounds, multiply by 2.2.

Source: DOE 2000f.

Table 3–53 Waste Management Capabilities at Oak Ridge Reservation

Facility Name/ Description	*Capacity*	*Status*	*Applicable Waste Type*					
			TRU	*Mixed TRU*	*LLW*	*Mixed LLW*	*Haz*	*Non-Haz*
Y-12: Treatment Facility (cubic meters per year except as otherwise specified)								
West End Treatment Facility (Building 9616-7)	10,221	Online			X	X	X	X
Central Pollution Control Facility	10,200	Online			X	X	X	
Acid Neutralization and Recovery Facility (Building 9818)	2,100	Online				X		
Uranium Chip Oxidizer Facility	Classified	Online			X			
Cyanide Treatment Facility	185	Online				X	X	
Plating Rinsewater Treatment Facility (Building 9623)	30,283	Online					X	X
Steam Plant Wastewater Facility	177,914	Online					X	X
Oak Ridge Sewage Treatment Plant (offsite) (cubic meters per day)	5,300	Online						X
Baler Facility (Building 9720-25)	41,700	Online						X
Waste Coolant Processing Facility (Building 9983-78)	1,363	Online			X	X		
Organic Handling Unit (Building 9815) (gallons per day)	500	Online			X	X		
Uranium Recovery Operations (Building 9212)	2,100	Online				X		
Y-12: Storage Facility (cubic meters)								
Aboveground Storage Pads (Buildings 9830-2 through 7)	7,130	Online			X			
Container Storage Areas (Buildings 9206 and 9212)	30	Online			X	X		
Container Storage Facility (Building 9720-12)	123	Online			X	X		
Contaminated Scrap Metal Storage Yard	4,740	Online			X			X
Cyanide Treatment Facility (Building 9201-5N)	8	Online				X	X	
Liquid Organic Waste Storage Facility (Building 9720-45, OD-10)	198	Online				X	X	
Liquid Storage Facility (Building 9416-35)	416	Online				X	X	
PCB and RCRA Hazardous Drum Storage Facility (Building 9720-9)	1,404	Online				X	X	
RCRA and PCB Container Storage Area (Building 9720-58)	1,130	Online				X	X	
RCRA Staging and Storage Facility (Building 9720-31)	170	Online				X	X	
RCRA Storage Facility (Building 9811-1, OD-8)	723	Online			X	X	X	
Waste Oil/Solvent Storage Facility (Building 9811-8, OD-9)	790	Online			X	X	X	

Facility Name/ Description	**Capacity**	**Status**	***Applicable Waste Type***					
			TRU	***Mixed TRU***	***LLW***	***Mixed LLW***	***Haz***	***Non-Haz***
Tank Farm (Building 9212)	151	Planned				X		
Container Storage Area/Production Waste Storage Facility (Building 9720-32)	2,335	Online					X	
Low Level Waste Storage Pad (Building 9720-44)	Not specified	Online			X			
Classified Waste (Container) Storage Area (Building 9720-59)	1,090	Online			X	X		
Organic Handling Unit (Building 9815)	8	Online					X	
Depleted Uranium Storage Vaults I and II (Building 9825-1 and 2 oxide vaults and Building 9809)	1,020	Online			X			
West Tank Farm	10,600	Online			X	X		
Y-12: Disposal Facility (cubic meters)								
Industrial and Sanitary Landfill V [a]	1,100,000 [a]	Online						X
Construction Demolition Landfill VI [a]	119,000 [a]	Online						X
ORNL: Treatment Facility (cubic meters per year)								
Process Waste Treatment Plant	280,000	Online			X			
Melton Valley Low-Level Waste Immobilization Facility and Liquid Low-Level Waste Evaporation Facility	110,000	Online			X			
Waste Compaction Facility (Building 7831)	11,300	Online			X			
Sanitary Waste Water Treatment Facility (design capacity)	414,000	Online						X
Nonradiological Wastewater Treatment Facility	1,510,000	Online					X	
ORNL: Storage Facility (cubic meters)								
Buildings 7826, 7834, 7842, 7878, 7879, and 7934	1,760	Online	X	X				
Bunker and Earthen Trenches (Solid Waste Storage Area 5N Building 7855 and Solid Waste Storage Area 7 Building 7883)	1085	Online	X		X			
Liquid Low-Level Radioactive Waste Systems	3,230	Online			X			
Onsite tanks	7,850	Online			X			
Buildings 7507W, 7654, 7823, and Tank 7830a	393	Online Tank 7830a (standby)				X		
Hazardous Waste Storage Facility (Buildings 7507 and 7652 and Buildings 7651 and 7653)	130	Online					X	
Interim Waste Management Facility	5,365 (1,730) [b]	Online			X			

Facility Name/ Description	***Capacity***	***Status***	***Applicable Waste Type***					
			TRU	***Mixed TRU***	***LLW***	***Mixed LLW***	***Haz***	***Non-Haz***
ORNL: Disposal Facility (cubic meters)								
Shared Landfills V and VI	(a)	Online						X
TRU Waste Treatment Facility (low-temperature drying) (five year capacity)	4,050	Planned	X	X	X	X		
ETTP: Treatment Facility (cubic meters per year)								
TSCA Incinerator (Building K-1435)	15,700	Online			X	X		
Central Neutralization Facility (permitted operating capacity)	221,000	Online				X		
Sewage Treatment Plant (Building K-1203)	829,000	Online						X
ETTP: Storage Facility (cubic meters)								
Building K-25, outside areas, K-1313 A and K-33	44,000	Online			X			
Current permitted container (solids/sludges/liquid wastes) and tank (liquids) storage capacity	97,000	Online				X		
Total current permitted waste pile unit storage capacity	120,000	Online				X		
Stockpiled at scrap yard	Not specified	Online						X
ETTP: Disposal Facility (cubic meters)								
Shared Landfills V and VI	(a)	Online						X

TRU = transuranic, LLW = low-level waste; HAZ = hazardous; PCB = polychlorinated biphenyl; RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act; ETTP = East Tennessee Technology Park.

[a] Industrial and Sanitary Landfill V and Construction Demolition Landfill VI serve all three sites for disposal of solid nonhazardous waste. Their disposal capacities are 1,100,000 cubic meters and 119,000 cubic meters, respectively.

[b] Available as of June 1999.

Note: To convert from cubic meters to cubic yards, multiply by 1.308.

Source: DOE 2000f.

3.4.11.2 Transuranic Waste

Although ORNL is the only current generator of transuranic waste, other sites at ORR have produced small quantities of transuranic waste in the past and are likely to do so again during decontamination and decommissioning activities. Transuranic waste includes contact-handled transuranic and remotely handled transuranic. Normally, contact-handled transuranic waste consists primarily of miscellaneous waste from glovebox operations (e.g., paper, glassware, plastic, shoe covers, and wipes), discarded HEPA filters, and discarded equipment (e.g., gloveboxes and processing equipment). Contact-handled transuranic waste has a surface dose rate that does not exceed 200 millirem per hour. Generally, contact-handled transuranic waste is contained within polyethylene bags inside 208-liter (55-gallon) stainless steel drums. Metal paint cans, plastic buckets, and other similar containers are also used to package waste inside the drums.

Remotely handled transuranic wastes are usually contained in concrete casks (1.4 meters [4.5 feet] in diameter by 2.3 meters [7.5 feet] high). The wall thicknesses of the casks are currently either 15 centimeters (6 inches) or 30.5 centimeters (12 inches) thick, depending on the radiation level of the contents. A large polyethylene bag is placed inside the cask for additional contamination control prior to use. Most remotely handled transuranic wastes inside the concrete casks are also contained inside polyethylene bags. Smaller waste packages such as 11-liter (2.9-gallon) plastic buckets, 3.7-liter (0.98-gallon) paint cans, and 18.9-liter (5.0-gallon) metal cans are packaged within the polyethylene bags. Fiber drums and carbon and steel drums have also been used to package waste inside the concrete casks. Intermediate-sized items that will not fit in the previously mentioned packages are generally placed in vinyl bags, then placed inside the lined waste casks. Large cask items may be placed directly in the casks.

As of January 1999, approximately 1,000 cubic meters (1,310 cubic yards) of contact-handled transuranic waste was in retrievable drum storage in the Bunker and Earthen Trenches. The amount of remotely handled transuranic waste was about 550 cubic meters (719 cubic yards) (64 FR 4079). Current activities center around certification of contact-handled waste, designing of a repackaging and certification facility for remote-handled wastes, and planning for shipment of transuranic waste to WIPP.

3.4.11.3 Low-Level Radioactive Waste

Solid low-level radioactive waste is compactible radioactive waste such as paper, plastic, cloth, glass, cardboard, filters, floor sweepings, styrofoam, clothing, ceiling tile, and miscellaneous radioactively contaminated trash. The waste may include up to 20 percent lightweight or non-smeltable metal items. The solid low-level radioactive waste normally generated at ORNL consists primarily of radioactively contaminated personnel protection equipment, paper debris, trapping media, and process equipment. The Interim Waste Management Facility at ORNL only accepts low-level radioactive waste generated at ORNL. However, the Interim Waste Management Facility is at two-thirds of capacity, and access to this facility for the proposed RPS nuclear production activities is not expected. Solid low-level radioactive waste is also being stored at the ETTP and Y-12 for future disposal. Contaminated scrap metal is stored above ground at the Scrap Metal Facility, the old salvage yard at Y-12, and at ORNL which is being managed by the DOE scrap metal program until further disposal methods are evaluated.

The basic low-level radioactive waste strategy is to:

1. Use the Interim Waste Management Facility for legacy waste until it is filled to capacity.

2. Stage low-level radioactive waste at all sites, with emphasis on storage at the ETTP until a disposal site is available.

3. Ship waste to the NTS, the Hanford Site, or a commercial disposal site as access is approved, and according to site-specific waste acceptance criteria.

3.4.11.4 Mixed Low-Level Radioactive Waste

RCRA mixed low-level radioactive waste is in storage at Y-12, ETTP, and ORNL. Because prolonged storage of these wastes exceeded the 1-year limit imposed by RCRA, ORR entered into a Federal Facility Compliance Agreement for RCRA Land Disposal Restriction wastes with EPA on June 12, 1992. This agreement was terminated with the issuance of the TDEC Commissioner's Order, effective October 1, 1995, which requires DOE to comply with the *Site Treatment Plan* prepared by ORR. The plan contains milestones and target dates for DOE to characterize and treat its inventory of mixed wastes at ORR. Sludges contaminated with low-level radioactivity are generated by settling and scrubbing operations, and in the past were stored in ponds at the ETTP.

Sludges have been removed from these ponds and a portion has been fixed in concrete at the Sludge Treatment Facility. The concreted sludges are being shipped offsite for disposal. The raw sludges are stored, pending further treatment.

The primary facility generator of liquid mixed waste is the Toxic Substances Control Act Incinerator from the wet scrubber blowdown. This waste is currently being treated at the Central Neutralization Facility, which provides pH adjustment and chemical precipitation. Treated effluents are discharged through an NPDES outfall. The contaminated sludges are stored as mixed waste at the ETTP.

The ETTP Toxic Substances Control Act Incinerator has a design capacity to incinerate 909 kilograms (2,000 pounds) per hour of mixed liquid waste and up to 455 kilograms (1,000 pounds) per hour of solids and sludge (91 kilograms [200 pounds] per hour maximum sludge content). The Toxic Substances Control Act Incinerator is capable of incineration of both Toxic Substances Control Act- and RCRA-mixed wastes. The Toxic Substances Control Act Incinerator capacity utilization for incinerable solids is limited to ORR wastes to support the completion of enforceable milestones required by the ORR *Site Treatment Plan*. Because of permit limits (Toxic Substances Control Act, RCRA, state of Tennessee), the incinerator is not running at full capacity.

The major type of mixed waste generated at ORNL is mixed waste oils. Mixed waste oils are generated when oils are removed from systems that have operated in radiation environments. Radiation levels in these oils are typically low (less than or equal to 10 millirem per hour). Generally, these wastes consist of vacuum pump oil, axle oil, refrigeration oil, mineral oil, or oil/water mixtures. The principal components of scintillation fluids are toluene and/or xylene, culture medium, and miscellaneous organics. Other mixed wastes generated at ORNL include organic wastes, carcinogenic wastes, mercury-contaminated solid waste, waste solvents, corrosives, poisons, and other process waste. Because of the diversity of the mixed waste generated at ORNL, quantities are usually small.

Radioactive wastes contaminated with polychlorinated biphenyl are being stored because of lack of treatment and disposal capacities. DOE and EPA signed a Federal Facility Compliance Agreement, effective December 16, 1996, to bring ETTP into compliance with Toxic Substances Control Act regulations for use, storage, and disposal of polychlorinated biphenyls. It also addressed the approximately 10,000 pieces of nonradioactive polychlorinated biphenyls-containing dielectric equipment used in the shutdown of diffusion plant operations.

3.4.11.5 Hazardous Waste

RCRA-regulated wastes are generated by ORR and ORNL in laboratory research, electroplating operations, painting operations, descaling, demineralizer regeneration, and photographic processes. Certain other wastes (e.g., spent photographic processing solutions) are processed onsite into a nonhazardous state. Those wastes that are safe to transport, and have been certified as having no radioactivity added, are shipped offsite to RCRA-permitted commercial treatment and disposal facilities. Small amounts of reactive chemical explosives that would be dangerous to transport offsite, such as aged picric acid, are processed onsite in the Chemical Detonation Facility at ORNL.

3.4.11.6 Nonhazardous Waste

Nonhazardous wastes are generated from numerous ORR and ORNL activities. For example, the steam plant produces nonhazardous sludge. Scrap metals are discarded from maintenance and renovation activities and are recycled when appropriate. Construction and demolition projects produce nonhazardous industrial wastes. Other nonhazardous wastes include paper, plastic, glass, can, cafeteria wastes, and general trash. All nonradioactive medical wastes are autoclaved to render them noninfectious and are sent to the Y-12 Sanitary Landfill. Remedial action projects also produce wastes requiring proper management. The state of Tennessee permitted landfill (Construction Demolition Landfill VI) receives nonhazardous industrial materials such as fly ash and construction debris. Asbestos and general refuse are managed in Industrial and Sanitary Landfill V located at Y-12.

3.4.11.7 Waste Minimization

The DOE Oak Ridge Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at ORR. This is accomplished by eliminating waste through source reduction or material substitution; recycling potential waste materials that cannot be minimized or eliminated; and treating waste generated to reduce its volume, toxicity, or mobility prior to storage or disposal. Implementing pollution prevention projects reduced the amount of waste generated at ORR in 1998 by approximately 64,900 cubic meters (84,000 cubic yards). Examples of pollution prevention projects completed in 1998 at the Oak Ridge Operations Office include reducing cleanup/stabilization of low-level radioactive waste by approximately 395 cubic meters (517 cubic yards), mixed low-level radioactive waste by approximately 119 cubic meters (156 cubic yards), and hazardous waste by approximately 83 metric tons (91 tons) by providing incentives in contracts for projects to turn over vacant and decontaminated buildings to the Oak Ridge Operations Office; reducing routine operations mixed low-level radioactive waste by approximately 693 cubic meters (906 cubic yards) by selling various scrap metals (including clean and contaminated carbon steel and copper) to an outside vendor for cleaning and recycling; and reducing transuranic waste generation by less than 1 cubic meter (1.3 cubic yards) per year by replacing three oil-lubricated vacuum pumps with dry pumps, which eliminated the transuranic-contaminated waste oil stream and associated waste (DOE 2000f).

3.4.11.8 *Waste Management PEIS* Records of Decision

Waste Management PEIS RODs affecting ORR and ORNL are shown in **Table 3–54** for the waste types analyzed in this *Consolidation EIS*. Decisions on the various waste types are being announced in a series of RODs that have been issued under the *Waste Management PEIS*. The initial transuranic waste ROD was issued on January 20, 1998 (63 FR 3629) with several subsequent amendments; the hazardous waste ROD was issued on August 5, 1998 (63 FR 41810); the high-level radioactive waste ROD was issued on August 12, 1999 (64 FR 46661); and the low-level radioactive waste and mixed low-level radioactive waste ROD was issued on February 18, 2000 (65 FR 10061). The transuranic waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare transuranic waste for disposal at WIPP. Each DOE site that has or will generate transuranic waste will, as needed, prepare and store its transuranic waste onsite until the waste is shipped to WIPP. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own nonwastewater hazardous waste onsite in existing facilities, where this is economically favorable. The high-level radioactive waste ROD states that immobilized high-level radioactive waste will be stored at the site of generation until transfer to a geologic repository. The low-level radioactive waste and mixed low-level radioactive waste ROD states that for the management of low-level radioactive waste, minimal treatment will be performed at all sites and disposal will continue, to the extent practicable, onsite at INL, LANL, ORR, and SRS. In addition, the Hanford Site and NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at the Hanford Site, INL, ORR, and SRS and disposed of at the Hanford Site and NTS. More detailed information concerning DOE's preferred alternatives for the future configuration of waste management facilities at ORR is presented in the *Waste Management PEIS* and the high-level radioactive waste, transuranic waste, hazardous waste, and low-level radioactive and mixed low-level radioactive waste RODs.

Table 3–54 *Waste Management PEIS* Records of Decision Affecting Oak Ridge Reservation and Oak Ridge National Laboratory

Waste Type	*Preferred Action*
High-level radioactive	ORR does not currently manage high-level radioactive waste. [a]
Transuranic and mixed transuranic	DOE has decided that ORR should prepare and store its transuranic waste onsite pending disposal at WIPP [b].
Low-level radioactive	DOE has decided to treat ORR liquid low-level radioactive waste onsite. [c] Separate from the *Waste Management PEIS*, DOE prefers offsite management of ORR solid low-level radioactive waste after temporary onsite storage.
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at ORR. [c] This includes the onsite treatment of ORR waste and could include treatment of some mixed low-level radioactive waste generated at other sites.
Hazardous	DOE has decided to use commercial and onsite ORR facilities for treatment of ORR nonwastewater hazardous waste. DOE will also continue to use onsite facilities for wastewater hazardous waste. [d]

[a] From the ROD for high-level radioactive waste (64 FR 46661).
[b] From the ROD for transuranic waste (63 FR 3629).
[c] From the ROD for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[d] From the ROD for hazardous waste (63 FR 41810).
Sources: DOE 2000f, 63 FR 3629, 63 FR 41810, 64 FR 46661, 65 FR 10061.

3.4.12 Environmental Restoration Program

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at ORR and ORNL. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

On November 21, 1989, EPA placed ORR on the National Priorities List, which identifies sites for possible long-term remedial action under CERCLA. DOE, EPA Region IV, and the TDEC completed a Federal Facility Agreement, effective January 1, 1992. This agreement coordinates ORR inactive site assessment and remedial actions. Portions of the Federal Facility Agreement are applicable to operating waste management systems. Existing actions are conducted under RCRA and applicable State laws that minimize duplication, expedite response actions, and achieve a comprehensive remediation of the site. More information on regulatory requirements for waste disposal is provided in Chapter 5 of this EIS.

CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

4.0 ENVIRONMENTAL CONSEQUENCES

The impact analyses in this chapter focus on those areas where the potential exists for effects on the environment. Each of the alternatives (the No Action, Consolidation, and Consolidation with Bridge Alternatives) is discussed separately in Sections 4.1, 4.2, and 4.3, respectively. The cumulative impacts associated with the alternatives are presented in Section 4.4. Potential mitigation measures are described in Section 4.5. Resource commitments, including unavoidable adverse environmental impacts, the relationship between short-term use of the environment and long-term productivity, and irreversible and irretrievable commitments of resources, are presented in Section 4.6. A detailed discussion of each alternative is given in Chapter 2 of this environmental impact statement (EIS); a summary comparison of the environmental effects among alternatives is presented in Section 2.5.

In this *Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)*, the impact analyses assess all disciplines where the potential exists for effects on the environment, as follows:

- Land resources
- Site infrastructure
- Geology and soils
- Water resources
- Air quality and noise
- Ecological resources
- Cultural resources
- Socioeconomics
- Public and occupational health and safety (associated with normal operations, facility accidents, and transportation)
- Environmental justice
- Waste management

These disciplines are analyzed in a manner commensurate with their importance under a specific alternative—the sliding-scale assessment approach. For example, under the No Action Alternative, the U.S. Department of Energy (DOE) has determined that minimal impacts would be associated with land resources, noise, water resources, geology and soils, ecological resources, and cultural and paleontological resources. This is because existing facilities in developed areas would be used, no new land disturbance would take place, and proposed activities would be consistent with current operations. Therefore, impacts associated with these resources are assessed for operations only. Where construction is an integral part of an alternative (i.e., the Consolidation and Consolidation with Bridge Alternatives), the impacts associated with such construction are included in the assessments. The sliding-scale assessment approach has been applied in the evaluation of all the alternatives addressed in this EIS.

The environmental consequence analyses associated with the alternatives assessed in this EIS were performed in accordance with the impact assessment methods described in Appendix B of this EIS. More detailed descriptions of the impacts development for the evaluation of human health effects are presented in

Appendix C and for transportation in Appendix D of this EIS. For consistency, numerical results are often rounded.

Analyses presented in the following sections include discussion of mitigation measures such as those that would be standard practice during facility construction. Section 4.5 presents a more detailed discussion of possible mitigation measures. Appropriate mitigation measures would be utilized to reduce or avoid impacts for each alternative.

4.1 No Action Alternative

A detailed description of the No Action Alternative is presented in Section 2.2.1 of this EIS.

Impacts of operations at the Fuel Manufacturing Facility (FMF) and Advanced Test Reactor (ATR) at Idaho National Laboratory (INL), and the High Flux Isotope Reactor (HFIR) and Radiochemical Engineering Development Center (REDC) at Oak Ridge National Laboratory (ORNL), are summarized from the *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS)* (DOE 2000f). Assembly and Testing Facility operational impacts are based on information presented in the *Finding of No Significant Impact and Final Environmental Assessment for the Future Location of the Heat Source/Radioisotope Power System Assembly and Test Operations Currently Located at the Mound Site (FONSI and Mound EA)* (DOE 2002c). Impacts of purification, pelletization, and encapsulation operations at the Plutonium Facility within Technical Area 55 (TA-55) at Los Alamos National Laboratory (LANL) are largely from the *Environmental Assessment for Radioisotope Heat Source Fuel Processing and Fabrication* (DOE 1991).

4.1.1 Land Resources

4.1.1.1 Land Use

All activities under the No Action Alternative would take place within existing facilities. There would be no change or effect on land use at INL, LANL, or ORNL, because no additional land would be disturbed, and the use of existing facilities would be compatible with their present missions (DOE 2000f).

4.1.1.2 Visual Environment

All activities under the No Action Alternative would take place within existing facilities. There would be no impact on visual resources since the current Visual Resource Management Class IV rating would not change.

4.1.2 Site Infrastructure

Utility infrastructure requirements under the No Action Alternative are summarized in **Table 4–1**. It is expected that electricity consumption, fuel consumption, and water use associated with storage of neptunium-237 in the existing FMF at the Materials and Fuels Complex (MFC) would be negligible. Also, there would be no additional utility requirements associated with irradiation of neptunium-237 targets in ATR and HFIR (should it be required), because these reactors are already in continuous operation for other purposes (DOE 2000f).

Table 4–1 Annual Incremental Infrastructure Requirements Associated with Operating Existing Facilities Under the No Action Alternative

Indicator	*INL*			*ORNL*		*LANL Plutonium Facility*
	FMF	*ATR* [a]	*SSPSF* [b]	*HFIR* [a]	*REDC*	
Electricity (megawatt-hours per year)	Negligible	0	2,039	0	Negligible	870
Natural gas (cubic meters per year)	0	0	0	0	0	78,000
Fuel oil (liters per year)	0	0	189,000	0	0	0
Water use (million liters per year)	0	0	28	0	2.9	0.19

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory, LANL = Los Alamos National Laboratory, FMF = Fuel Manufacturing Facility, ATR = Advanced Test Reactor, SSPSF = Space and Security Power Systems Facility, HFIR = High Flux Isotope Reactor, REDC = Radiochemical Engineering Development Center.

[a] There would be no incremental impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions.

[b] Also known as the Assembly and Testing Facility.

Note: To convert from cubic meters to cubic feet, multiply by 35.315; from liters to gallons, by 0.26418.

Sources: DOE 2000f, 2002c, 2003d.

Requirements for operation of the Assembly and Testing Facility are well within the current INL utility capacity. Annual electrical energy demands of some 2,039 megawatt-hours at the Assembly and Testing Facility are within INL's current electrical supply capacity of 481,800 megawatt-hours per year. The 189,000 liters (50,000 gallons) of fuel oil required to heat the facility is within the range of the 2 to 2.5 million liters (550,000 to 650,000 gallons) of total fuel oil burned each year at MFC. The annual water requirement of 28 million liters (7.3 million gallons) is within the capacity of the MFC water supply system and INL's water rights (DOE 2002c). The MFC system can deliver up to 1,790 million liters (473 million gallons) annually from its two deep wells (see Section 3.2.2.4). Information on current utility infrastructure usage and system capacities at INL is presented in Section 3.2.2.

Water requirements of 2.9 million liters (0.76 million gallons) per year at REDC is well within the capacity of the ORNL water supply system, which can deliver 9.7 billion liters (2.6 billion gallons) annually (see Section 3.4.2.4). Incremental electrical consumption for continued operations would be negligible (DOE 2000f). No additional fuel would be required because this facility is already being operated for other purposes. Information on current utility infrastructure usage and system capacities at ORNL is presented in Section 3.4.2.

The annual average electrical energy demand, an estimated 870 megawatt-hours for the Plutonium Facility at TA-55, is within LANL's current electrical supply capacity of 963,600 megawatt-hours per year. The 78,000 cubic meters (2.8 million cubic feet) of natural gas estimated to be required is a small percentage of the 38 million cubic meters (1.3 billion cubic feet) of natural gas used each year at LANL. The annual water requirement of 0.19 million liters (0.05 million gallons) is well within the capacity of the Los Alamos water supply system. Information on current infrastructure utility usage and system capacities at LANL is presented in Section 3.3.2.

4.1.3 Geology and Soils

All activities under the No Action Alternative would take place within existing facilities. There would be no disturbance to either geologic or soil resources.

Hazards from large-scale geologic conditions at INL, such as earthquakes and volcanoes, were previously evaluated in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (*Storage and Disposition PEIS*) (DOE 1996d). The analysis determined that these hazards present a low risk to long-term storage facilities. Further review of the data and analyses presented in the referenced document and the site-specific data presented in the *NI PEIS* (DOE 2000f) indicates that large-scale geologic conditions likewise present a low risk to the proposed INL facilities. Ground shaking of Modified Mercalli Intensity VI to VII (see Table B–7) at INL associated with postulated earthquakes is expected to primarily affect the integrity of inadequately designed or nonreinforced structures. Damage to properly or specially-designed or upgraded facilities is not expected. Also, the likelihood of future volcanic activity during the 35-year operational period evaluated under the No Action Alternative is considered low. The potential for other nontectonic events to affect INL facilities is also low (DOE 2000f).

Hazards from large-scale geologic conditions at ORNL, were previously evaluated in the *Storage and Disposition PEIS* (DOE 1996d). The analysis determined that these hazards present a low risk to long-term storage facilities. Further review of the data and analyses presented in the referenced document and the site-specific data presented in the *NI PEIS* (DOE 2000f) indicates that large-scale geologic conditions likewise present a low risk to HFIR and REDC operations. This is based on the fact that there is no evidence of capable (active) faults on or near ORNL, and no volcanic hazard exists. While sinkholes are present in the Knox Group, the 7900 Area is underlain by the Conasauga Group, in which karst features are less well developed. Thus, sinkholes do not present a geologic hazard to HFIR. The analysis determined that these hazards present a low risk to specially-designed or upgraded facilities such as HFIR (DOE 2000f).

4.1.4 Water Resources

Estimated water use and wastewater generation under the No Action Alternative are summarized in **Table 4–2**. There would be no impact on water resources associated with operations in FMF, ATR and HFIR (should it be required), because there would be no additional incremental use of surface water or groundwater, and there would be no change in the quantity or quality of effluents discharged to surface water or groundwater. ATR and HFIR are already in operation for other purposes, so neptunium-237 target irradiation would not have measurable impacts (DOE 2000f).

Table 4–2 Annual Incremental Water Use and Wastewater Generation Associated with Operating Existing Facilities Under the No Action Alternative

Indicator (million liters per year)	*INL*			*ORNL*		*LANL Plutonium Facility*
	FMF	*ATR* [a]	*SSPSF* [b]	*HFIR* [a]	*REDC*	
Water use	0	0	28	0	2.9	0.19
Process wastewater generation	0	0	0	0	0.023	< 0.0012
Sanitary wastewater generation	0	0	28 [c]	0	2.9	0.19

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory, LANL = Los Alamos National Laboratory, FMF = Fuel Manufacturing Facility, ATR = Advanced Test Reactor, SSPSF = Space and Security Power Systems Facility, HFIR = High Flux Isotope Reactor, REDC = Radiochemical Engineering Development Center.

[a] There would be no incremental impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions.

[b] Also known as the Assembly and Testing Facility.

[c] Assumes all water used becomes sanitary wastewater.

Note: To convert from liters to gallons, multiply by 0.26418.

Sources: DOE 2000f, 2002c.

Operation of the Assembly and Testing Facility would require approximately 28 million liters (7.3 million gallons) of water annually. Sanitary wastewater would be treated in the INL sewage lagoons. The waste streams from the Assembly and Testing Facility are within the capacity of these facilities (DOE 2002c). Information on current water usage, effluent discharge, and water quality at INL is presented in Section 3.2.4.

As summarized in Table 4–2, water use and sanitary wastewater generation would be relatively small and largely associated with staffing requirements at REDC at ORNL and the Plutonium Facility at LANL. The only other measurable wastewater generation would be 23,000 liters (6,100 gallons) per year of process wastewater associated with target processing at REDC and 1,130 liters (300 gallons) per year of radioactive liquid process wastewater from the Plutonium Facility (DOE 1991). Specifically, the 23,000 liters (6,100 gallons) of process wastewater generated per year would be negligible relative to the total volume of process wastewater generated and treated at the ORNL Process Waste Treatment Complex (DOE 2000f). In addition, the 1,130 liters (300 gallons) per year of radioactive liquid process wastewater is negligible relative to the total volume of process wastewater treated and discharged from the LANL Radioactive Liquid Waste Treatment Facility annually (11 million liters [3.0 million gallons]) (LANL 2004a). Impacts on the quantity or quality, if any, of process and sanitary wastewater discharges would be very small, with no radiological liquid effluent discharges to the environment under normal operations. Overall, no measurable impact on water resources at ORNL and LANL are expected.

4.1.5 Air Quality and Noise

4.1.5.1 Air Quality

Nonradiological Releases

It is estimated that there would be no measurable nonradiological air pollutant emissions at INL and ORNL associated with operations in FMF, ATR and HFIR (should it be required). Therefore, there would be no nonradiological air quality impacts at INL or ORNL associated with these activities (DOE 2000f).

The primary source of criteria pollutant emissions due to continued operation of the Assembly and Testing Facility would be from burning fuel oil in the boilers that provide heat and power for the facilities at INL. Each of the boilers has specific limits on the levels of emissions. Continued operation of the Assembly and Testing Facility would not cause the boilers to exceed their permitted levels of nitrogen oxide emissions and other air pollutants (DOE 2002c).

The nonradiological air pollutant concentrations at ORNL from activities at REDC are presented in **Table 4–3**. Concentrations are based on a dispersion-modeling screening analysis conducted with maximum expected emission rates and a set of worst-case meteorological conditions. Criteria pollutants were modeled for a stack height of 76.2 meters (250 feet) at the boundary limit of 5.0 kilometers (3.1 miles). Only those air pollutants expected to be emitted that have ambient air quality standards are presented in the table. The concentrations were determined to be small and would be below applicable standards even when ambient monitored values and the contributions from other site activities were included (DOE 2000f). Health effects of hazardous chemicals associated with this alternative are addressed in Section 4.1.9.

Table 4–3 Incremental Oak Ridge National Laboratory Air Pollutant Concentrations Associated with Operating Existing Facilities Under the No Action Alternative

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline (micrograms per cubic meter)*	*Modeled Increment (micrograms per cubic meter)*
Nitrogen dioxide	Annual	100	0.000199
Sulfur dioxide	Annual	80	0.04
	24 hours	365	0.31
	3 hours	1,300	0.70

Source: Modeled increments are based on the SCREEN3 computer code (DOE 2000f).

The primary source of criteria pollutant emissions from LANL's Plutonium Facility would be from burning natural gas to provide heat. Each of the boilers has specific limits on the levels of emissions. Operations in the Plutonium Facility would not cause the boilers to exceed their permitted levels of emissions. The contributions to ambient concentrations attributable to purification, pelletization, and encapsulation operations would be minor.

The air pollutant emissions from operations under this alternative would be small and not subject to Prevention of Significant Deterioration (PSD) regulations. Therefore, a PSD increment analysis is not required (see Section B.4.1).

The Final Rule for "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" requires a conformity determination for certain-sized projects in nonattainment areas. DOE has performed a review for this alternative and concluded that a conformity determination is not necessary to meet the requirements of the Final Rule, because INL, ORNL, and LANL are located in attainment areas for all criteria pollutants, except for ozone and particulate matter (PM) with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) at ORNL, and threshold emission levels would not be exceeded by the activities considered (DOE 2000a). See Section D.5.2 for a discussion of the human health risks from pollutants emitted by transport vehicles.

Radiological Releases

Radioactive releases associated with storage of neptunium-237 at FMF would be essentially zero, as the canisters containing the neptunium-237 would remain in containment vessels during storage. Incremental releases to the environment from ATR and HFIR (should it be required) during target irradiation would be zero, because there would be no increase in activities in those reactors due to additional target irradiation. An estimated 1.7×10^{-7} curies per year of plutonium-238 could be released to the environment during target fabrication and post-irradiation processing operations at REDC if the No Action Alternative is implemented (see Section C.2.1.4). An estimated 1.0×10^{-8} curies per year of plutonium-238 could be released to the environment from purification, pelletization, and encapsulation operations at LANL's Plutonium Facility. No releases are expected from the radioisotope power system (RPS) Assembly and Testing Facility at INL, because the facility would handle only fully encapsulated radioactive material. There would be no other types of radiological releases from RPS nuclear production operations. Impacts of radiological releases are discussed in Section 4.1.9.

4.1.5.2 Noise

Operations in FMF and the Assembly and Testing Facility at MFC, and the ATR at the Reactor Technology Complex (RTC) (formerly Test Reactor Area), would generate noise levels similar to those presently associated with operations conducted in these areas of INL. Onsite noise impacts are expected to be minimal, and offsite noise levels should not be noticeable, as the nearest site boundary is 6.4 kilometers (4 miles) from MFC and 11 kilometers (6.8 miles) from RTC. Traffic increases would be small and would result in only minor on- and offsite noise levels. There would be no loud noises associated with these operations that would adversely impact wildlife (DOE 2000f, 2002c).

Noise associated with operations in REDC and HFIR (should it be required) would be similar to sound levels associated with current operations, as well as other operations conducted at ORNL. Onsite noise impacts are expected to be minimal, and offsite noise levels would not be noticeable because the nearest site boundary is 2.5 kilometers (1.6 miles) to the southeast. Traffic increases would be minor and would not lead to noticeable noise levels either on or offsite. There would be no loud noises associated with these operations that would adversely impact wildlife (DOE 2000f).

Noise associated with operations in the Plutonium Facility at LANL would be similar to sound levels generated by present Plutonium Facility operations, as well as other operations in TA-55. Onsite noise impacts are expected to be minimal, and offsite noise levels would not be noticeable. Traffic associated would be minor and would not lead to noticeable noise levels either on or offsite. There would be no loud noises associated with these operations that would adversely impact wildlife.

4.1.6 Ecological Resources

All activity under the No Action Alternative would take place within existing facilities; therefore, direct disturbance to ecological resources at INL, ORNL, and LANL would not occur. As noted in Section 4.1.5.2, wildlife would not be affected by noise associated with operations at these facilities. There would be no impact on wetlands or aquatic resources because there would be no construction, no increase in water usage, and no direct discharge of wastewater (Section 4.1.4). Because of the developed nature of the areas and the fact that no new construction would take place, impacts on threatened and endangered species would not occur (DOE 2000f).

Measurable impacts on populations of plants and animals on or off the DOE sites are not expected as a result of the incremental increase in exposure to radionuclides or chemicals that could result from operation of facilities under this alternative. DOE routinely samples game species residing on or near the sites, livestock in the region, locally grown crops, and milk for radionuclides. The results of this monitoring are reported in the annual environmental reports prepared for each site. Concentrations of radionuclides in the plant and animal samples are generally small and seldom higher than concentrations observed at control locations distant from the sites. Additional deposition resulting from implementation of this alternative is not expected to lead to levels of contaminants that would exceed the historically reported ranges of concentrations. Therefore, DOE anticipates minimal impacts on the ecology of the DOE sites, and on plant and animal populations, as a result of exposure to radionuclides or chemicals under this alternative.

4.1.7 Cultural Resources

All facilities located at INL (FMF, ATR, and the Assembly and Testing Facility), as well as the Plutonium Facility at LANL and HFIR at ORNL, are existing structures and would not require modification under this alternative. REDC at ORNL would require some internal modifications, but no land disturbance is expected. As no new land disturbance would occur and all building modifications would be internal, no impacts on prehistoric, historic, or American Indian cultural resources at INL, LANL, or ORNL are expected.

4.1.8 Socioeconomics

Under the No Action Alternative, current levels of employment at the INL MFC and LANL's Plutonium Facility would remain unchanged. As no new employment or in-migration of workers would be required, socioeconomic conditions around INL and LANL would remain unchanged. Also, no additional workers would be required for irradiation of neptunium-237 targets in ATR at INL or HFIR (should it be required) at ORNL, as these reactors are in operation and already irradiate targets for other customers.

As noted in the *NI PEIS*, target fabrication and post-irradiation processing of neptunium-237 targets at ORNL's REDC would require about 41 workers. This level of employment was estimated to generate approximately 105 additional jobs in the region around ORNL. Assuming these are new jobs to the region, the potential increase of 146 jobs would represent a less than 0.1 percent increase in the workforce. An increase in employment of this size and other related economic activity in support of RPS nuclear production operations at ORNL would have no noticeable impact on socioeconomic conditions in the ORNL region of influence (ROI) (DOE 2000f).

Since employment in support of RPS nuclear production operations at INL and LANL would not change, traffic volumes would not change. The increase in traffic volume at ORNL from RPS nuclear production at REDC would be small and not likely to be noticed by commuters in the vicinity of ORNL.

4.1.9 Public and Occupational Health and Safety

Assessments of radiological and chemical impacts associated with the No Action Alternative are presented in this section. Supplemental information is provided in Appendix C of this EIS.

4.1.9.1 Construction and Normal Operations

No construction activities are associated with the No Action Alternative. During normal operations, there could be incremental radiological and hazardous chemical releases to the environment and also incremental direct in-plant exposures. The resulting doses and potential health effects on the public and workers under this alternative are described below.

Radiological Impacts

Incremental radiological doses to three receptor groups from operations at INL, ORNL, and LANL are given in **Table 4–4**: the population within 80 kilometers (50 miles) in the year 2050, the maximally exposed individual (MEI) of the public, and the average exposed member of the public. The projected number of excess latent cancer fatalities (LCFs) in the surrounding population and the excess LCF risk to the MEI and average exposed individual are also presented in the table. A probability coefficient of 6×10^{-4} LCFs per rem (roentgen equivalent man) is applied for the public and workers.

Table 4–4 Incremental Radiological Impacts on the Public of Facility Operations Under the No Action Alternative

Receptor	*INL*		*ORNL*		*LANL Plutonium Facility*
	MFC [a]	*ATR* [b]	*HFIR* [b]	*REDC*	
Population within 80 kilometers (50 miles) in the year 2050					
Dose (person-rem)	1.7×10^{-6}	No change	No change	1.5×10^{-4}	1.8×10^{-5}
35-year period excess latent cancer fatalities	3.5×10^{-8}	No change	No change	3.2×10^{-6}	3.8×10^{-7}
Maximally exposed individual					
Annual dose (millirem)	1.4×10^{-7}	No change	No change	4.5×10^{-6}	1.0×10^{-6}
35-year excess latent cancer fatality risk	2.9×10^{-12}	No change	No change	9.5×10^{-11}	2.1×10^{-11}
Average exposed individual within 80 kilometers (50 miles)					
Annual dose [c] (millirem)	4.7×10^{-9}	No change	No change	1.1×10^{-7}	3.0×10^{-8}
35-year excess latent cancer fatality risk	9.9×10^{-14}	No change	No change	2.2×10^{-12}	6.3×10^{-13}

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory, LANL = Los Alamos National Laboratory, MFC = Materials and Fuels Complex, ATR = Advanced Test Reactor, HFIR = High Flux Isotope Reactor, REDC = Radiochemical Engineering Development Center.

[a] Because exposure data are not available for neptunium-237 storage exclusively, values were conservatively estimated to be 10 percent (DOE 2000f) of the fabrication and processing component of the total neptunium-237 target fabrication, processing, and storage doses at REDC. These values serve as an upper-bound representation of the potential impacts that could be incurred from neptunium-237 storage.

[b] There would be no incremental radiological impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions or contribute a new source of radiological emissions.

[c] Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of the site in the year 2050 (ATR at INL = 172,200; MFC at INL = 355,000; REDC and HFIR at ORNL = 1,438,000; Plutonium Facility at LANL = 608,800).

Source: DOE 2000f.

Doses at INL would be attributed to storage of the neptunium-237 targets. Assembly and Testing Facility operations at MFC are not expected to release any radioactivity on or offsite because the facility would handle only fully encapsulated radioactive material. Doses at ORNL would be attributed to target fabrication and post-irradiation processing at REDC. Doses at LANL would be attributed to purification, pelletization, and encapsulation activities at the Plutonium Facility in TA-55. There would be no incremental dose and no excess LCFs from operations at ATR and HFIR (should it be required) because there would be no increase in radiological releases to the environment from either of these reactors associated with this alternative (DOE 2000f).

The highest population, MEI, and average exposed individual doses would occur at ORNL from activities at REDC. The annual population dose at ORNL would be 1.5×10^{-4} person-rem, with a 35-year excess LCF risk of a 3.2×10^{-6}. The annual MEI dose would be 4.5×10^{-6} millirem, with a 35-year excess LCF risk of 9.5×10^{-11}. The annual average exposed individual dose would be 1.1×10^{-7} millirem, with a 35-year excess LCF risk of 2.2×10^{-12}.

Doses to involved workers from normal operations are given in **Table 4–5**; these workers are defined as those directly associated with process activities. The incremental annual average dose to workers from irradiation activities at ATR and HFIR would be negligible; to REDC, FMF, and Plutonium Facility workers, approximately 170 (DOE 2000f), 17, and 240 (LANL 2005) millirem, respectively. No LCFs would be expected from these exposures. Doses to individual workers would be kept to minimal levels by instituting badged monitoring and "as low as is reasonably achievable" (ALARA) programs.

Table 4–5 Incremental Radiological Impacts on Involved Workers of Facility Operations Under the No Action Alternative

Receptor – Involved Workers [a]	*INL*		*ORNL*		*LANL Plutonium Facility*
	MFC [a]	*ATR* [b]	*HFIR* [b]	*REDC*	
Total dose (person-rem per year)	1.2 [c]	No change	No change	12 [d]	19 [e]
35-year excess latent cancer fatalities	0.025	No change	No change	0.25	0.4
Average worker dose (millirem per year)	17	No change	No change	170	240
35-year excess latent cancer fatality risk	0.00036	No change	No change	0.0036	0.005

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory, LANL = Los Alamos National Laboratory, MFC = Materials and Fuels Complex, ATR = Advanced Test Reactor, HFIR = High Flux Isotope Reactor, REDC = Radiochemical Engineering Development Center.

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 *Code of Federal Regulations* [CFR] 835). However, the maximum dose to a worker involved with radiological operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999e). Further, DOE recommends that facilities adopt a more limiting, 500-millirem-per-year, Administrative Control Level (DOE 1999e). To reduce doses to ALARA levels, an effective ALARA program would be enforced (see Section 4.5.5).

[b] There would be no incremental radiological impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions or contribute a new source of radiological emissions.

[c] Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent (DOE 2000f) of the total dose from neptunium-237 target fabrication/processing and neptunium-237 storage, and serve as an upper-bound representation of the potential impacts that could be incurred from neptunium-237 storage.

[d] Based on an estimated 75 badged workers.

[e] Based on an estimated 79 badged workers and an average of 0.24 rem per worker at LANL (LANL 2005).

Hazardous Chemical Impacts

Hazardous chemical impacts at INL would be unchanged from baseline site operations because no new chemicals would be emitted to the air from storage of neptunium-237 in FMF at MFC or irradiation of neptunium-237 targets in ATR at INL and HFIR at ORNL (DOE 2000f).

Carcinogenic and noncarcinogenic health effects of exposure to hazardous chemicals emitted from operations in REDC at ORNL were evaluated and reported in the *NI PEIS* (DOE 2000f). The hazardous chemical health effects are summarized in **Table 4–6**. The Hazard Index for activities at ORNL is estimated to be much less than 1 (0.006), and the cancer risk to be less than 1 in 1 million. Therefore, no chemical health effects are anticipated under the No Action Alternative.

Nonradioactive air emissions from activities at the Plutonium Facility at LANL would be mainly from the glovebox gases argon and helium. These are inert and nonhazardous. Ethanol, used as a solvent at LANL, is likewise not hazardous. Vapors of hydrofluoric and nitric acids, used in decontamination, would be emitted at rates well below threshold values (DOE 1991).

Table 4–6 Incremental Hazardous Chemical Impacts on the Public around Oak Ridge National Laboratory Under the No Action Alternative

Chemical	*Modeled Annual Increment (milligrams per cubic meter)*	*RfC to Inhalation (milligrams per cubic meter)*	*Unit Cancer Risk (risk per milligram per cubic meter)*	*Hazard Quotient*	*Cancer Risk*
REDC at ORNL					
Diethyl benzene	3.37×10^{-5}	1	7.8×10^{-3}	3.37×10^{-5}	2.63×10^{-7}
Methanol	1.23×10^{-6}	1.75	NA	7.03×10^{-7}	NA
Nitric acid	1.53×10^{-6}	0.123	NA	1.25×10^{-5}	NA
Tributyl phosphate	6.34×10^{-5}	0.01	NA	6.34×10^{-3}	NA
			Hazard Index =	6.39×10^{-3}	

RfC = reference concentration, NA = not applicable (the chemical is not a known carcinogen or it is a carcinogen and only unit risk will apply).

Note: For diethyl benzene, the RfC for ethyl benzene and the unit cancer risk for benzene were used to estimate Hazard Quotient and cancer risk because no information was available for diethyl benzene. For tributyl phosphate, the RfC for phosphoric acid was used to estimate the Hazard Quotient because no information was available for tributyl phosphate.

Source: DOE 2000f.

4.1.9.2 Facility Accidents

This section discusses potential accident impacts under the No Action Alternative. Detailed descriptions are provided in Appendix C of this EIS. The accident scenarios chosen for analysis have impacts that bound the suite of accidents that have occurred and could occur at the facilities. The selection of accident scenarios described in Appendix C of this EIS include the review of accident history as presented in Sections 3.2.9.4, 3.3.9.4, and 3.4.9.4. The accident scenarios that were analyzed result in higher public and noninvolved worker risks than historic accidents.

Incremental radiological doses to three receptor groups from postulated accidents at INL, ORNL, and LANL are estimated: the population within 80 kilometers (50 miles), the MEI of the public, and the noninvolved worker. The projected number of excess LCFs in the surrounding population and the excess LCF risk to the MEI and noninvolved worker are also presented. A probability coefficient of 6×10^{-4} LCFs per rem is applied for the public and workers.

Radiological Impacts

Potential accidents under the No Action Alternative have been evaluated by DOE in previous National Environmental Policy Act (NEPA) documents (DOE 2000f, 2002c).

Neptunium-237 Storage—At INL, neptunium-237 would be stored in the FMF vault. While the postulated beyond-evaluation-basis earthquake may cause portions of the facility to collapse, the storage cans would not be stressed to a level that would breach the double containment of the can design (DOE 2000f).

Target Irradiation—For ATR target irradiation accidents, the annual increased risk of an LCF to the offsite MEI and a noninvolved worker associated with plutonium-238 production would be 3.0×10^{-8} and 3.0×10^{-7}, respectively. The annual risk in terms of the increased number of LCFs in the surrounding population would be 2.6×10^{-3} (DOE 2000f).

For HFIR target irradiation accidents, the annual increased risk of an LCF to the offsite MEI and a noninvolved worker associated with plutonium-238 production would be 1.7×10^{-7} and 6.9×10^{-7}, respectively. The annual risk in terms of the increased number of LCFs in the surrounding population would be 1.5×10^{-4}. These target irradiation accident risks were calculated in the *NI PEIS* (DOE 2000f).

Target Fabrication and Post-irradiation Processing—For REDC target fabrication and processing accidents, the annual increased risk of an LCF to the offsite MEI and a noninvolved worker was estimated to be 1.6×10^{-6} and 1.0×10^{-5}, respectively. The annual accident risk in terms of the increased number of LCFs in the surrounding population was estimated to be 4.5×10^{-3}.

Assembly and Testing Operations—A range of accidents were considered for the Assembly and Testing Facility, including welding fire accidents, catastrophic failure of one or more of the fuel elements, and the potential for a wind-driven missile to penetrate a facility wall and glovebox. However, because of the solid ceramic form of the plutonium and the multiple protective features of the Category 3 building, any release to the environment from these accidents would be negligible. Any adverse effects would be mitigated by air filtration systems, room and building barriers, and air locks that contain releases (DOE 2002c). Because the probability of occurrence and, release of radioactive materials outside of the building for these accidents was estimated to be less than 1 in 1 million per year, the risks to noninvolved workers and the public were not considered further.

Plutonium-238 Purification, Pelletization, and Encapsulation—The consequences and risks of plutonium-238 purification, pelletization, and encapsulation accidents are shown in **Table 4–7**. Four potential accidents were postulated:

- An unmitigated evaluation-basis fire during plutonium-238 powder-to-pellet fabrication. Unmitigated conditions assume failure of heating, ventilating, and air conditioning (HVAC) and fire suppression systems. The estimated frequency of this accident is 1×10^{-5} per year.
- An unmitigated evaluation-basis earthquake (0.3-g[1] acceleration), causing failure of the HVAC, fire safety equipment, nonsafety-class ductwork, and internal nonsafety-grade structures, but not the structure shell itself. The estimated frequency of this accident is 5×10^{-4} per year.
- A beyond-evaluation-basis fire similar to the evaluation-basis fire, but involving two gloveboxes and the assumption that exterior doors are open for the duration of the fire, providing a direct unfiltered release to the environment. The estimated frequency of this accident is 1×10^{-6} per year.
- A beyond-evaluation-basis earthquake (0.5-g), with all the same assumed failures as the evaluation basis earthquake but in addition, a 50-percent degradation in high-efficiency particulate air (HEPA) filter removal efficiency. The estimated frequency of this accident is 1×10^{-4} per year.

The risks of the postulated accidents are shown in **Table 4–8**. The accident with the highest risk is an unmitigated evaluation-basis earthquake. If this accident were to occur, the annual risk of an LCF would be 1.4×10^{-7} and 2.3×10^{-6} for the MEI and noninvolved worker, respectively. The annual risk for the offsite population would be 2.5×10^{-4}. The 35-year risk for the highest-consequence accident, an unmitigated evaluation-basis earthquake, for the MEI, noninvolved worker, and offsite population would be 4.9×10^{-6}, 8.1×10^{-5}, and 0.0088, respectively.

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[1] *In measuring earthquake ground motion, the acceleration (the rate of change in velocity) experienced relative to that due to Earth's gravity (i.e., approximately equal to 980 centimeters per second squared).*

Table 4–7 Plutonium-238 Purification, Pelletization, and Encapsulation Annual Accident Consequences at Los Alamos National Laboratory Under the No Action Alternative

Accident	*Maximally Exposed Individual*		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
	Dose (rem)	*Latent Cancer Fatality* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b]	*Dose (rem)*	*Latent Cancer Fatality* [a]
Unmitigated evaluation-basis fire	10.2	0.0061	1,850	1.11	15.9	0.0095
Unmitigated evaluation-basis earthquake	4.70	0.0028	834	0.50	7.64	0.0046
Beyond-evaluation-basis fire	5.37	0.0032	675	0.41	8.04	0.0048
Beyond-evaluation-basis earthquake	0.72	0.00043	165	0.10	1.17	0.00070

[a] Likelihood of an LCF.
[b] Number of LCFs.

Table 4–8 Plutonium-238 Purification, Pelletization, and Encapsulation Annual Accident Risks at Los Alamos National Laboratory Under the No Action Alternative

Accident	*Maximally Exposed Individual* [a]	*Population to 80 Kilometers* [b] *(50 miles)*	*Noninvolved Worker* [a]
Unmitigated evaluation-basis fire	6.1×10^{-8}	1.1×10^{-5}	9.5×10^{-8}
Unmitigated evaluation-basis earthquake	1.4×10^{-7}	2.5×10^{-4}	2.3×10^{-6}
Beyond-evaluation-basis fire	3.2×10^{-9}	4.1×10^{-7}	4.8×10^{-9}
Beyond-evaluation-basis earthquake	4.3×10^{-8}	9.9×10^{-6}	7.0×10^{-8}

[a] Increased likelihood of an LCF.
[b] Increased number of LCFs.

Chemical Impacts

Storage of neptunium-237 would not involve hazardous chemicals. Therefore, no chemical accidents would be associated with storage of neptunium-237 in FMF (DOE 2000f).

Irradiation of neptunium-237 targets at ATR and HFIR (should it be required) would not introduce any additional hazardous chemicals. Thus, no postulated chemical accidents would be attributable to irradiation of neptunium-237 targets (DOE 2000f).

Target processing associated with plutonium-238 production at REDC, including storage of neptunium-237 and plutonium-238; neptunium-237 target fabrication; and post-irradiation processing to extract plutonium-238 and to recycle the unconverted neptunium-237 into new targets would not require any chemicals that are not already in use in the facility. The quantities of in-process hazardous chemicals for the plutonium-238 production program would be bounded by the quantities of the material currently stored in the facility. Therefore, the impacts of in-process hazardous chemical accidents associated with plutonium-238 production would be bounded by the impacts of hazardous chemical accidents associated with existing chemical storage facilities at REDC (DOE 2000f).

Plutonium-238 purification, pelletization, and encapsulation would not require the use of hazardous chemicals.

4.1.9.3 Transportation

Transportation impacts consist of impacts of incident-free or routine transportation and impacts of transportation accidents. Incident-free transportation impacts include radiological impacts on the public and workers from the radiation field surrounding the transportation package. Nonradiological impacts of potential transportation accidents include traffic accident fatalities. See Section D.5.2 for a discussion of the human health risks from pollutants emitted by transport vehicles.

The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing the individual risks from all reasonably conceivable accidents. The analysis of accident risks takes into account a spectrum of accidents ranging from high-probability accidents (fender bender) of low consequence to high-consequence accidents that have a low probability of occurrence. Only as a result of a severe fire and/or a powerful collision, which are of extremely low probability, could a transportation package of the type used to transport radioactive material be damaged to the extent that there could be a release of radioactivity to the environment with significant consequences. In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive materials, DOE assessed the consequences of maximum reasonably foreseeable accidents with a probability greater than 1×10^{-7} (1 chance in 10 million) per year. The latter consequences were determined for atmospheric conditions that would prevail during accidents. The analysis used the RISKIND computer code to estimate doses to individuals and populations (Yuan et al. 1995).

Radiological accident risk is expressed as additional LCFs, and nonradiological accident risk as additional immediate (traffic) fatalities. Incident-free risk is also expressed as additional LCFs.

In determining the transportation risks, per-shipment risk factors were calculated for the incident-free and accident conditions using the RADTRAN 5 computer program (SNL 2003) in conjunction with the Transportation Routing Analysis Geographic Information System (TRAGIS) computer program (Johnson and Michelhaugh 2003) to choose transportation routes in accordance with U.S. Department of Transportation (DOT) regulations. The TRAGIS program provides population estimates based on the 2000 census along the routes for determining the population radiological risk factors. The analysis approach and details on modeling and parameter selections are provided in Appendix D of this EIS.

Under the No Action Alternative, DOE would transport neptunium-237 from its storage location in FMF at INL to the REDC target fabrication facility at ORNL. Nonirradiated neptunium-237 targets would be transported from REDC to ATR at INL (and also to HFIR at ORNL, should it be required). Following irradiation in ATR (and HFIR), the targets would be returned to REDC for processing. The separated plutonium-238 products would be shipped to the Plutonium Facility at LANL for purification, pelletization, and encapsulation within strong cladding material. The encapsulated plutonium-238 would be shipped to the Assembly and Testing Facility at INL for RPS assembly and testing. The neptunium and plutonium materials would be transported between the sites using DOE Safe, Secure Trailers (SSTs), and the nonirradiated and irradiated fabricated targets would be transported using commercial trucks. It was assumed that HFIR would produce about 1 to 2 kilograms (2.2 to 4.4 pounds) of plutonium-238 per year. These assumptions are consistent with those used in the *NI PEIS* (DOE 2000f).

Under the No Action Alternative, 595 truck shipments of radioactive materials would be made between the sites involved. The total distance traveled on public roads would be 1.92 million kilometers (1.2 million miles).

Impacts of Incident-Free Transportation

The dose to transportation workers from all transportation activities under the No Action Alternative has been estimated to be 15 person-rem, and the dose to the public would be 22 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.009 LCFs among transportation workers and 0.013 LCFs in the total affected population over the duration of transportation activities. LCFs associated with radiological releases were estimated by multiplying the occupational (worker) and public dose by 6.0×10^{-4} LCFs per person-rem of exposure.

Impacts of Transportation Accidents

As stated earlier, two sets of analyses were performed for the evaluation of transportation accident impacts: impacts of maximum reasonably foreseeable severe accidents and impacts of all conceivable accidents (total transportation accidents).

The maximum reasonably foreseeable offsite transportation accident under the No Action Alternative (probability of occurrence: more than 1 in 10 million per year) is a medium to high category impact with fire accident involving a shipment of irradiated neptunium targets to REDC at ORNL. The consequences of such an accident in terms of population dose in the rural, suburban, and urban zones are: 0.019, 0.43, and 3.0 person-rem, respectively. The likelihood of occurrence of such consequences per year is less than 1.4×10^{-5}, 3.6×10^{-6}, and 3.2×10^{-7} in rural, suburban, and urban zones, respectively. This accident could result in a dose of 0.008 rem to a hypothetical individual exposed to the accident plume for 2 hours at a distance of 100 meters (330 feet), with a corresponding LCF risk of 4.8×10^{-6}.

As described in Appendix D, Section D.7 of this EIS, estimates of the total transportation accident risks under this alternative are as follows: a radiological dose to the population of 0.0038 person-rem, resulting in 2.3×10^{-6} LCFs, and traffic accidents resulting in 0 (0.036) fatalities, based on 1.9 million kilometers (1.2 million miles) traveled.

4.1.9.4 Emergency Preparedness

Under the No Action Alternative—Transportation of radioactive materials would occur between INL, ORNL, and LANL. Radioactive waste shipments would occur to offsite waste management facilities under all alternatives.

This section addresses emergency management and response along transport routes and at the DOE sites. The emergency management and response infrastructure that supports current RPS production activities and that would support response to activities within INL boundaries is discussed in the emergency preparedness and security sections in Chapter 3 of this EIS.

State and local governments are responsible for emergency preparedness, management, and response programs. These programs must be capable of managing all hazards, ranging from natural disasters to hazardous material incidents, on a day-to-day basis. To maintain these programs, various State, Tribal, and local governments receive Federal funding. DOE, along with other Federal agencies (e.g., DOT, The U.S. Nuclear Regulatory Commission [NRC], Federal Emergency Management Agency, U.S. Department of Defense, and U.S. Environmental Protection Agency [EPA]), would provide support and assistance to State, Tribal, and local government agencies responsible for responding to a radioactive material incident (DOE 1996b).

Radioactive Material Transportation—Radioactive material shipments transported by truck carrier would be subject to the same potential problems as any other hazardous material shipment—severe weather, mechanical problems, derailments, and collisions. Radioactive material shipments, like other hazardous material shipments, have been involved in accidents or incidents. In most cases, no radioactive material was released into the environment. When releases have occurred, the material has been cleaned up, with no identifiable harm to the public or environment (DOE 1999d).

DOE fulfills its role and responsibilities as the Federal agency tasked with developing and maintaining the capability to safely transport radioactive materials, in part by setting overall program management responsibility and policy for transportation and emergency management and response; resolving policy questions; issuing guidance; providing information; and accomplishing oversight by including regulatory compliance requirements in its radioactive-material-related contracts and by monitoring the performance of those involved (DOE 1996b). In 2002, there were 5,028 radioactive material shipments (DOE 2003b). To date, no one has ever been killed or seriously injured in an accident involving radioactive materials as a result of the radioactive nature of the cargo (DOE 1999d).

States and tribes are responsible for notifying DOE of any conditions that could affect the safe, and secure transport of shipments through their jurisdictions. States coordinate with local jurisdictions on emergency planning and information. DOE provides technical advice and assistance to the shippers and affected government jurisdictions to ensure safe transportation (DOE 1996b).

Nonsecurity-Risk Radioactive Materials and Waste Shipments—During transport of the nonsecurity-risk radioactive materials and wastes, DOE and the commercial carrier are required to ensure that all activities conform to regulatory requirements. For shipments identified as “Highway Route Controlled Quantity,” DOE requires the shipper, on behalf of DOE and/or the carrier, to provide DOE Headquarters National Transportation Program a shipment plan with routing identified 45 days in advance of the shipment. The carrier must provide a written route plan to the shipper and the driver prior to departure (DOE 1999d). DOE provides the governor or the governor's designee written notice in advance of unclassified spent nuclear fuel and high-level radioactive waste shipments within or through their state. DOE also notifies tribal governments of DOE shipments through their jurisdictions. This written notice includes the planned schedule(s), route, shipment description, and carrier’s name and address (DOE 1999d).

Radioactive material shipments are tracked by either the commercial carrier or a satellite tracking system similar to DOE’s original Transportation Tracking and Communications System (TRANSCOM). TRANSCOM2000 is an updated tracking system used to monitor the progress of various unclassified, high-visibility-shipments. It is available to more than 300 authorized DOE shipping and transportation clients, including state, local, and tribal governments. TRANSCOM2000 uses onboard satellite Global Positioning Systems to track truck and rail shipments from origin to destination. Shipment position and messaging data are made available over the TRANSCOM2000 Website in 4- to 7-minute intervals (TCC 2005).

If a situation arose (e.g., severe weather, mechanical difficulties, protesters, security threat, personnel illness or injury) that presented a hazard or threat to a highway shipment, DOE would have arranged through a memorandum of agreement for the commercial carrier to divert to any Federal installation (e.g., a DOE site or military base) and request “SAFE PARKING” at that facility until the situation is resolved. The receiving facility would assist in providing security and logistical support until the shipment was prepared to depart. The satellite tracking system would be used to coordinate “SAFE PARKING” requests (DOE 1996b).

Security-Risk Radioactive Material Shipments—In addition to the above requirements for nonsecurity-risk radioactive material shipments, security-risk radioactive materials would be shipped using SSTs. These are specially-designed, operated, and monitored vehicles that contain various security features not found in typical commercial trucks. Security-risk material shipments are tracked by TRANSCOM2000. Radioactive materials transported by SST would be subject to the same potential problems as any other hazardous material shipment that travels daily by these means, namely, severe weather, mechanical problems, and collisions (DOE 1996b).

First Responders—State, local, and tribal agencies, as well as commercial carriers, maintain various emergency response plans and procedures. During an accident, the personnel accompanying the shipment would be the immediate contact for information to the local emergency responders having jurisdiction and Incident Commander authority over the situation. Additionally, the hazardous material regulations (49 CFR 177.861) advise highway shippers, carriers, and emergency responders to contact DOE if assistance with radioactive materials is required. A DOE Radiological Assistance Program (RAP) team could respond to the scene if requested (DOE 1996b).

Primary responsibility for emergency response to a radioactive material incident resides with local authorities. Each corridor state or tribe is responsible for augmenting their existing emergency management and response plans and procedures with any shipment-specific information determined necessary (DOE 1996b).

First responders cordon off contaminated areas and initiate controls to minimize further release of contaminated or radioactive material. They also perform lifesaving duties, extinguish fires, clear unauthorized people from the immediate area, and control traffic in the event of an accident. Local responders usually contact state public health agencies. These agencies have trained personnel to conduct radiological tests at the site to determine if any radioactive material releases have occurred. Many local and state governments have emergency plans and training programs to prepare first responders for transportation accidents involving radioactive materials (DOE 1999d).

Incident Commanders have other sources of technical assistance available, such as the commercial carrier's technical experts (through a 24-hour contact number), the National Response Center, and the Chemical Transportation Emergency Center (CHEMTREC), which provides immediate response advice and information from the shipper on a 24-hour basis (DOE 1996b).

DOE maintains eight Regional Coordinating Offices across the country. Staffed 24 hours a day, 365 days a year, they are prepared to offer advice and assistance. They also ensure that appropriate state and tribal agencies are contacted and coordinate any necessary RAP team activities. These teams include nuclear engineers, health physicists, industrial hygienists, public affairs specialists, and other personnel who provide field monitoring, sampling, decontamination, communications, and other services as requested (DOE 1999d).

DOE offers training courses designed to teach basic emergency response procedures for dealing with radioactive materials. Assistance and emergency response training are also provided by the Federal Emergency Management Agency, DOT, NRC, and EPA. Assistance is also offered by the chemical industry through CHEMTREC. The National Response Center works closely with CHEMTREC on emergency calls and activates National Response Teams, if necessary. If commercial carriers are involved, the carrier of the cargo works with the appropriate Government agencies to address all cleanup issues, such as arranging for repackaging of the cargo, if necessary, and disposing of contaminated materials (DOE 1999d).

Assistance to States and Tribes—DOE is responsible for assisting state, local, and tribal officials in preparing for the safe shipment of radioactive materials through their communities and in responding to transportation incidents (DOE 2005c). The following assistance is provided:

- emergency planning and guidance,
- training material development and delivery,
- emergency drills and exercises,
- centralized emergency notification,

- support to emergency responders (radiological surveys, technical assistance, and public information), and

- post-incident assessment (along with other agencies).

Section 180(c) of the Nuclear Waste Policy Act, as amended, requires DOE to provide technical assistance and funds to states for training public safety officials of appropriate units of local government and American Indian tribes through whose jurisdiction the Secretary plans to transport spent nuclear fuel or high-level radioactive waste. The training is to cover procedures required for safe routine transportation of these materials, as well as procedures for dealing with emergency response situations (DOE 2004c). Funding for tribes is also made available through several other Federal agencies (i.e., Federal Emergency Management Agency, Homeland Security) and other organizations and programs (e.g., Comprehensive HAZMAT Emergency Response-Capability Assessment Program, First Responder Grant, Firefighters Grant Program) (DOE 2003b). As a means of assisting tribes in obtaining funding from appropriate sources to develop and sustain emergency preparedness/response and other programs, DOE prepared "Developing Grant Proposals: A Guide for Tribal Emergency Preparedness Coordinators." This document provides an exhaustive list of funding sources, along with detailed step-by-step guidance on the grant application process (DOE 2004b).

RAP is the primary DOE response group that would assist at a radioactive material incident. RAP is divided into eight geographical regions, each managed by a Regional Coordinating Office. Each region has one or more RAP response teams (DOE 2005d). The program assists state, tribal, local, and other Federal agencies in responding to radiological incidents. RAP provides a graded response based on accident severity (DOE 2003b). It provides resources (trained personnel and equipment) to evaluate, assess, advise, and assist in the mitigation of actual or perceived radiation hazards and risks to workers, the public, and the environment (DOE 2005d).

RAP teams are comprised of DOE and DOE contractor personnel specifically trained to perform radiological response activities as part of their formal employment or as part of the terms of the contract between their employer and DOE. A fully configured RAP team consists of a Team Leader, a Team Captain, four health physicists, survey/support personnel, and a Public Information Officer. A RAP team may deploy with two or more members, depending on the potential hazards, risks, or emergency scenario. The teams are equipped with personnel protective equipment, radiation monitoring instruments, air sampling equipment, communications equipment, and other emergency response devices (DOE 2005d).

Liability—The required amount of liability coverage for carriers of radioactive materials varies according to the mode of transport (road, rail, waterway, or air) and the type and quantity of radioactive material being shipped. If the damages from a transportation-related accident exceed the amount of the carrier's private insurance coverage, umbrella coverage is provided under the Price-Anderson Act (DOE 1999d).

Coverage is also provided for damages created as a result of terrorism, sabotage, and other illegal acts occurring during transport. In addition, the 1988 amendments clarified coverage for the costs of precautionary evacuation initiated by state, tribal, or local officials. If damage claims from an accident exceed the maximum limits of protection, Congress would review the incident and enact legislation to provide full and prompt public compensation (DOE 1999d).

4.1.10 Environmental Justice

No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under the No Action Alternative. This conclusion is a result of investigations in this EIS that determined there would be no significant impacts on human health or ecological, cultural, socioeconomic, or other resource areas described in other subsections of Section 4.1.

Under the No Action Alternative, all RPS nuclear production operations would be conducted in existing facilities at ATR and MFC at INL, REDC and HFIR at ORNL, and the Plutonium Facility at LANL, and no new facilities would be constructed. As discussed in Section 4.1.9.1, radiological and hazardous chemical risks to the public resulting from normal operations would be small. Routine normal operations at these existing facilities are not expected to cause fatalities or illness among the general population, including minority and low-income populations living within the potentially affected area.

Annual radiological risks to the offsite population that could result from accidents at these existing facilities are estimated to be less than 0.0045 LCFs (see Section 4.1.9.2). Hence, the annual risks of an LCF in the entire offsite population resulting from an accident under the No Action Alternative would be less than 1 in 222.

In summary, implementation of the No Action Alternative would pose no disproportionately high and adverse health or safety risks to minority and low-income populations living in the potentially affected area surrounding RPS nuclear production facilities at MFC.

Subsistence Consumption of Fish, Wildlife, and Game

Section 4-4 of Executive Order 12898 directs Federal agencies "whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence and that Federal governments communicate to the public the risks of these consumption patterns." DOE has considered whether there are any means for minority and low-income populations to be disproportionately affected by examining health studies and levels of contaminants in fish, crops, livestock, and game animals on or near ORNL, LANL, and INL (DOE 1999a, 2001, 2002e).

As discussed in this section, selection of the No Action Alternative would pose no disproportionately high and adverse human health impacts on minority or low-income populations in the regions around ORNL, LANL, and INL. Moreover, the impact analyses conducted for this EIS (see Section 4.1.6) indicate that native plants and wildlife in the ROIs would not be harmed by RPS nuclear production operations at these sites. Consequently, no disproportionately high and adverse human health impacts are expected in minority or low-income populations as a result of subsistence consumption of fish, wildlife, native plants, or crops.

4.1.11 Waste Management and Pollution Prevention

4.1.11.1 Waste Management

The impacts on the INL, ORNL, and LANL waste management systems in terms of managing the additional waste generated under the No Action Alternative are discussed in this section. This analysis is consistent with policy and DOE Order 435.1 that DOE radioactive waste shall be treated, stored, and, in the case of low-level radioactive waste, disposed of at the site where the waste is generated, if practical, or at another DOE facility. However, if DOE determines that use of the INL, ORNL, or LANL waste management infrastructure or other DOE sites is not practical or cost-effective, DOE may issue an exemption under DOE Order 435.1 for the use of non-DOE facilities (i.e., commercial facilities) to store, treat, and dispose of such waste. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts that are provided in Section 4.1.9.

Under the No Action Alternative, no waste is expected to be generated during storage of neptunium-237 at INL. Therefore, incremental impacts on the environment would be negligible (DOE 2000f). Only very small amounts of additional waste would be generated as a result of irradiating neptunium-237 targets in ATR and HFIR (should it be required) because these reactors are already in continuous operation for other purposes. The incremental amount of this waste is anticipated to be very small (about 1 cubic meter [1.3 cubic yards] per year of solid low-level radioactive waste), and, therefore, no impacts on the waste management systems at INL or ORNL are anticipated (DOE 2000f).

The expected generation rates of waste at ORNL that would be associated with the operation of REDC to fabricate and process the neptunium-237 targets are compared with ORNL's treatment, storage, and disposal capacities in **Table 4–9**. Target fabrication and processing in REDC would generate a total of 385 cubic meters (504 cubic yards) of transuranic waste over the 35-year operational period. The waste would be vitrified into a glass matrix at a glass melter installed within REDC. The resulting glass matrix would be stored onsite pending shipment to the Waste Isolation Pilot Plant (WIPP). This additional waste would represent approximately 18 percent of the available 2,169-cubic-meter (2,837-cubic-yard) storage capacity in facilities 7572, 7574, 7826, 7878, 7879, and 7883. The impacts of managing the additional quantities of this waste at ORNL would be minimal (DOE 2000f).

Table 4–9 Incremental Waste Management Impacts of Operating the Radiochemical Engineering Development Center at Oak Ridge National Laboratory Under the No Action Alternative

Waste Type [a]	***Estimated Annual Waste Generation (cubic meters)***	***Estimated Additional Waste Generation as a Percent of*** [b]		
		Onsite Treatment Capacity	***Onsite Storage Capacity***	***Onsite Disposal Capacity***
Transuranic [c]	11	(c)	18	Not applicable [d]
Liquid low-level radioactive	25	0.13	24 [e]	Not applicable [h]
Solid low-level radioactive	35	Not applicable [f]	2.6 [g]	Not applicable [h]
Solid mixed low-level radioactive	< 5	< 2.2 [i]	< 0.57 [j]	Not applicable [h]
Hazardous	6,500 kilograms	Not applicable [k]	Not applicable [k]	Not applicable [k]
Nonhazardous process wastewater	23	0.0017	Not applicable [l]	Not applicable [l]
Nonhazardous sanitary wastewater	2,832	0.0068	Not applicable	Not applicable
Nonhazardous solid	148	Not applicable [m]	Not applicable [m]	0.42

[a] See definitions in Section B.12.1.

[b] The estimated additional amounts of waste generated annually are compared with the annual site treatment capacities. The estimated total amounts of additional waste generated over the assumed 35-year operational period are compared with the site storage and disposal capacities.

[c] Refer to Section 3.4.11 for a discussion on waste classification and treatment.

[d] This waste would be stored onsite pending availability of a suitable repository. It is assumed this waste would be remotely handled.

[e] Liquid low-level radioactive waste is processed through an evaporator for volume reduction. The evaporator bottoms are stored as a concentrated solution.

[f] The solid low-level radioactive waste would not be treated onsite.

[g] Refer to the text for a discussion of potential limitations of the onsite storage capacity for solid low-level radioactive waste and the probable solution.

[h] It is anticipated that solid low-level radioactive waste and solid mixed low-level radioactive waste would be disposed of at an offsite facility.

[i] In the short-term, the Toxic Substances Control Act Incinerator would be used for the treatment of solid mixed low-level radioactive waste. If this facility is shut down, the site's management and integration contractor would identify other options for treatment of this waste.

[j] Refer to the text for a discussion of potential limitations of the onsite storage capacity for solid mixed low-level radioactive waste and the probable solution.

[k] Although there is some treatment and storage capacity for hazardous waste, this waste would be shipped offsite to permitted commercial facilities.

[l] The nonhazardous process wastewater would be discharged to a permitted outfall or otherwise disposed of offsite after onsite treatment.

[m] Solid nonhazardous waste would be taken to the Oak Ridge Y-12 landfill for disposal.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079; from kilograms to pounds, by 2.2046.

Source: DOE 2000f.

Low-level radioactive waste at ORNL would be treated, packaged, certified, and accumulated before transfer for additional treatment and disposal at on- and offsite facilities. Annual liquid low-level radioactive waste generation (including mixed low-level radioactive waste—see Table 4–9) that would be associated with target fabrication and processing in REDC is estimated to be 0.13 percent of the 19,908-cubic-meter-per-year (26,040-cubic-yard-per-year) site treatment capacity. If all the liquid low-level radioactive waste generated over the 35-year operational period were stored onsite, the amount would represent 24 percent of the 3,646-cubic-meter (4,769-cubic-yard) storage capacity at ORNL (DOE 2000f). Storage capacity would not be exceeded, because liquid low-level radioactive waste is continually treated by evaporation, which significantly reduces the volume.

Solid low-level radioactive waste would not be treated onsite. If all the solid low-level radioactive waste generated over the 35-year operational period were stored onsite, the amount would represent 2.6 percent of the 47,000-cubic-meter (61,500-cubic-yard) storage capacity at ORNL. If account is taken of the existing inventory of solid low-level radioactive waste (41,000 cubic meters [53,600 cubic yards]) and of its present generation rate (7,000 cubic meters [9,160 cubic yards] per year), sufficient storage capacity probably would not be available. However, this should be considered only an interim situation. Arrangements are being made that would allow the solid low-level radioactive waste to be treated and disposed of offsite at another DOE site or at a commercial facility, thereby eliminating any onsite storage problems, including the storage capacity limitations at ORNL. Management of the additional low-level radioactive waste from 35 years of operating REDC to fabricate and process neptunium-237 targets would not have a major impact on ORNL's ability to manage low-level radioactive waste (DOE 2000f).

Canisters used to transport neptunium-237 to ORNL would constitute a very small amount of solid low-level radioactive waste—less than 10 cubic meters (13.1 cubic yards) over the 35-year operational period, even if no credit is taken for volume reduction by compaction (DOE 2000f). Annual generation of this waste would fall within the range of accuracy of the generation rate of solid low-level radioactive waste provided in Table 4–9, and its management is not addressed separately.

Mixed low-level radioactive waste associated with target fabrication and processing at ORNL would be stabilized, packaged, and stored onsite for treatment and disposal in a manner consistent with the site treatment plan. Liquid mixed low-level radioactive waste is reported as low-level radioactive waste; generation and management of this waste are covered under the low-level radioactive waste discussion above. Solid mixed low-level radioactive waste generation is estimated to be less than 2.2 percent of the 227-cubic- meter-per-year (297-cubic-yard-per-year) site treatment capacity. If all the solid mixed low-level radioactive waste generated over the 35-year operational period were stored onsite, the amount would represent less than 0.57 percent of the 30,780-cubic-meter (40,260-cubic-yard) storage capacity at ORNL. However, if account is taken of the existing inventory of solid mixed low-level radioactive waste (24,964 cubic meters [32,700 cubic yards]) and of its present generation rate (801 cubic meters [1,050 cubic yards] per year), part or all of the storage capacity may not be available. As is the case for the solid low-level radioactive waste, solid mixed low-level radioactive waste could be disposed of offsite at another DOE site or at a commercial facility, thereby eliminating any onsite storage problems, including the storage capacity limitations at ORNL. Managing the small additional quantities of mixed low-level radioactive waste that would be generated at ORNL would not impact ORNL's management of this type of waste (DOE 2000f).

At ORNL, hazardous waste associated with the fabrication and processing of neptunium-237 targets at REDC would be packaged in DOT-approved containers and shipped offsite to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operational period would have only a minimal impact on ORNL's management of hazardous waste (DOE 2000f).

Nonhazardous solid waste associated with target fabrication and processing in REDC would be packaged in conformance with standard industrial practices and disposed of in the onsite landfills. If all the nonhazardous solid waste generated over the 35-year operational period were disposed of in Industrial Landfills V and VI, only 0.42 percent of the 1,219,000-cubic-meter (1,594,000-cubic-yard) total capacity of these landfills would be needed. Nonhazardous sanitary wastewater from REDC operations would be discharged to the sanitary wastewater treatment facility. Nonhazardous process wastewater would be processed, as necessary, in the wastewater treatment facilities before discharge to an outfall or other offsite disposal facility. The additional solid and liquid waste loads would have only a minimal impact on nonhazardous waste management at ORNL (DOE 2000a).

The generation rates of waste at ORNL associated with this alternative (see Table 4–9) can be compared with the current waste generation rates at the site, provided in Table 3–52. The waste generation rates associated with plutonium-238 production would be much smaller than the current waste generation rates at the site (DOE 2000f).

The expected generation rates of waste at LANL associated with operation of the Plutonium Facility to purify, pelletize, and encapsulate the plutonium-238 are compared with LANL's sitewide 2003 waste generation rate in **Table 4–10**. Waste generation rates for the Plutonium Facility are less than 3 percent of the annual sitewide waste generation rates and are not expected to adversely affect the LANL waste management infrastructure.

Table 4–10 Incremental Waste Management Impacts of Operating the Plutonium Facility at Los Alamos National Laboratory Under the No Action Alternative

Waste Type	*Annual Generation Rate (cubic meters, except as noted)*	*Annual LANL 2003 Sitewide Generation Rate (cubic meters, except as noted)*	*Percent of Sitewide Generation*
Transuranic	13	560	2.3
Low-level radioactive	150	5,625	2.7
Mixed low-level radioactive	0.34	36	0.9
Hazardous [a]	< 1 kilogram	689,000 kilograms	Less than 0.0001 percent

LANL = Los Alamos National Laboratory.

[a] The amount of hazardous waste generated at the LANL Plutonium Facility at TA-55 for the production of heat sources is very small. The hazardous waste generated from TA-55 overall operations is insignificant compared to other facilities at LANL.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079; from kilograms to pounds, by 2.2046.

Source: LANL 2004b.

4.1.11.2 Waste Minimization and Pollution Prevention

As previously described, this alternative would result in continued waste generation. Waste generation activities would be scrutinized to identify opportunities for waste minimization. Wastes would be minimized where feasible by: (1) recycling; (2) processing waste to reduce its quantity, volume, or toxicity; (3) substituting materials or processes that generate hazardous wastes with others that result in less hazardous wastes; and (4) segregating waste materials to prevent contamination of nonradioactive and nonhazardous materials.

4.1.12 Environmental Restoration Program

The cleanup of past releases of contaminants at INL, ORNL, and LANL is occurring under applicable Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations and consent agreements. Because current activities would continue in existing facilities under the No Action Alternative, no impacts on the Environmental Restoration Program are anticipated.

4.2 Consolidation Alternative

A detailed description of the Consolidation Alternative is presented in Section 2.2.2 of this EIS.

Information on impacts of continued operation of the FMF storage facility and ATR at INL was compiled from the *NI PEIS* (DOE 2000f). The impacts of construction and operation of the new RPS nuclear production facilities at MFC at INL are largely based on the *Consolidation EIS* information document (INL 2005c). The impacts of Assembly and Testing Facility operation at INL are based on the *FONSI and Mound EA* (DOE 2002c). Under this alternative, the Plutonium Facility at LANL would continue to support RPS nuclear production operations until 2011 when the new Plutonium-238 Facility becomes operational. The impacts from purification, pelletization, and encapsulation operations would be the same as described under the No Action Alternative. After 2011, these operations would be conducted at the new Plutonium-238 Facility at INL.

4.2.1 Land Resources

4.2.1.1 Land Use

Construction and Operations Impacts—Under the Consolidation Alternative, FMF at MFC, ATR, and the Assembly and Testing Facility at INL would continue to be used. There would be no change or effect on land use at INL from the continued use of these facilities because no additional land would be disturbed, and the use of existing facilities would be compatible with their present missions (DOE 2000f).

Total land disturbance during construction of the new Plutonium-238 Facility at MFC, its associated Support Building, and the Radiological Welding Laboratory (an addition to existing to Building 772 at MFC) would involve approximately 24 hectares (60 acres). Permanent disturbance, consisting of land used for buildings and parking lots, would impact approximately 12 hectares (30 acres). The remaining 12 hectares (30 acres) would be used for temporary construction laydown areas, trailers, and parking (INL 2005c). All of the new facilities would be located on previously disturbed land within the MFC Property Protected Area, and would be compatible with existing land use practices.

As part of the Consolidation Alternative, DOE would construct a paved, nonpublic service road from MFC to ATR for tractor/trailer transfers of radioactive materials. Figure 2-12 shows three potential routes for the new road, each of which would be located wholly on DOE INL land. The northern most route would extend westward from MFC for approximately 22 kilometers (14 miles) and generally follows the existing unimproved T-3 Road, where it would then connect with another existing gravel road near the Old Dairy Farm Project. This gravel road would be followed for approximately another 2.4 kilometers (1.5 miles) to its intersection with existing improved roads accessing the RTC. The entire route following T-3 Road and the dairy gravel road, 24 kilometers (15 miles) long, would be improved and paved with asphalt. Total land disturbance during construction of this new road would involve approximately 51 hectares (125 acres). Permanent disturbance, consisting of the land used from the pavement width and granular shoulders on either side, would impact approximately 36 hectares (90 acres) (INL 2005c).

The T-24 Road is an alternative route for the proposed new road between MFC and RTC and is located south of the T-3 Road. Approximately 16 kilometers (10 miles) would need to be paved from MFC until the road reaches the Critical Infrastructure Test Range Complex (CITRC) (formerly the Power Burst Facility) and connects to internal roads leading to RTC (INL 2005c). Total land disturbance during construction of this route would involve approximately 34 hectares (85 acres), with permanent disturbance impacting approximately 24 hectares (60 acres).

The East Power Line Road is another possible route that could lead from MFC to RTC. The East Power Line Road is currently maintained to a higher level than the other two jeep trails because of ongoing activities related to power line maintenance. Approximately 19 kilometers (12 miles) would need to be paved before the new road connects to internal INL paved roads at CITRC (INL 2005c). Total land disturbance during construction of this route would involve approximately 40 hectares (100 acres), with permanent disturbance impacting approximately 28 hectares (70 acres).

Impacts on land use along each of the proposed corridors would occur within the INL Central Core Area and would be compatible with associated land use practices. Impacts on previously undisturbed land could occur due to widening of the existing roadbed and use of heavy equipment, as well as if the new road does not completely follow the existing unimproved roads.

4.2.1.2 Visual Environment

Construction and Operations Impacts—Under the Consolidation Alternative, FMF, ATR, and the Assembly and Testing Facility would continue to be used. There would be no impact on visual resources from the continued use of these facilities since the current Visual Resource Management Class IV rating would not change.

Impacts on visual resources resulting from construction of consolidated RPS production facilities at MFC would be temporary in nature and could include increased levels of dust and human activity. Once completed, the general appearance of the one- to two-story facilities would be consistent with the other buildings located in MFC. Although these new facilities would add to the overall development of MFC and would likely be visible from Idaho State Route 20, they would not alter the industrial nature of the area. Accordingly, the current Class IV Visual Resource Contrast rating for MFC would not change.

Impacts on visual resources resulting from construction of the new road connecting MFC and ATR would include temporary increased levels of dust and human activity. In addition, completion and operation of the new road would alter the visual environment and likely change the Visual Resource Contrast ratings at undeveloped points along this corridor from Class II and Class III to Class III and Class IV.

4.2.2 Site Infrastructure

Construction Impacts—The projected annualized demands on site utility infrastructure resources associated with site construction under the Consolidation Alternative are presented in **Table 4–11**. Resources would be consumed in the construction of the new Plutonium-238 Facility at MFC, its associated Support Building, and the Radiological Welding Laboratory (an addition to existing Building 772 at MFC). A new road would be constructed to connect MFC and RTC.

Electric power needed to operate portable construction and supporting equipment would be supplied by portable diesel-fired generators. Therefore, there would be no electrical energy consumption directly associated with construction. A variety of heavy equipment, motor vehicles, and trucks would be deployed in both new facility and road construction, which would consume diesel fuel and gasoline. Propane-fired equipment would also be used. Liquid fuels would be brought to the site as needed from offsite sources and, therefore, would not be limited resources. Water requirements would be driven primarily by the need to provide dust control and aid soil compaction at the construction sites, and possibly for equipment washdown. Water would not be required for concrete mixing, as ready-mix concrete would be procured from offsite sources (INL 2005c). Portable sanitary facilities would be provided to meet the workday potable and sanitary needs of construction personnel on the site, which would constitute a relatively small percentage of the total water demand. It is expected that water would be trucked to the point of use as needed.

Over the 2-year construction period, total liquid fuel consumption is estimated to be 750,000 liters (198,000 gallons); including 204,000 liters (54,000 gallons) of diesel fuel; 397,000 liters (105,000 gallons) of gasoline; and 148,000 liters (39,000 gallons) of propane. Total water consumption is estimated to be 1,640,000 liters (432,000 gallons). The existing INL infrastructure would easily be capable of supporting the requirements for new facility construction without exceeding site capacities, resulting in negligible impact onsite utility infrastructure.

Table 4–11 Annual Utility Infrastructure Requirements for New Construction Under the Consolidation Alternative

Resource	*Available Site Capacity* [a]	*INL* [b]			*Percent of Available Site Capacity*
		New Road	*New Facilities at MFC*	*Total*	
Transportation					
Roads (kilometers)	Not applicable	24	0	22	Not applicable
Electricity					
Energy (megawatt-hours per year)	325,161	0	0	0	0
Peak load (megawatts)	19	0	0	0	0
Fuel					
Diesel fuel (liters per year)	Not limited [c]	(d)	(d)	103,000	Not applicable
Gasoline (liters per year)	Not limited [c]	(d)	(d)	199,000	Not applicable
Propane (liters per year)	Not limited [c]	(d)	(d)	74,000	Not applicable
Water (million liters per year)	38,800	(d)	(d)	0.82	0.002

INL = Idaho National Laboratory, MFC = Materials and Fuels Complex.

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 3–2 of this *Consolidation EIS*.

[b] Reflects additional demand in excess of existing MFC facilities proposed for use under this alternative. Includes construction of the road along the longest (northern most) route.

[c] Capacity is limited only by the ability to ship resource to the site.

[d] Projected consumption of liquid fuels and water is not split between new road and new building construction.

Note: To convert from kilometers to miles, multiply by 0.62137; from liters to gallons, by 0.26418.

Sources: Table 3–2 of this *Consolidation EIS,* INL 2005c, DOE 2002c.

Operations Impacts—The projected annualized demands onsite utility infrastructure resources associated with operations under the Consolidation Alternative are presented in **Table 4–12**. It is projected that existing INL and MFC infrastructure resources would be adequate to support proposed mission activities over 35 years.

As with the No Action Alternative, no incremental infrastructure usage would be associated with irradiation of neptunium-237 targets in ATR under the Consolidation Alternative because this reactor is already in continuous operation for other purposes (DOE 2000f). Similarly, storage of neptunium-237 targets in the existing FMF would have a negligible incremental impact on infrastructure demands. Operation of the new Plutonium-238 Facility at MFC, Support Building, and Radiological Welding Laboratory would have a minor incremental impact on utility infrastructure resources, as would RPS assembly and testing in the Assembly and Testing Facility.

The increased electric power load of the new facilities would be accommodated by a new substation equipped with two 2-megavolt-amphere-capacity (equivalent to approximately 3.2 megawatts) transformers. Additional fuel oil would be consumed by an existing heat plant at MFC to provide steam heat for the new facilities. Diesel fuel and gasoline would be consumed primarily by motor vehicles, including maintenance, delivery, and service trucks. This includes trucks used to transport neptunium-237 targets and irradiated targets between MFC and the RTC (INL 2005c). Emergency generators would also consume diesel fuel on an as-needed basis. Liquid fuels would be brought to the site as needed from offsite sources and, therefore, would not be limited resources. Water to meet the process, cooling, potable, and sanitary needs of the mission facilities would be supplied via the existing MFC water supply and distribution system.

Table 4–12 Annual Infrastructure Requirements for Facility Operations Under the Consolidation Alternative

Resource	Available Site Capacity [a]	MFC at INL [b]			Percent of Available Site Capacity
		New Facilities	SSPSF [c]	Total	
Electricity					
Energy (megawatt-hours per year)	325,161	8,600	2,039	10,639	3.3
Peak load (megawatts)	19	1.2 [d]	0.30 [d]	1.5	7.9
Fuel					
Fuel oil (liters per year)	Not limited [e]	800,000 [f]	189,000	989,000	Not applicable
Diesel fuel (liters per year)	Not limited [e]	87,000	0	87,000	Not applicable
Gasoline (liters per year)	Not limited [e]	16,300	0	16,300	Not applicable
Propane (liters per year)	Not limited [e]	0	0	0	Not applicable
Water (million liters per year)	38,800	47	28	75	0.19

MFC = Materials and Fuels Complex, INL = Idaho National Laboratory, SSPSF = Space and Security Power Systems Facility.

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 3–2 of this *Consolidation EIS*.

[b] Reflects additional demand in excess of existing MFC facilities proposed for use under this alternative.

[c] Also known as the Assembly and Testing Facility.

[d] Peak load estimated from average electrical energy usage, assuming peak load is 120 percent of average demand.

[e] Capacity is limited only by the ability to ship resource to the site.

[f] Fuel oil consumption estimated from increase in heating demand to accommodate floor area of new facilities.

Note: To convert from liters to gallons, multiply by 0.26418.

Source: INL 2005c.

4.2.3 Geology and Soils

***Construction Impacts*—**Impacts on geology and soils under the Consolidation Alternative would generally be directly proportional to the total area of land disturbed by site grading and grubbing, soil compaction work, and the depth of construction associated with the new facilities. Consumption of geologic resources, including rock, mineral, and soil resources, to support new facility and road construction would constitute an indirect impact on geologic and soil resources.

New facility construction under this alternative would disturb about 24 hectares (60 acres) of land, while construction of the new road would disturb up to an additional 51 hectares (125 acres). For new facility construction, the area of disturbance includes temporary disturbance for construction laydown areas, construction parking, and temporary access roads. It also includes disturbance involved with trenching and excavation work necessary to install piping, utilities, and other conveyances between buildings and other facilities. Much of the area to be disturbed by construction of the new Plutonium-238 Facility at MFC, Support Building, and Radiological Welding Laboratory has been lightly disturbed previously, while the right-of-way for construction of the new road would follow existing unimproved roads to the extent possible (INL 2005c). Surface soils and unconsolidated sediments exposed in excavations would be subject to wind and water erosion if left exposed over an extended period of time. Adherence to standard best management practices for soil erosion and sediment control, including watering, during construction would serve to minimize soil erosion and loss. After construction, temporarily disturbed areas would be stabilized and/or revegetated and would not be subject to long-term soil erosion.

For construction of the basement level production wing of the new Plutonium-238 Facility at MFC, excavation depths of up to 4.6 meters (15 feet) may be necessary. Because of the presence of basalt outcrops in the MFC area and the general shallow depth to bedrock, rock excavation and/or blasting could be necessary. However, the site for construction of the Plutonium-238 Facility at MFC that is directly south of the Assembly and Testing Facility was selected to minimize rock removal for basement excavation and trenching for utility lines (INL 2005c). A site survey and foundation study would be conducted as necessary to confirm site geologic characteristics for facility engineering purposes.

New facility and road construction would require modest volumes of geologic resources. In addition to concrete (produced from cement, sand, and gravel), additional geologic resources in the form of borrow materials would be required for site grading, backfilling, and other construction-related uses as shown in **Table 4–13**. Total borrow material demand is estimated at 255,000 cubic meters (334,000 cubic yards). Project planning calls for ready-mix concrete and asphalt (comprised of bitumen and aggregate) to be procured from offsite resources, with aggregate (sand and gravel, crushed stone) and fill (soil and sediment) obtained from onsite quarries and borrow areas, including rye grass flats, Spreading Areas A, and the Water Reactor Research Test Facility (DOE 1997a). Construction activities are not expected to deplete available deposits or stockpiles of these materials, as they are widely available in the region. Offsite commercial quarries could supplement onsite sources if needed.

Table 4–13 Geologic and Soil Resource Requirements for New Construction Under the Consolidation Alternative

Geologic Resource (cubic meters)	*MFC at INL*		
	New Road [a]	*New Facilities*	*Total*
Construction Materials			
Concrete	0	31,600	31,600
Asphalt	20,700	400	21,100
Borrow Materials			
Aggregate	91,900	7,300	99,200
Fill (soil)	73,500	82,300	155,800

MFC = Materials and Fuels Complex, INL = Idaho National Laboratory.
[a] For longest route.
Note: To convert from cubic meters to cubic yards, multiply by 1.3079.
Source: INL 2005c.

As discussed in Section 3.2.3.1, the Eastern Snake River Plain on which INL is situated is a region of relatively low seismicity, although higher rates of seismic activity are indicated for regions in the surrounding Basin and Range Physiographic Province. Ground shaking of MMI VI (see Table B–7) has been reported on the site in the recent past associated with a major earthquake located in the Borah Peak Range northwest of INL. Otherwise, relatively few and minor earthquakes have occurred in the area surrounding INL. MMI VI shaking typically causes only slight damage to structures, while MMI VII activity is expected to primarily affect the integrity of inadequately designed or nonreinforced structures, but damage to properly or specially-designed or upgraded facilities is not expected. Nevertheless, two fault segments in the vicinity of INL are considered potentially active. The closest fault (the Howe Segment of the Lemhi Fault) is located 31 kilometers (19 miles) northwest of MFC. The likelihood of future volcanic activity along the Axial Volcanic Zone during the 35-year project period is considered low. The potential for nontectonic events to affect MFC facilities is also low.

All new facilities would be designed, constructed, and operated in compliance with applicable DOE Orders, requirements, and governing standards that have been established to protect public and worker health and the environment. DOE Order 420.1A requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that the public, workers, and environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes. The Order stipulates natural phenomena hazards mitigation requirements for DOE facilities and specifically provides for reevaluation and upgrade of existing DOE facilities when there is a significant degradation in the safety basis for the facility. DOE Standard 1020-2002 implements DOE Order 420.1A and provides criteria for design of new structures, systems, and components and for evaluation, modification, or upgrade of existing structures, systems, and components so that DOE facilities safely withstand the effects of natural phenomena hazards, such as earthquakes. The criteria specifically reflect adoption of the seismic design and construction provisions of the *International Building Code* for DOE Performance Category 1 and 2 facilities. An analysis of potential effects of a beyond-design-basis earthquake on human health and the environment is provided in Section 4.2.9.2.

Operations Impacts—Operations of the new facilities at MFC are expected to result in minimal impacts on geologic and soil resources at INL, and the new facilities would not preclude use of rare or otherwise valuable geologic or soil resources. Accordingly, neptunium-237 storage in FMF and operation of ATR would have minimal operational impact on geology and soils (see Section 4.1.3).

As discussed above, the proposed new facilities and uses at MFC would be evaluated, designed, and constructed in accordance with DOE Order 420.1A and sited to minimize the risk from geologic hazards, including earthquakes. Further, seismic conditions present a low risk to properly designed facilities such as the existing MFC facilities proposed for use under this alternative. Thus, site geologic conditions would not likely affect the facilities during the 35-year project period.

4.2.4 Water Resources

4.2.4.1 Surface Water

Construction Impacts*—Surface water* would not be used to support construction of new facilities or facility modifications under the Consolidation Alternative. Groundwater is the source of water at MFC and across INL.

Construction personnel would generate sanitary wastewater. As project plans call for use of portable sanitary facilities during new facility construction, there would be no onsite discharge of sanitary wastewater and no impact on surface water quality. Waste generation and management activities are detailed in Section 4.2.11.1.

The potential for stormwater runoff from construction areas to impact downstream surface water quality is small. Surface drainages in the vicinity of MFC are poorly defined and ephemeral, while infiltration to the subsurface is relatively rapid on unconsolidated sediment. Further, the closest major surface water drainage is more than 20 kilometers (12 miles) west of MFC. Any effects on runoff quality would likely be very localized and of short duration. Appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) and spill prevention practices would be employed during construction to minimize suspended sediment and material transport and potential water quality impacts. Specifically, in accordance with INL's General Permit for Storm Water Discharges from Construction Sites, the *INEEL Storm Water Pollution Prevention Plan for Construction Activities* provides for measures and controls to prevent pollution of stormwater from construction activities at INL (see Section 3.2.4.1). MFC is not located in an area prone to flooding, as the complex is 82 meters (270 feet) feet higher and approximately 18 kilometers (11 miles) away from the nearest potential source of river flooding (ANL 2003).

Figure 2–12 shows three potential routes for the new road. DOE regulations (10 CFR 1022) for implementation of Executive Order 11988, Floodplain Management require that a floodplain assessment be prepared for any proposed action located in a base (100-year) or critical action (500-year) floodplain. New construction on the southern two routes would not cross major stream drainages and would not be in the 100 or 500-year floodplains, and therefore would not impact surface water resources. The northernmost route that parallels the T-3 Road (old stagecoach trail) could affect the Big Lost River floodplain. Appendix F of this EIS contains a Preliminary Floodplain/Wetland Assessment.

Operations Impacts—No surface water would be used to support facility activities, and there would be no direct discharge of sanitary or industrial effluent to surface waters from facility operations. All wastewater would be collected and conveyed to existing wastewater treatment facilities. Nonhazardous wastewater (primarily sanitary) would comprise the majority of the liquid effluent generated by the proposed facilities as presented in **Table 4–14**.

Table 4–14 Annual Water Use and Wastewater Generation Associated with Operating Facilities Under the Consolidation Alternative

Indicator (million liters per year)	*MFC at INL*		
	New Facilities	*SSPSF* [a]	*Total*
Water use	47	28	75
Process wastewater generation	0.023	none	0.023
Sanitary wastewater generation	47 [b]	28 [b]	75

MFC = Materials and Fuels Complex, INL = Idaho National Laboratory, SSPSF = Space and Security Power Systems Facility.

[a] Also known as the Assembly and Testing Facility.

[b] Assumes all water used becomes sanitary wastewater.

Note: To convert from liters to gallons, multiply by 0.26418.

Sources: DOE 2002c, INL 2005c.

Specifically, sanitary wastewater would be generated from operations personnel use of lavatory, shower, and break-room facilities and from miscellaneous physical plant (e.g., HVAC) uses. Sanitary wastewater would be disposed of in the MFC sanitary lagoons. An estimated 23,000 liters (6,100 gallons) per year of process wastewater would also be generated associated with target processing in the Plutonium-238 Facility at MFC. This wastewater would be collected, processed, and eventually shipped by a specially equipped tanker trailer truck to the Radioactive Liquid Waste Treatment Facility for final disposal. There would be no radiological liquid effluent discharge to the environment under normal operations. Waste generation and management activities are detailed in Section 4.2.11.1.

The design and operation of new facility areas would incorporate appropriate stormwater management controls to safely collect and convey stormwater from facilities while minimizing washout and soil erosion. Also, in accordance with INL's Storm Water Multi-Sector General Permit for stormwater discharges associated with industrial activity, the *INEEL Storm Water Pollution Prevention Plan for Industrial Activities* provides for baseline and tailored controls and measures to prevent pollution of stormwater from industrial activities at INL (see Section 3.2.4.1). Overall, no measurable impacts on surface water resources are expected as a result of facility operations at MFC under this alternative.

4.2.4.2 Groundwater

Construction Impacts—Water would be required during construction for uses such as dust control and soil compaction, equipment washing and flushing activities, and to meet the potable and sanitary needs of construction employees. Water use by construction personnel would be greatly reduced over that normally required by the use of portable toilets. As outlined in Section 4.2.2, water would not be required for mixing concrete, as ready-mix concrete would be brought from offsite. As a result, it is estimated that new facility and road construction activities would require about 1,640,000 liters (432,000 gallons) of groundwater during the 2-year construction period (see Section 4.2.2). It is anticipated water would be trucked to the point of use. The relatively small volume of groundwater required during the period of construction compared to site availability and historic usage indicates that construction withdrawals should not have an additional impact on regional groundwater levels or availability. As the depth of groundwater is some 183 meters (600 feet), construction dewatering would not be required for construction of the below-grade portions of the Plutonium-238 Facility at

MFC. Facility construction would be unlikely to have any direct impact on groundwater hydrology or contaminant plumes under this alternative.

There would be no onsite discharge of wastewater to the surface or subsurface during construction, and appropriate spill prevention controls, countermeasures, and procedures would be employed to minimize the chance for petroleum, oils, lubricants, and other materials used during construction to be released to the surface or subsurface and to ensure that waste materials are properly disposed of. Waste generation and management activities are detailed in Section 4.2.11.1. In general, minimal impact on groundwater availability or quality is anticipated.

Operations Impacts—Facilities supporting RPS nuclear production operations at MFC would use groundwater primarily to meet the potable and sanitary needs of facility support personnel, as well as for miscellaneous building physical plant uses. Total annual water usage is estimated at 74.4 million liters (19.7 million gallons). As this demand would be a small fraction of existing INL and MFC usage and would not exceed site capacity (see Table 4–12), no additional measurable impact on regional groundwater levels or availability is anticipated.

No sanitary or industrial effluent would be directly discharged to the surface or subsurface, as discussed in Section 4.2.4.1. Waste generation and management activities are detailed in Section 4.2.11.1. Thus, minimal operational impacts on groundwater quality are expected.

4.2.5 Air Quality and Noise

4.2.5.1 Air Quality

Nonradiological Releases

It is estimated that there would be no measurable nonradiological air pollutant emissions at INL associated with storage of neptunium-237 in FMF and irradiation of neptunium-237 targets in ATR. Therefore, there would be no nonradiological air quality impacts of these activities (DOE 2000f).

Construction and Operations Impacts—of the new Plutonium-238 Facility at MFC, Support Building, and Radiological Welding Laboratory at MFC at INL would result in temporary increases in criteria and toxic pollutant emissions. The sources of these emissions would include diesel- and gasoline-fueled construction equipment, employee and shipping vehicles, and exposed soil, resulting in suspension of PM by equipment activity and wind. These emissions are not expected to result in the ambient standards being exceeded. Measures such as watering would be used to mitigate any potential impacts of PM emissions during construction (DOE 2002c).

Air pollutant concentrations at INL attributable to neptunium-237 target fabrication and processing activities and plutonium-238 purification, pelletization, and encapsulation operations at MFC at INL are presented in **Table 4–15**. The increase in emissions would be from increased operation of the four boilers to provide heat for the facilities and testing of an emergency diesel generator. The increase in emissions was assumed to be proportional to the increase in square footage, which is about 20 percent. This increase in use of the boilers would be well within the capacity of the existing boilers. Each of the boilers has a specific permit limit on the level of emissions. Operations would not result in the boilers exceeding their permitted levels of emissions. The concentrations are based on a dispersion-modeling screening analysis conducted with maximum expected emission rates and a set of worst-case meteorological conditions. Criteria pollutants were modeled for a stack height of 15 meters (50 feet) at the boundary limit of 6.4 kilometers (4 miles). The concentrations were determined to be small and would be below the applicable standard even when ambient monitored values and the contributions from other site activities were included. Small quantities of toxic air pollutants would be emitted from operation of this facility. Emissions would include small quantities of solvents from cleaners and adhesives, alcohol, leak-test fluids, lubricants, and acids. Health effects of hazardous chemicals associated with this alternative are addressed in Section 4.2.9.

Table 4–15 Incremental Idaho National Laboratory Air Pollutant Concentrations [a] Associated with Operating Facilities Under the Consolidation Alternative

Pollutant	*Averaging Period*	*Most Stringent Standard (micrograms per cubic meter)*	*Modeled Increment (micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	10,000 40,000	0.076 0.11
Nitrogen dioxide	Annual	100	0.025
PM_{10}	Annual 24 hours	50 150	0.0020 0.016
$PM_{2.5}$	Annual 24 hours	15 65	0.0020 [b] 0.016 [b]
Sulfur dioxide	Annual 24 hours 3 hours	80 365 1,300	0.041 0.33 0.74

PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

[a] For comparison with ambient air quality standards.

[b] Assumed to be the same as PM_{10}, as data for $PM_{2.5}$ were not available.

Source: Modeled increments are based on the SCREEN3 computer code and emission estimates for increased boiler use, INL 2005c.

The primary source of criteria pollutant emissions from operation of the Assembly and Testing Facility for RPS assembly and testing would be from burning fuel oil in the boilers that provide heat and power for the facilities at INL. As described above, each of the boilers has a specific limit on the level of emissions. Operation of the Assembly and Testing Facility would not result in the boilers exceeding their permitted levels of emissions. Small quantities of toxic air pollutants would be emitted from use of small quantities of various chemicals for assembly and testing operations (DOE 2002c).

Construction of the proposed new road from MFC to ATR at INL would result in temporary increases in criteria and toxic pollutant emissions. The sources of these emissions would include diesel- and gasoline-fueled construction equipment, construction worker and delivery vehicles, and exposed soil resulting in suspension of PM by equipment activity and wind. Actual equipment use would be intermittent and would depend on the phase of construction activity and the construction schedule. It is expected that most of the new road construction would be performed during daytime hours. These emissions are not expected to result in the ambient standards being exceeded. Measures such as watering would be used to mitigate any potential impacts of PM emissions during construction (INL 2005c).

Increases in air pollutant emissions from operations under this alternative are expected to be small and not subject to PSD regulations. Therefore, a PSD increment analysis is not required (see Section B.4.1).

The Final Rule for "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" requires a conformity determination for certain-sized projects in nonattainment areas. DOE has performed a review for this alternative and concluded that a conformity determination is not necessary to meet the requirements of the Final Rule, because INL is located in an attainment area for all criteria pollutants, and threshold emission levels would not be exceeded by the activities considered (DOE 2000c). See Section D.5.2 for a discussion of the human health risks from pollutants emitted by transport vehicles.

Radiological Releases

Construction Impacts—While no radiological releases to the environment are expected in association with RPS consolidation construction activities at MFC, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of contamination and would be required to clean-up contamination in accordance with procedures established under INL's Environmental Restoration Program and INL's Hazardous Waste Facility Permit.

Operations Impacts—Radioactive releases associated with storage of neptunium-237 at FMF would be essentially zero, as the canisters containing the neptunium-237 would remain in containment vessels during storage. An estimated 1.7×10^{-7} curies per year of plutonium-238 could be released to the environment during target fabrication and post-irradiation processing operations, and about 1.0×10^{-8} curies per year of plutonium-238 could be released to the environment from purification, pelletization, and encapsulation operations at the Plutonium Facility at LANL and the Plutonium-238 Facility at MFC (see Section C.2.1.4). There would be no incremental releases to the environment from ATR during target irradiation, because there would be no increase in activities in this reactor due to additional target irradiation. No releases are expected from the RPS Assembly and Testing Facility at MFC, because the facility would handle only fully encapsulated radioactive material. There would be no other types of radiological releases from RPS nuclear production operations. Impacts of radiological releases are discussed in Section 4.2.9.

4.2.5.2 Noise

Construction Impacts— Construction of the new Plutonium-238 Facility, Support Building, and Radiological Welding Laboratory at MFC at INL would result in minor and temporary construction noise. This noise would be typical of other construction projects at INL and would result in minor noise impacts onsite near the facility. Offsite noise levels would not be noticeable, as the nearest site boundary is 6.4 kilometers (4 miles) to the south-southeast.

Construction of the new road from MFC to ATR would result in minor and temporary construction noise. Noise sources from road construction would include trucks, generators, graders, scrapers, dozers, backhoes, asphalt pavers, compactors, and front-end loaders. The noise would be typical of other construction projects at INL, except the noise would be dispersed along the road. It is expected that most of the road construction would be performed during daytime hours, and that this work would result in minor noise impacts onsite along the route. Offsite noise impacts would be minor, as the nearest site boundary is more than 6.4 kilometers (4 miles) distant (INL 2005c).

Operations Impacts—Operations in FMF and the Assembly and Testing Facility at MFC, and the ATR at RTC, would generate noise levels similar to those presently associated with operations conducted in these areas of INL. Onsite noise impacts are expected to be minimal, and offsite noise levels should not be noticeable, as the nearest site boundary is 6.4 kilometers (4 miles) from MFC and 11 kilometers (6.8 miles) from RTC. Increases in traffic would be small and would result in only minor on and offsite noise levels. There would be no loud noises associated with these operations that would adversely impact wildlife (DOE 2000f, 2002c).

Noise associated with neptunium-237 target fabrication and processing at the new Plutonium-238 Facility at MFC would be similar to sound levels generated by other operations at MFC. Onsite noise impacts are expected to be minimal, and offsite noise levels would not be noticeable because the nearest site boundary is 6.4 kilometers (4 miles) to the south-southeast. Traffic associated with neptunium-237 target fabrication and processing activities at the Plutonium-238 Facility at MFC would be minor and would not lead to noticeable noise levels either on or offsite. There would be no loud noises associated with target fabrication and processing that would adversely impact wildlife.

4.2.6 Ecological Resources

Construction Impacts—A number of existing INL facilities would be used under the Consolidation Alternative. These include FMF (for storage of neptunium-237), ATR (for neptunium-237 target irradiation), and the Assembly and Testing Facility (for RPS assembly and testing). There would be no impacts on ecological resources of use of these facilities under this alternative, as they are existing facilities within developed areas, and their use would not result in a meaningful increase in noise or change in water use or wastewater discharge.

Operations Impacts—Measurable impacts on populations of plants and animals on or off INL are not expected as a result of the incremental increase in exposure to radionuclides or chemicals that could result from operation of facilities under this alternative. DOE routinely samples game species residing on INL, livestock that have grazed on INL, locally grown crops, and milk around INL for radionuclides. The results of this monitoring are reported in the *INEEL Site Environmental Report*, prepared each year. Concentrations of radionuclides in the plant and animal samples have been small and are seldom higher than concentrations observed at control locations distant from INL (DOE 2002e). Additional deposition resulting from implementation of this alternative is not expected to lead to levels of contaminants that would exceed the historically reported ranges of concentrations. Therefore, DOE anticipates minimal impacts on the ecology of INL, and on plant and animal populations, as a result of exposure to radionuclides or chemicals under this alternative.

4.2.6.1 Terrestrial Resources

Construction Impacts—Under the Consolidation Alternative, new construction would take place at INL. Because the Radiological Welding Laboratory (an addition to existing Building 772) would be constructed within the highly developed portion of MFC, direct impacts on terrestrial resources are not expected. Indirect impacts of noise and other disturbance associated with construction could briefly impact wildlife in the immediate area, but such impacts would be minimal, as wildlife use of the area is minimal, and noise impacts would be short term. Any new lighting associated with the Radiological Welding Laboratory would be minimal and is not expected to affect wildlife.

Construction of the Plutonium-238 Facility and associated Support Building at MFC would take place within a currently undeveloped portion of MFC located immediately south of the existing fence line (see Figure 2–9). Construction would disturb 24 hectares (60 acres); however, only 12 hectares (30 acres) would be permanently disturbed once construction is complete (INL 2005c). Construction would remove all vegetation within this area, which consists of big sagebrush habitat, as well as some areas that have been replanted to crested wheatgrass. Although plant communities in which big sagebrush is the dominant overstory species are well represented on INL, they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Mitigation could include reestablishment of shrub-steppe habitat on the 12 hectares (30 acres) disturbed during construction but not required during operations.

Construction of the Plutonium-238 Facility at MFC would affect animal populations. Less-mobile animals within the project area, such as reptiles and small mammals, are not expected to survive. Nests of birds would also be destroyed if construction occurred during the nesting season. To minimize impacts on migratory birds, which are protected under the Migratory Bird Treaty Act, ground disturbance could be scheduled to avoid the breeding season. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. Noise and human disturbance could be minimized by properly maintaining equipment and clearly marking the limits of the construction area.

The northern most route connecting MFC and ATR, generally following the T-3 Road, would traverse 24 kilometers (15 miles) of big sagebrush and grassland habitat. During construction of the new road at INL, up to 51 hectares (125 acres) would be disturbed with a construction right-of-way of 18 meters (60 feet) (INL 2005c). The actual acreage of natural habitat disturbed would be somewhat less, as a portion of the road would utilize the existing T-3 Road right-of-way. Impacts on vegetation and wildlife would be similar to those described above for the Plutonium-238 Facility at MFC. However, potential disturbance resulting from noise and human activity during construction would be greater. Thus, mitigation measures, such as proper maintenance of equipment, restricting all activity to the construction right-of-way, and avoiding construction during the breeding season, would be especially important. Also, elk, pronghorn, and mule deer are found in the area of the road and could be disturbed by its construction and use. Adjusting construction timing may mitigate some of these impacts. Although the potential exists for collisions with wildlife when material is being shipped along the new road, its limited use and 55-kilometer-per-hour (35-mile-per-hour) speed limit are expected to minimize this impact. Impacts of construction and operation of the two southerly routes would involve less land disturbance because less new road would be required (INL 2005c). Therefore, impacts from land disturbance would be less. In addition, the East Power Line Road is maintained to a higher level of service than the T-3 and T-24 Roads. This would likely result in less disruption to ecological resources if this route was selected. In any event additional surveys would be conducted prior to any decision to determine the exact nature of the ecological resources along each route.

Operations Impacts—Activities associated with operation of the Plutonium-238 Facility at MFC, such as noise and human activity, could affect wildlife living in the immediate area. These disturbances may cause some species to move from the area. Disturbance to wildlife would be minimized by preventing workers from entering undisturbed areas. Those portions of the site disturbed by construction, but not occupied by facility structures, would be landscaped. Such areas would be of minimal value to wildlife. Because MFC is presently lit at night, the additional lighting associated with the Plutonium-238 Facility at MFC is not expected to further affect site wildlife present in the vicinity.

4.2.6.2 Wetlands

Construction and Operations Impacts—There would be no impacts on wetlands of the Plutonium-238 Facility construction, as there are no wetlands located within or in the vicinity of the proposed facility site. Although one of the potential routes for the new road connecting MFC and ATR would cross the Big Lost River and may require construction of a new bridge, wetland vegetation along the river is in poor condition because of only intermittent flows in recent years. Further, wetlands in this area have not been designated as jurisdictional by the U.S. Army Corps of Engineers and, thus, are not regulated under Section 404 of the Clean Water Act. Nevertheless, a Preliminary Floodplain/Wetland Assessment has been prepared for this proposed activity in accordance with 10 CFR 1022 (see Appendix F of this EIS). Construction of a new bridge would use best management practices to minimize disturbance and erosion potential. The nearest jurisdictional wetland, the Big Lost River Sinks, located 21 kilometers (13 miles) north of the proposed river crossing, would not be affected by construction of the new road.

4.2.6.3 Aquatic Resources

Although the waste disposal ponds provide habitat for a variety of aquatic invertebrates, there is no natural aquatic habitat within MFC. Because construction and operation of the Plutonium-238 Facility at MFC would not impact the waste ponds and there is no natural aquatic habitat in the area, there would be no impacts on aquatic resources under this alternative.

One of the potential routes for the new road connecting the MFC and ATR passes across the Big Lost River. Because this river remains dry for extended periods of time, there are no fish or other aquatic species present within its channel. Thus, construction of a bridge over the channel would not be expected to result in any adverse impacts to aquatic resources. Regardless, best management practices would limit disturbance of the dry river channel.

4.2.6.4 Threatened and Endangered Species

Construction and Operations Impacts—Construction of the Plutonium-238 Facility at MFC is not expected to impact any threatened or endangered species, or other sensitive species, as no such species have been observed within the proposed site area (see Section 3.2.6.4). Although the rattlesnake is not threatened or endangered, it is protected in Idaho. As it is possible that snakes using the hibernacula located 0.62 kilometers (1 mile) south of MFC could migrate to the site in the spring, construction could result in the loss of some of these animals. However, depending on when ground clearing activities took place, snakes present within the site area could be removed to another location.

As noted in Section 3.2.6.4, no Federally or state-listed threatened or endangered species have been observed along any of the three proposed routes connecting the MFC and ATR. However, the potential exists for a number of special status species to be found along each route. In fact, the sage grouse, pygmy rabbit, and ferruginous hawk have been found along the T-3 Road. Regardless of the route selected, the potential exists to impact sensitive species both directly and indirectly during construction. A survey of each route would be conducted prior to any decision to document the presence of sensitive species. Based on the results of the surveys, mitigation measures such as adjustments in the specific route chosen, not clearing the route right-of-way during the breeding season, and preventing workers from leaving the construction right-of-way would help lessen potential impacts.

Consultation to comply with Section 7 of the Endangered Species Act (16 U.S.C. 1531 *et seq*.) was initiated with the U.S. Fish and Wildlife Service and state wildlife officials, and responses are pending. No decision would be made relative to the construction of any proposed facilities, or the new road prior to completion of the consultation process.

4.2.7 Cultural Resources

Construction and Operations Impacts—Under the Consolidation Alternative, construction of the Plutonium-238 Facility at MFC, Support Building, Radiological Welding Laboratory, and a new road between ATR and MFC are proposed at INL (INL 2005c). The proposed Radiological Welding Laboratory, an addition to existing Building 772, would be constructed within the fenced area at MFC under this alternative. Although 12 isolated prehistoric finds and two archaeological sites were located within this area, most of the land in this area is highly disturbed and not likely to yield any new significant archaeological or historic material. The Experimental Breeder Reactor-II, designated as a Nuclear Historic Landmark by the American Nuclear Society, would not be impacted by construction of this proposed addition.

As shown in Figure 2–12, there are three possible routes the new road could take between MFC and RTC. One route would follow the existing unimproved T-3 Road. The T-3 Road is classified as a historic stagecoach trail and is also know as and the Lost River/Arco Road. The existence of this road has been documented from 1917, but it is believed this road was used since 1888. No archaeological, prehistoric or historical surveys have been conducted along this road, but there are several historic home sites along the road, including one within INL boundaries. Pavement would be required for 24 kilometers (15 miles) from MFC until the new road connects to internal INL roads leading to RTC (INL 2005c).

If this route is selected, a cultural resources study would be conducted prior to any construction. The survey would also determine if any pioneer homesteads are located along this section of the T-3 Road. Specific concerns about the presence, type, and location of American Indian resources, including any resources located near "Aviators Cave" (INL 2005c), would be addressed through consultation with potentially affected tribes in accordance with the *Agreement-in-Principle between the Shoshone-Bannock Tribes and the United States Department of Energy*, dated December 10, 2002, as well as the National Historic Preservation Act, Native American Graves Protection and Repatriation Act, and American Indian Religious Freedom Act.

The T-24 Road is located south of the T-3 Road. Approximately 16 kilometers (10 miles) would need to be paved from MFC until the road reaches CITRC and connects to internal roads leading to RTC. This road has been partially surveyed for cultural resources, is not classified as a historic trail, and was probably constructed sometime after 1950 (INL 2005c).

The East Power Line Road is currently maintained to a higher level than the other two jeep trails because of ongoing activities related to power line maintenance. Approximately 19 kilometers (12 miles) would need to be paved before the new road connects to internal INL paved roads at CITRC. A number of cultural consultations and mitigations have been conducted along the Power Line Road (INL 2005c).

If this alternative is selected, any prehistoric or historic resources, including those that are or may be eligible for listing on the National Register of Historic Places, would be identified. These resources would be identified through site surveys and consultation with the State Historic Preservation Officer. Consultation to comply with Section 106 of the National Historic Preservation Act (16 U.S.C. 470 *et seq*.) was initiated with the Idaho State Historic Preservation Office. No decision would be made relative to use of existing buildings, construction of any proposed facilities, or the new road prior to completion of the consultation process.

Consultation with potentially affected American Indian tribal governments has been initiated, and a response is pending. No decision would be made relative to construction of any proposed facilities or the new road prior to completion of the consultation process.

4.2.8 Socioeconomics

***Construction Impacts*—**Modifications to existing MFC facilities at INL and construction of the new buildings and road would require a peak construction employment level of 245 workers (INL 2005c). This level of employment would generate about 237 indirect jobs in the region around INL. The potential total employment increase of 482 direct and indirect jobs represents an approximate 0.4 percent increase in the workforce and would occur only during the 22 months of construction. It would have little to no noticeable impact on the socioeconomic conditions of the ROI. Since the employment requirements in support of construction at INL would be relatively small, the increase in traffic volume would also be small and not likely to be noticed by commuters in the vicinity of INL.

***Operations Impacts*—**The consolidation of RPS nuclear production operations at MFC could result in the permanent relocation or hiring of approximately 75 new employees (INL 2005c). This level of employment would generate about 72 indirect jobs in the region around INL. The potential total employment increase of 147 direct and indirect jobs represents an approximate 0.1 percent increase in the workforce. The increase in the number of workers in support of consolidated RPS nuclear operations would have little or no noticeable impact on socioeconomic conditions in the INL ROI. Workers assigned to the new RPS nuclear production facilities would be drawn for the most part from the existing INL workforce. The contributory effect of the remaining new employment, in combination with potential effects of other industrial and economic sectors within the regional economic area, would serve to reduce or mask any effect on the regional economy. New MFC employees hired to support the production of RPSs would compose a small fraction of the INL workforce (8,100 in 2001) and an even smaller fraction of the regional workforce (more than 92,000 in 1999). Since the employment requirements in support of consolidated RPS nuclear production operations at INL would be small, the increase in traffic volume at INL from RPS nuclear production at MFC would also be small and not likely to be noticed by commuters in the vicinity of INL.

Under the Consolidation Alternative, target fabrication and processing operations at REDC would not start up. Therefore, there would be no impacts on socioeconomic conditions in the ORNL region. Operations at the Plutonium Facility at LANL currently employ a small number of non-dedicated workers. There would be no impacts on socioeconomic conditions in the LANL region since these workers would continue to be employed handling other radioactive materials.

4.2.9 Public and Occupational Health and Safety

Assessments of radiological and chemical impacts at INL during normal operations and accident conditions associated with the Consolidation Alternative are presented in this section. Supplemental information is provided in Appendix C of this EIS. Radiological and chemical impacts during normal operations and accident conditions at LANL from purification, pelletization, and encapsulation operations from 2007 to 2011 would be the same as described under the No Action Alternative.

4.2.9.1 Construction and Normal Operations

No routine radiological or hazardous chemical releases are expected during construction activities. During normal operations, there could be incremental radiological and hazardous chemical releases to the environment and incremental direct in-plant exposures. The resulting doses and potential health effects on the public and workers under this alternative are described below.

Radiological Impacts

Incremental radiological doses to three receptor groups from operations at INL are given in **Table 4–16:** the population within 80 kilometers (50 miles) in the year 2050, the MEI, and the average exposed member of the public. The projected number of excess LCFs in the surrounding population and the excess LCF risk to the MEI and average exposed individual are also presented in the table. A probability coefficient of 6×10^{-4} LCFs per rem is applied for the public and workers.

Table 4–16 Incremental Radiological Impacts on the Public of Facility Operations at Idaho National Laboratory Under the Consolidation Alternative

Receptor	*INL*	
	MFC	*ATR* [a]
Population within 80 kilometers (50 miles) in the year 2050		
Dose (person-rem)	1.9×10^{-5}	No change
35-year period excess latent cancer fatalities	4.1×10^{-7}	No change
Maximally exposed individual		
Annual dose (millirem)	1.6×10^{-6}	No change
35-year excess latent cancer fatality risk	3.4×10^{-11}	No change
Average exposed individual within 80 kilometers (50 miles)		
Annual dose [b] (millirem)	5.4×10^{-8}	No change
35-year excess latent cancer fatality risk	1.1×10^{-12}	No change

INL = Idaho National Laboratory, MFC = Materials and Fuels Complex, ATR = Advanced Test Reactor.

[a] There would be no incremental radiological impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions or contribute a new source of radiological emissions.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of the site in the year 2050 (ATR at INL = 172,200; MFC at INL = 355,000).

Doses at INL would be attributed to all RPS production activities performed at MFC. This includes storage of target materials at FMF; fabrication and post-irradiation processing at the Plutonium-238 Facility; purification, pelletization, and encapsulation activities at the Plutonium-238 Facility; and assembly and test operations at the Assembly and Testing Facility. The alternative does not include activities at any other sites.

There would be no incremental dose to the MEI from annual ATR operations because there would be no increase in radiological releases to the environment under this alternative.

The annual population dose at INL would be 1.9×10^{-5} person-rem, with a 35-year excess LCF risk of 4.1×10^{-7}. The annual MEI dose would be 1.6×10^{-6} millirem per year, with a 35-year excess LCF risk of 3.4×10^{-11}. The annual average exposed individual dose would be 5.4×10^{-8} millirem per year, with an excess LCF risk of 1.1×10^{-12}.

Doses to involved workers from normal operations are given in **Table 4–17**; these workers are defined as those directly associated with process activities. The incremental annual average dose to workers at ATR would be negligible, and approximately 32 person-rem to workers at MFC. Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

Table 4–17 Incremental Radiological Impacts on Involved Workers of Facility Operations at Idaho National Laboratory Under the Consolidation Alternative

Receptor—Involved Workers [a]	*INL*	
	MFC	*ATR* [b]
Total dose (person-rem per year)	32	No change
35-year period excess latent cancer fatalities	0.68	No change
Average worker dose (rem per year)	0.49 [c]	No change
35-year excess latent cancer fatality risk	0.010	No change

INL = Idaho National Laboratory, MFC = Materials and Fuels Complex, ATR = Advanced Test Reactor.

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, the maximum dose to a worker involved with operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999e). Further, DOE recommends that facilities adopt a more limiting, 500-millirem-per-year, Administrative Control Level (DOE 1999e). To reduce doses to ALARA levels, an effective ALARA program would be enforced.

[b] There would be no incremental radiological impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions or contribute a new source of radiological emissions.

[c] Based on an estimated 65 badged workers (INL 2005c).

Hazardous Chemical Impacts

Hazardous chemical impacts at INL would be unchanged from baseline site operations because no new chemicals would be emitted to the air from storage of neptunium-237 in FMF at MFC or continued operation of ATR (DOE 2000f). Impacts of hazardous chemical emissions due to target fabrication and post-irradiation processing operations, are expected to be less than those reported for REDC at ORNL under the No Action Alternative. This is due to the new, modern facilities at MFC and the longer distance to a public receptor compared to the REDC at ORNL. Therefore, no chemical health effects are anticipated at INL under the Consolidation Alternative.

Nonradioactive air emissions from activities at the Plutonium Facility at LANL would be mainly from the glovebox gases argon and helium. These are inert and nonhazardous. Ethanol, used as a solvent at LANL, is likewise not hazardous. Vapors of hydrofluoric and nitric acids, used in decontamination, would be emitted at rates well below threshold values (DOE 1991).

4.2.9.2 Facility Accidents

This section discusses potential accident impacts under the Consolidation Alternative. Under accident conditions, there could be impacts at INL associated with storage of neptunium-237 in the FMF vault; target fabrication, post-irradiation processing, and plutonium-238 purification, pelletization, and encapsulation in the new Plutonium-238 Facility at MFC; assembly and test operations in the Assembly and Testing Facility; and target irradiation at ATR. The accident scenarios chosen for analysis have impacts that bound the suite of accidents that have occurred, and could occur, at the facilities. The selection of accident scenarios described in Appendix C of this EIS included the review of accident history as presented in Sections 3.2.9.4, 3.3.9.4, and 3.4.9.4. The accident scenarios that were analyzed result in higher public and noninvolved worker risks than historic accidents.

Incremental radiological doses to three receptor groups from postulated accidents at INL are estimated: the population within 80 kilometers (50 miles), the MEI of the public, and the noninvolved worker. The projected number of excess LCFs in the surrounding population and the excess LCF risk to the MEI and noninvolved worker are also presented. A probability coefficient of 6×10^{-4} LCFs per rem is applied for the public and workers.

Radiological Impacts

The sealed design of the plutonium-238 heat sources, which will be shipped from Pantex and LANL to INL, is not expected to cause any radiological risks from credible accidents. Potential impacts of neptunium-237 storage and target irradiation accidents under the Consolidation Alternative have been evaluated by DOE in previous NEPA documents (DOE 2000f, 2002c).

Neptunium-237 Storage—At INL, neptunium-237 would be stored in the FMF vault. The FMF vault has 100 in ground concrete storage silo positions sealed with 5.1-centimeter (2-inch) stainless steel shielding plugs. The neptunium-237 storage cans would be placed in a rack inside the silo. While the postulated beyond-design-basis earthquake may cause portions of the facility to collapse, the storage cans would not be stressed to a level that would breach the double containment of the can design (DOE 2000f).

Target Irradiation—For ATR target irradiation accidents, the 35-year increased risk of an LCF to the offsite MEI and a noninvolved worker associated with plutonium-238 production at INL would be 1.8×10^{-7} and 2.9×10^{-6}, respectively. The 35-year accident risk in terms of the increased number of LCFs in the offsite population would be 7.0×10^{-4}. These target irradiation accident risks were calculated in the *NI PEIS* (DOE 2000f).

Assembly and Testing Operations—A range of accidents were considered for the Assembly and Testing Facility, including welding fire accidents, catastrophic failure of one or more of the fuel elements, and the potential for a wind-driven missile to penetrate a facility wall and glovebox. However, because of the solid ceramic form of the plutonium and the multiple protective features of the Category 3 building, any release to the environment from these accidents would be negligible. Any adverse effects would be mitigated by air filtration systems, room and building barriers, and air locks that contain releases (DOE 2002c). Because the probability of occurrence and release of radioactive materials outside of the building for these accidents was estimated to be less than 1 in 1 million per year, the risks to noninvolved workers and the public were not considered further.

Target Fabrication and Post-irradiation Processing—The consequences and risks of target processing accidents are shown in **Table 4–18**. Four potential accidents were postulated:

- A neptunium-237 target preparation ion exchange explosion. The estimated frequency of this accident is 1×10^{-2} per year.
- A plutonium-238 separation tank failure. The estimated frequency of this accident is 1×10^{-2} per year.
- An explosion of a plutonium-238 ion exchange column. The estimated frequency of this accident is 1×10^{-2} per year.

- A beyond-evaluation-basis earthquake, resulting in a collapse of the nearby stack and failure of the HEPA filter system intended to mitigate the consequences of releases. The estimated frequency of this accident is 1×10^{-5} per year.

Table 4–18 Target Processing Accident Consequences at Idaho National Laboratory Under the Consolidation Alternative

Accident	*Maximally Exposed Individual*		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
	Dose (rem)	*Latent Cancer Fatality* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b]	*Dose (rem)*	*Latent Cancer Fatality* [a]
Neptunium-237 target preparation ion exchange	5.2×10^{-9}	3.1×10^{-12}	7.9×10^{-7}	4.8×10^{-10}	7.2×10^{-8}	4.3×10^{-11}
Plutonium-238 separation tank failure	1.3×10^{-7}	7.5×10^{-11}	2.8×10^{-5}	1.7×10^{-8}	1.9×10^{-6}	1.1×10^{-9}
Plutonium-238 ion exchange explosion	4.9×10^{-4}	3.0×10^{-7}	7.4×10^{-2}	4.5×10^{-5}	6.9×10^{-3}	4.1×10^{-6}
Beyond-evaluation-basis earthquake	8.4	5.0×10^{-3}	4.0×10^{3}	2.4	2.0×10^{2}	2.3×10^{-1}

[a] Likelihood of an LCF.
[b] Number of LCFs.

The risks of the postulated accidents are shown in **Table 4–19**. The accident with the highest risk is a beyond-evaluation-basis earthquake. If this accident were to occur, the annual risk of an LCF would be 5.0×10^{-8} and 2.3×10^{-6} for the MEI and noninvolved worker, respectively. The annual risk for the offsite population would be 2.4×10^{-5}. The 35-year risk for the highest-consequence accident, a beyond-evaluation-basis earthquake, for the MEI, noninvolved worker, and offsite population would be 1.8×10^{-6}, 8.2×10^{-5}, and 8.4×10^{-4}, respectively.

Table 4–19 Target Processing Annual Accident Risks at Idaho National Laboratory Under the Consolidation Alternative

Accident	*Maximally Exposed Individual* [a]	*Population to 80 Kilometers* [b] *(50 miles)*	*Noninvolved Worker* [a]
Neptunium-237 target preparation ion exchange	3.1×10^{-14}	4.8×10^{-12}	4.3×10^{-13}
Plutonium-238 separation tank failure	7.5×10^{-13}	1.7×10^{-10}	1.1×10^{-11}
Plutonium-238 ion exchange explosion	3.0×10^{-9}	4.5×10^{-7}	4.1×10^{-8}
Beyond-evaluation-basis earthquake	5.0×10^{-8}	2.4×10^{-5}	2.3×10^{-6}

[a] Increased likelihood of an LCF.
[b] Increased number of LCFs.

Plutonium-238 Purification, Pelletization, and Encapsulation—The consequences and risks of plutonium-238 purification, pelletization, and encapsulation accidents are shown in **Table 4–20**. Four potential accidents were postulated:

- An unmitigated evaluation-basis fire during plutonium-238 powder-to-pellet fabrication. Unmitigated conditions assume failure of HVAC and fire suppression systems. The estimated frequency of this accident is 1×10^{-5} per year.
- An unmitigated evaluation-basis earthquake (0.3-g acceleration), causing failure of the HVAC, fire safety equipment, nonsafety-class ductwork, and internal nonsafety-grade structures, but not the structure shell itself. The estimated frequency of this accident is 5×10^{-4} per year.

- A beyond-evaluation-basis fire similar to the evaluation-basis fire, but involving two gloveboxes and the assumption that exterior doors are open for the duration of the fire, providing a direct unfiltered release to the environment. The estimated frequency of this accident is 1×10^{-6} per year.
- A beyond-evaluation-basis earthquake (0.5-g), with all the same assumed failures as the evaluation-basis-earthquake but in addition, a 50-percent degradation in HEPA filter removal efficiency. The estimated frequency of this accident is 1×10^{-4} per year.

Table 4–20 Plutonium-238 Purification, Pelletization, and Encapsulation Annual Accident Consequences at Idaho National Laboratory Under the Consolidation Alternative

Accident	*Maximally Exposed Individual*		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
	Dose (rem)	*Latent Cancer Fatality* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b]	*Dose (rem)*	*Latent Cancer Fatality* [a]
Unmitigated evaluation-basis fire	0.70	4.2×10^{-4}	228	0.14	15.60	0.0094
Unmitigated evaluation-basis earthquake	0.27	1.6×10^{-4}	169	0.10	6.38	0.0038
Beyond-evaluation-basis fire	0.42	2.5×10^{-4}	84.2	0.051	7.87	0.0047
Beyond-evaluation-basis earthquake	0.04	2.5×10^{-5}	20	0.012	0.97	0.00058

[a] Likelihood of an LCF.
[b] Number of LCFs.

The risks of the postulated accidents are shown in **Table 4–21**. The accident with the highest risk is an unmitigated evaluation-basis earthquake. If this accident were to occur, the annual risk of an LCF would be 8.2×10^{-8} and 1.9×10^{-6} for the MEI and noninvolved worker, respectively. The annual risk for the offsite population would be 5.1×10^{-5}. The 35-year risk for the highest-consequence accident, an unmitigated evaluation-basis earthquake, for the MEI, noninvolved worker, and offsite population would be 2.9×10^{-6}, 6.7×10^{-5}, and 1.8×10^{-3}, respectively.

Table 4–21 Plutonium-238 Purification, Pelletization, and Encapsulation Annual Accident Risks at Idaho National Laboratory Under the Consolidation Alternative

Accident	*Maximally Exposed Individual* [a]	*Population to 80 Kilometers (50 miles)* [b]	*Noninvolved Worker* [a]
Unmitigated evaluation-basis fire	4.2×10^{-9}	1.4×10^{-6}	9.4×10^{-8}
Unmitigated evaluation-basis earthquake	8.2×10^{-8}	5.1×10^{-5}	1.9×10^{-6}
Beyond-evaluation-basis fire	2.5×10^{-10}	5.1×10^{-8}	4.7×10^{-9}
Beyond-evaluation-basis earthquake	2.5×10^{-9}	1.2×10^{-6}	5.8×10^{-8}

[a] Increased likelihood of an LCF.
[b] Increased number of LCFs.

Hazardous Chemical Impacts

Storage of neptunium-237 in FMF would not involve hazardous chemicals. Thus, no hazardous chemical accidents would be associated with storage of neptunium-237 in FMF at INL (DOE 2000f).

Irradiation of neptunium-237 targets at ATR would not introduce any additional operations that require the use of hazardous chemicals. Thus, no postulated hazardous chemical accidents would be attributable to irradiation of neptunium-237 targets at ATR (DOE 2000f).

Plutonium-238 processing at INL would involve a variety of chemicals that are potentially hazardous to workers and the public. Based on an anticipated annual inventory of 40 chemicals (DOE 2000f), two—nitric acid and hydrochloric acid—were selected for evaluation of potential impacts based on their large quantities, chemical properties, and health effects. **Table 4–22** shows the estimated stored quantities and levels of concern for these two chemicals.

Table 4–22 Chemicals of Concern Used in the Plutonium-238 Facility at Idaho National Laboratory Under the Consolidation Alternative

Chemical	*Inventory (kilograms)*	*ERPG-1* [a] *Concentration*	*ERPG-2* [b] *Concentration*	*ERPG-3* [c] *Concentration*
Nitric acid	984	1 ppm	6 ppm	78 ppm
Hydrochloric acid	146	3 ppm	20 ppm	150 ppm

ERPG = Emergency Response Planning Guideline, ppm = parts per million.

[a] ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor (NOAA 2005).

[b] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (NOAA 2005).

[c] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (NOAA 2005).

Note: To convert from kilograms to pounds, multiply by 2.2046.

Source: DOE 2000f.

The postulated accident is a catastrophic release of either of the chemicals as a result of a break in a storage vessel or piping. The cause of the break could be mechanical failure, corrosion, mechanical impact, or natural phenomena. The estimated frequency of the accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year. The potential impacts of an accidental chemical release are shown in **Table 4–23**. The distances to the Emergency Response Planning Guideline (ERPG) -2 and -3 levels of concern are 128 and 21 meters (140 and 23 yards), respectively, for a nitric acid release. The distances to the ERPG-2 and -3 levels of concern are 232 and 80 meters (254 and 87 yards) respectively, for a hydrochloric acid release. Depending on the magnitude of the release and plume characteristics, workers and members of the public could be exposed to harmful concentrations of each chemical within these distances from the point of release. Table 4–23 also shows the estimated concentration of each chemical at a distance of 640 meters (700 yards) from the release point where a representative noninvolved worker is assumed to be located. The seriousness of the exposure of a noninvolved worker at this distance is determined by comparing the concentration at that distance to the ERPG-2 and -3 levels of concern. Table 4–23 also shows the estimated concentration at the nearest site boundary located at a distance of 5.2 kilometers (3.2 miles) from the release point. The accident evaluation assumes a hypothetical member of the public is located at this site boundary. As in the case of the noninvolved worker, the seriousness of the exposure of a member of the public located at the nearest site boundary is determined by comparing the concentration at that distance to the ERPG-2 and -3 levels of concern. Neither the noninvolved worker nor the hypothetical member of the public would be exposed to chemical concentrations exceeding levels of concern. The direction traveled by the chemical plume would depend upon meteorological conditions at the time of the accident.

Construction Accidents

New facility construction includes the risk of accidents that could impact workers. Because construction activities do not involve radioactive materials, there would be no radiological impacts. The presence of hazardous flammable, explosive, and other chemical substances could initiate accident conditions that could impact the health and safety of workers. In addition, in the course of their work, construction personnel and site personnel could receive serious or fatal injuries as a result of incidents that are in the category of industrial accidents. The occurrence of these incidents and their impacts cannot be meaningfully predicted. However, DOE and its construction contractors adhere to strict safety standards and procedures to provide a working environment that minimizes the possibility of accidents.

Table 4–23 Chemical Accident Impacts at Idaho National Laboratory Under the Consolidation Alternative

Chemical	*Quantity Released (kilograms)*	*ERPG-2* [a]		*ERPG-3* [b]		*Concentration*	
		Limit	*Distance to Limit (meters)*	*Limit*	*Distance to Limit (meters)*	*Noninvolved Worker at 640 Meters*	*Nearest Site Boundary at 5.2 Kilometers*
Nitric acid	984	6 ppm	128	78 ppm	21	0.33 ppm	0.013 ppm
Hydrochloric acid	146	20 ppm	232	150 ppm	80	2.85 ppm	0.037 ppm

ERPG = Emergency Response Planning Guideline, ppm = parts per million.

[a] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (NOAA 2005).

[b] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (NOAA 2005).

Note: To convert from kilograms to pounds, multiply by 2.2046; from meters to yards, by 1.0936; from kilometers to miles, by 0.62137.

4.2.9.3 Transportation

Transportation impacts consist of impacts of incident-free or routine transportation and impacts of transportation accidents. Incident-free transportation impacts include radiological impacts on the public and workers from the radiation field surrounding the transportation package. Nonradiological impacts of potential transportation accidents include traffic accident fatalities. See Section D.5.2 for a discussion of the human health risks from pollutants emitted by transport vehicles.

The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing the individual risks from all reasonably conceivable accidents. The analysis of accident risks takes into account a spectrum of accidents ranging from high-probability accidents (fender bender) of low-consequence to high-consequence accidents that have a low probability of occurrence. The analysis approach and details on modeling and parameter selections are provided in Appendix D of this EIS.

Under this alternative, DOE would consolidate all activities related to RPS production at INL. DOE would use facilities at MFC for neptunium storage, target fabrication, post-irradiation target processing, plutonium purification, pelletization, and encapsulation, and RPS assembly and test operations. Target irradiation would occur at ATR. Transportation impacts of activities within INL would be very small and enveloped by the operational impacts associated with RPS production.

This alternative would also involve the transportation of existing available inventory of plutonium-238 inside milliwatt generator heat sources from dismantled nuclear weapons. The offsite transportation impacts under this alternative would include those resulting from intersite shipments of milliwatt generator heat sources between Pantex or LANL, and INL, from 2009 to 2022. This alternative would involve 28 intersite shipments of radioactive materials. The total distance traveled on public roads would be about 52,600 kilometers (32,690 miles).

Impacts of Incident-Free Transportation

The dose to transportation workers from all transportation activities under this alternative has been estimated to be about 0.77 person-rem, and the dose to the public would be about 0.43 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.00046 LCFs among transportation workers and 0.00026 LCFs in the total affected population over the duration of transportation activities. LCFs associated with radiological releases were estimated by multiplying the occupational (worker) and public dose by 6.0×10^{-4} LCFs per person-rem of exposure.

Impacts of Accidents during Transportation

As stated earlier, two sets of analyses were performed for the evaluation of transportation accident impacts: impacts of maximum reasonably foreseeable severe accidents and impacts of all conceivable accidents (total transportation accidents).

The maximum reasonably foreseeable offsite transportation accident under this alternative (probability of occurrence: more than 1 in 10 million per year) would not breach the transportation package. The consequences of most-severe accidents that could breach the transportation package and its contents, releasing radioactive materials, were estimated to have a likelihood of less than 1 in 10 million per year.

As described in Appendix D, Section D.7 of this EIS, estimates of the total transportation accident risks under this alternative are as follows: a radiological dose to the population of 0.00021 person-rem, resulting in 1.25×10^{-7} LCFs, and traffic accidents resulting in 0 (0.00042) fatalities, based on 52,600 kilometers (32,690 miles) traveled.

4.2.9.4 Emergency Preparedness

During the production of plutonium-238 under the Consolidation Alternative, radioactive materials would be transported only within the boundaries of INL. Radioactive waste shipments would occur to offsite waste management facilities under all alternatives. Section 4.1.9.4 describes emergency preparedness measures that apply to the shipment of radioactive and hazardous waste.

4.2.10 Environmental Justice

Construction Impacts—There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction of RPS nuclear production facilities at MFC and the new road under this alternative. As stated in other subsections of Section 4.2, environmental impacts of construction would be small and are not expected to extend beyond the INL site boundary.

Operational Impacts—No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under this alternative. This conclusion is a result of analyses presented in this EIS that determined there would be no significant impacts on human health or ecological, cultural, socioeconomic, or other resource areas described in other subsections of Section 4.2.

As discussed in Section 4.2.9.1, radiological and hazardous chemical risks to the public resulting from normal operations would be small. Routine normal operations at these facilities are not expected to cause fatalities or illness among the general population, including minority and low-income populations living within the potentially affected area.

Annual radiological risks to the offsite population that could result from accidents at these facilities are estimated to be less than 5.1×10^{-5} LCFs (see Section 4.2.9.2). Hence, the annual risks of an LCF in the entire offsite population resulting from an accident under the Consolidation Alternative would be less than 1 in 20,000.

Subsistence Consumption of Fish, Wildlife, and Game

Section 4–4 of Executive Order 12898 directs Federal agencies “whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence and that Federal governments communicate to the public the risks of these consumption patterns." In the *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement (Idaho HLW and Facilities Disposition EIS)*, DOE considered whether there were any means for minority and low-income populations to be disproportionately affected by examining levels of contaminants in crops, livestock, and game animals on or near INL (DOE 2002e).

Controlled hunting is permitted on INL land but is restricted to a very small portion of the northern half of INL. The hunts are intended to assist the Idaho Department of Fish and Game in reducing crop damage on private agricultural lands adjacent to INL. In addition to the limited hunting on INL, several game species and birds live on and migrate through INL. DOE routinely samples game species residing on INL, sheep that have grazed on INL, locally grown crops, and milk around INL for radionuclides. Concentrations of radionuclides in the samples have been small and are seldom higher than concentrations observed at control locations distant from INL. The principal source of non-natural radionuclides at these control locations is very small amounts of residual atmospheric fallout from past nuclear weapons tests. Data from programs monitoring these sources of food are reported annually in the *INEEL Site Environmental Report* (DOE 2002e).

Based on DOE monitoring results, concentrations of contaminants in crops, livestock, and game animals in areas surrounding INL are low, and seldom above background levels (DOE 2002e). Moreover, the impact analyses conducted for this EIS (see Section 4.2.6) indicate that native plants and wildlife in the ROI would not be harmed by the proposed consolidation of RPS nuclear production operations at INL. Consequently, no disproportionately high and adverse human health impacts are expected in minority or low-income populations in the region as a result of subsistence consumption of fish, wildlife, native plants, or crops.

4.2.11 Waste Management and Pollution Prevention

4.2.11.1 Waste Management

Construction and Operations Impacts—Major operational activities related to waste management include: target fabrication, target irradiation, post-irradiation processing, and purification, pelletization, and encapsulation. Other RPS production operations, such as storage of target material, transportation, and RPS assembly and testing, would generate essentially no or minimum waste.

During storage of neptunium-237 at INL, essentially no waste is expected to be generated. As storage of neptunium-237 under the Consolidation Alternative remains the same as under the No Action Alternative, there would be no additional impact on the environment (DOE 2000f).

For the transportation of special nuclear materials between sites at INL, the only anticipated waste associated with this activity would be from decontamination of the shipping containers used for the transportation. The minor amount of low-level radioactive waste is expected to be less than 0.29 cubic meters (0.37 cubic yards) per year (ORNL 2005, DOE 2000f).

No impact on waste management activities of RPS assembly and testing is anticipated. RPS cleaning operations would generate, on a nonroutine basis, very small volumes of liquid low-level radioactive waste and hazardous waste. The amounts of these wastes generated by RPS assembly and testing operations would be a small fraction of the existing MFC waste streams (DOE 2002c). No incremental impact on waste management is anticipated.

For target irradiation in ATR, only very small amounts of additional waste would be generated because the reactor would already be operating for other purposes. The incremental amount of this waste would be very small. About 1 cubic meter (1.3 cubic yards) per year of solid low-level radioactive waste would be generated (DOE 2000f). Therefore, target irradiation at ATR would result in a very small impact on waste management at INL.

Target fabrication and post-irradiation processing would be transferred from REDC at ORNL to a new facility at INL, the Plutonium-238 Facility at MFC. The waste management impact on the existing operation at REDC is small, as discussed in the *NI PEIS* (DOE 2000f). The Proposed Action is to transfer this small impact from REDC at ORNL to the new facility at INL. The data basis at the Fluorinel Dissolution Process and Fuel Storage Facility at INL was used to project the proposed new facility waste generation at INL (DOE 2000f). **Table 4–24** summarizes the estimated waste generation from target fabrication and post-irradiation processing under the Consolidation Alternative and compares it with sitewide waste generation at INL. Table 4–24 shows that the incremental impact on waste management at INL would generally be small.

Table 4–24 Estimated Target Fabrication and Post-irradiation Processing Waste Generation Compared to Idaho National Laboratory Sitewide Waste Generation Under the Consolidation Alternative

Waste Type [a]	*Annual Generation Rate (cubic meters, except as noted)*	*Fraction of 2004 Sitewide INL Generation (percent)*
Transuranic [b]	7	70
Liquid low-level radioactive	30	0.30
Solid low-level radioactive	35	0.36
Mixed low-level radioactive	5	0.36
Hazardous	6,500 kilograms	2.4
Nonhazardous process wastewater	23	0.14 of INL Percolation Pond
Nonhazardous sanitary wastewater	1,658	0.00052 of INL Sewage Treatment Plant Capacity
Nonhazardous solid	149	0.31 of Central Facility Landfill

INL = Idaho National Laboratory.

[a] See definitions in Section B.12.1.

[b] The transuranic waste would be disposed of at WIPP (LANL 2005). After WIPP closure in 2034, transuranic waste would be disposed of in a suitable geologic repository.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079; from kilograms to pounds, by 2.2046.

Under the Consolidation Alternative, plutonium purification, pelletization, and encapsulation operations would be transferred from LANL to the proposed new Plutonium-238 Facility at MFC in 2011. Current waste generation data from the Plutonium Facility at LANL for nuclear operations in support of RPS production were used to estimate the additional waste generation at INL as well as LANL (from 2007 to 2011) (see Table 4–10). (LANL 2004d). **Table 4–25** summarizes the estimated waste generation from purification, pelletization, and encapsulation activities and compares it with sitewide waste generation at INL. Table 4–25 shows that the additional waste generated from plutonium purification, pelletization, and encapsulation would be small and the impact would generally be small. See **Table 4–26** and the accompanying text for a discussion of transuranic waste volumes.

Table 4–26 summarizes the estimated total waste generation from RPS production at INL under the Consolidation Alternative and compares it with the sitewide inventory/production. Table 4–26 also includes methods of disposition of these wastes. Table 4–26 shows that the impact on waste management under the Consolidation Alternative would be small, and the wastes generated would be disposed of in an acceptable manner approved by Federal agencies and the state.

Table 4–25 Estimated Plutonium Purification, Pelletization, and Encapsulation Waste Generation Compared to Idaho National Laboratory Sitewide Generation Under the Consolidation Alternative

Waste Type [a]	*Annual Generation Rate (cubic meters, except as noted)*	*Fraction of 2004 Sitewide INL Generation (percent)*
Transuranic [b]	13	130
Liquid low-level radioactive	133	1.4
Solid low-level radioactive	17	0.17
Mixed low-level radioactive	0.34	0.025
Hazardous [c]	<1 kilogram	< 0.3

INL = Idaho National Laboratory.

[a] See definitions in Section B.12.1.

[b] The transuranic waste would be disposed of at WIPP (LANL 2005).

[c] Hazardous wastes generated from all TA-55 operations, including plutonium-238 heat source production are insignificant.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079.

Table 4–26 Estimated Radioisotope Power System Production Total Waste Generation Compared to Idaho National Laboratory Sitewide Generation and Waste Disposition for the Consolidation Alternative

Waste Type [a]	*Annual Generation Rate (cubic meters, except as noted)*	*Fraction of 2004 INL Generation*	*Waste Disposition*
Transuranic	20	200 percent [b]	Certify and dispose of at WIPP
Liquid low-level radioactive	163	1.7 percent	Grout, certify, and dispose of at NTS or commercially
Solid low-level radioactive	52	0.53 percent	Certify and dispose of at NTS or commercially
Mixed low-level radioactive	5.4	0.39 percent	Treat (as required), certify, and dispose of at NTS or commercially
Hazardous	6,500 kilograms [c]	2.4 percent	Dispose of commercially
Nonhazardous solid	149 [c]	0.31 percent of INL Central Facility Landfill	INL Central Facility Landfill
Nonhazardous process wastewater	23 [c]	0.14 percent of INL Percolation Pond	INL Percolation Pond
Nonhazardous sanitary wastewater	1,658 [c]	0.00052 percent of INL Sewage Treatment Plant capacity	INL Sewage Treatment Plant

INL = Idaho National Laboratory, WIPP = Waste Isolation Pilot Plant, NTS = Nevada Test Site.

[a] See definitions in Section B.12.1.

[b] The annual transuranic waste generation would be less than 0.04 percent of the 61,553 cubic meters (80,505 cubic yards) of transuranic waste in storage at INL or 1 percent over the 35-year project life.

[c] The quantity of wastes generated from plutonium purification, pelletization, and encapsulation operations is not included. These wastes are expected to be small. The incremental impact at INL would be small as all of these wastes would be disposed of by using acceptable methods.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079; from kilograms to pounds, by 2.2046.

As shown in Table 4–26, total transuranic waste generation at the new Plutonium-238 Facility would be 95 percent of INL transuranic waste generation for 2004. Because transuranic waste would be certified for shipment to WIPP at the new Plutonium-238 Facility, and it would be less than 0.2 percent of the 11,140 cubic meters (14,570 cubic yards) of transuranic waste in storage at INL annually (6 percent over 35 years), minimal impacts to the transuranic waste management infrastructure at INL would be expected. If this waste is determined to be mixed transuranic waste, the treatment of this waste would be integrated into the Idaho Site Treatment Plan and Consent Order for Federal Facility Compliance Plan. The generation of this waste would not impact the plan for accelerating the Cleanup of the Idaho National Engineering and Environmental Laboratory because the waste would be disposed of off site after treatment.

4.2.11.2 Waste Minimization and Pollution Prevention

DOE Idaho Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at INL. This is accomplished by eliminating waste through source reduction or material substitution; recycling potential waste materials that cannot be minimized or eliminated; and treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The Idaho Operations Office published its first Waste Minimization Plan in 1990, which defined specific goals, methodologies, responsibilities, and achievements of programs and organizations.

INL now promotes the incorporation of pollution prevention into all planning activities, and that pollution prevention is integral to mission accomplishment. In 2002, INL reported 38 pollution prevention projects, which resulted in a waste reduction of 13,906 metric tons. Examples of pollution prevention projects at INL include the fabrication of lead bricks from over 90,720 kilograms (200,000 pounds) of radioactively contaminated lead taken from dismantled casks and shielding, which were reused/recycled by the Idaho State University Accelerator Center; and the sale of a variety of items, including desks, chairs, used tires, scrap metal, and computer components, to the public.

4.2.12 Environmental Restoration Program

Construction Impacts—Prior to commencing ground disturbance related to new facility and new road construction, DOE would survey potentially affected areas to ensure that no contaminated media would be disturbed. If contaminated media are detected, DOE would determine the extent and nature of any contamination and require remediation in accordance with procedures established under the site’s Environmental Restoration Program and in accordance with applicable RCRA and CERCLA regulations and consent agreements.

Operations Impacts— The consolidation of RPS nuclear production operations at MFC is not expected to affect the Environmental Restoration Program at INL. The Plutonium Facility at LANL would continue to be used for other purposes and would not be decommissioned after the cessation of the RPS mission.

4.3 Consolidation with Bridge Alternative

A detailed description of the Consolidation with Bridge Alternative is presented in Section 2.2.3 of this EIS.

Information on impacts from the operation of the FMF storage facility and ATR at INL, and HFIR and REDC at ORNL, were compiled from the *NI PEIS* (DOE 2000f). The impacts of Assembly and Testing Facility operation at INL are based on the *FONSI and Mound EA* (DOE 2002c). Information on impacts of continued operation of the purification, pelletization, and encapsulation functions at the Plutonium Facility at LANL is largely from the *Environmental Assessment for Radioisotope Heat Source Fuel Processing and Fabrication* (DOE 1991). Information on impacts of construction and operation of the new RPS nuclear production facilities at MFC at INL is based on the *Consolidation EIS* information document (INL 2005c). Under this alternative, the Plutonium Facility at LANL would continue to support RPS nuclear production operations until 2011 when the new Plutonium-238 Facility becomes operational. The impacts from purification, pelletization, and encapsulation operations would be the same as described under the No Action Alternative. After 2011, these operations would be conducted at the new Plutonium-238 Facility at INL.

4.3.1 Land Resources

4.3.1.1 Land Use

Construction and Operations Impacts—Impacts on land use at INL under this alternative would be the same as those addressed in Section 4.2.1.1 for the Consolidation Alternative.

All activities during the bridge period would take place within existing facilities. There would be no change or effect on land use at ORNL and LANL, because no additional land would be disturbed, and the use of existing facilities would be compatible with their present missions.

4.3.1.2 Visual Environment

Construction and Operations Impacts—Impacts on visual resources at INL under this alternative would be the same as those addressed for the Consolidation Alternative in Section 4.2.1.2.

All activities during the bridge period would take place within existing facilities. There would be no impact on visual resources since the current Visual Resource Management Class IV rating would not change.

4.3.2 Site Infrastructure

Construction Impacts—Under the Consolidation with Bridge Alternative, REDC at ORNL would be modified internally to fabricate and process irradiated targets. Because modification work would take place within an existing operational facility, no incremental impact on utility infrastructure demands is expected. Impacts on the local transportation network would also be negligible. The impacts on utility infrastructure requirements of new facility construction at INL would be the same as those described in Section 4.2.2.

Operations Impacts—Utility requirements of the modified REDC, while in operation, are not expected to vary substantially from those analyzed under the No Action Alternative (see Section 4.1.2). Subsequently, impacts on utility infrastructure requirements of new facility operations at INL would be the same as those described in Section 4.2.2.

4.3.3 Geology and Soils

Construction Impacts—Facility modifications at REDC would be confined to the interior of existing facilities. Therefore, there would be no disturbance to either geologic or soil resources. As detailed in Section 4.1.3, hazards from large-scale geologic conditions at ORNL present a low risk to facilities such as REDC. Further, DOE Order 420.1A requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that the public, workers, and environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes. The order stipulates natural phenomena hazards mitigation requirements for DOE facilities and specifically provides for reevaluation and upgrade of existing DOE facilities when there is a significant degradation in the safety basis for the facility. Subsequently, impacts on geologic and soil resources of new facility construction at INL would be the same as those described in Section 4.2.3.

Operations Impacts—Operations of the modified REDC under this alternative are expected to have minimal impacts on geologic and soil resources at ORNL. Subsequently, minimal impacts on geologic and soil resources of new facility operations at INL would be expected, and risks to new facilities from large-scale geologic hazards are expected to be low, as described in Section 4.2.3.

4.3.4 Water Resources

4.3.4.1 Surface Water

Construction Impacts—Facility modifications at REDC would be confined to the interior of existing facilities and would therefore have no impact on surface water resources. No incremental impact on utility infrastructure demands (see Section 4.3.2), including surface water use, is expected. In addition, there would be no measurable increase in wastewater generation associated with facility modifications. Subsequently, impacts on surface water resources of new facility construction at INL would be the same as those described in Section 4.2.4.

Operations Impacts—Operations of the modified REDC under this alternative would not have any measurable impact on effluent quantity or quality at ORNL, and no incremental impact on surface water. Subsequently, impacts on surface water resources of new facility operations at INL would be the same as those described in Section 4.2.4.

4.3.4.2 Groundwater

Construction Impacts—Facility modifications at REDC would be confined to the interior of existing facilities and would therefore have no impact on groundwater resources. No incremental impact on utility infrastructure demands (see Section 4.3.2), including groundwater use, is expected. Subsequently, impacts on groundwater resources of new facility construction at INL would be the same as those described in Section 4.2.4.

Operations Impacts—Operations of the modified REDC under this alternative would not have any measurable impact on effluent quantity or quality at ORNL, and no incremental impact on groundwater resources. Subsequently, impacts on groundwater resources of new facility operations at INL would be the same as those described in Section 4.2.4.

4.3.5 Air Quality and Noise

4.3.5.1 Air Quality

Nonradiological Releases

Construction and Operations Impacts—Nonradiological air quality impacts at INL under the Consolidation with Bridge Alternative would be the same as those under the Consolidation Alternative, described in Section 4.2.5.1.

Nonradiological air quality impacts at ORNL under the Consolidation with Bridge Alternative would be similar to those under the No Action Alternative, described in Section 4.1.5.1, except that operations would end after 5 years.

Under this alternative, operation of the Plutonium Facility at LANL for purification, pelletization, and encapsulation would result in nonradiological air quality impacts similar to the No Action Alternative as described in Section 4.1.5.1. These impacts would result from operation of the boilers for facility heating. Operations in the Plutonium Facility at TA-55 would not result in the boilers exceeding their permitted levels of emissions. Impacts would be similar to those under the No Action Alternative.

Air pollutant emissions from operations under this alternative would be small and not subject to PSD regulations. Therefore, a PSD increment analysis is not required (see Section B.4.1).

The Final Rule for "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" requires a conformity determination for certain-sized projects in nonattainment areas. DOE has performed a review for this alternative and concluded that a conformity determination is not necessary to meet the requirements of the Final Rule, because INL, ORNL, and LANL are located in attainment areas for all criteria pollutants, except for ozone and $PM_{2.5}$ (particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers) at ORNL, and threshold emission levels would not be exceeded by the activities considered (DOE 2000a). See Section D.5.2 for a discussion of the human health risks from pollutants emitted by transport vehicles.

Radiological Releases

Construction Impacts—While no radiological releases to the environment are expected in association with RPS consolidation construction activities at MFC, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of contamination and would be required to clean-up contamination in accordance with procedures established under INL's Environmental Restoration Program and INL's Hazardous Waste Facility Permit.

Operations Impacts—Radioactive releases associated with storage of neptunium-237 at FMF would be essentially zero, as the canisters containing the neptunium-237 would remain in containment vessels during storage. Should plutonium-238 be required prior to completion of the RPS nuclear production facilities at MFC, an estimated 6.8×10^{-8} curies per year of plutonium-238 could be released to the environment during target fabrication and post-irradiation processing operations at REDC if the Consolidation with Bridge Alternative is implemented (see Section C.2.1.4). In addition, an estimated 1.0×10^{-8} curies per year of plutonium-238 could be released to the environment from purification, pelletization, and encapsulation operations at LANL's Plutonium Facility. Once operational, an estimated 1.7×10^{-7} curies per year of plutonium-238 from target fabrication and post-irradiation processing operations and 1.0×10^{-8} curies per year of plutonium-238 from purification, pelletization, and encapsulation operations could be released to the environment from the new Plutonium-238 Facility at MFC (see Section C.2.1.4). There would be no incremental releases to the environment from ATR and HFIR during target irradiation, because there would be no increase in activities in those reactors due to additional target irradiation. No releases are expected from the RPS Assembly and Testing Facility at MFC, because the facility would handle only fully encapsulated radioactive material. There would be no other types of radiological releases from RPS nuclear production operations. Impacts of radiological releases are discussed in Section 4.3.9.

4.3.5.2 Noise

Construction and Operations Impacts—Noise impacts at INL under the Consolidation with Bridge Alternative are expected to be the same as those under the Consolidation Alternative, described in Section 4.2.5.2.

Noise impacts at ORNL under the Consolidation with Bridge Alternative would be similar to those under the No Action Alternative, described in Section 4.1.5.2, except that operations would end after 5 years.

Under this alternative, operation of the Plutonium Facility at LANL for purification, pelletization, and encapsulation of plutonium-238 would result in noise impacts similar to those under the No Action Alternative, described in Section 4.1.5.2. Onsite noise impacts are expected to be minimal, and offsite noise levels would not be noticeable. Traffic associated with plutonium-238 purification, pelletization, and encapsulation in the Plutonium Facility at LANL would be minor and would not lead to noticeable noise levels either on or offsite. Impacts would be similar to those under the No Action Alternative.

4.3.6 Ecological Resources

Construction Impacts— No new construction would occur under the Consolidation with Bridge Alternative at REDC at ORNL and the Plutonium Facility at LANL. There would be no direct disturbance to ecological resources, including threatened and endangered species, or loud noises that would adversely impact wildlife at these sites. Also, wetlands and aquatic resources would not be affected as water use and wastewater discharge would either not occur or would be minimal.

Construction impacts at INL under the Consolidation with Bridge Alternative would be the same as those under the Consolidation Alternative, described in Section 4.2.6. Ecological impacts from the construction of the Radiological Welding Laboratory would be minimal, as it would be located within a highly developed portion of MFC. Also, impacts on ecological resources from the construction of the Plutonium-238 Facility at MFC and new road connecting MFC and ATR would be as described in Section 4.2.6.

Operations Impacts—Measurable impacts on populations of plants and animals on or off DOE sites are not expected as a result of the incremental increase in exposure to radionuclides or chemicals that could result from operation of facilities under this alternative. DOE routinely samples game species residing on or near the sites, livestock in the region, locally grown crops, and milk for radionuclides. The results of this monitoring are reported in the annual environmental reports prepared for each site. Concentrations of radionuclides in the plant and animal samples are generally small and are seldom higher than concentrations observed at control locations distant from the sites. Additional deposition resulting from implementation of this alternative is not expected to lead to levels of contaminants that would exceed the historically reported ranges of concentrations. Therefore, DOE anticipates minimal impacts on the ecology of the DOE sites, and on plant and animal populations, as a result of exposure to radionuclides or chemicals under this alternative.

4.3.7 Cultural Resources

Construction and Operations Impacts—Under the Consolidation with Bridge Alternative, construction of new facilities, the Plutonium-238 Facility at MFC, Support Building, Radiological Welding Laboratory, and a new road between ATR and MFC are proposed at INL. Potential impacts on cultural resources, described in Section 4.2.7 would be the same under the Consolidation with Bridge Alternative as under the Consolidation Alternative.

The existing facilities, described for the No Action Alternative, would be used until the new consolidated RPS nuclear production facilities at MFC are ready for operation. As described for the No Action Alternative in Section 4.1.7, as no external modifications to existing buildings, new construction, or land disturbances are planned under the Consolidation with Bridge Alternative, no impacts on cultural resources are expected.

4.3.8 Socioeconomics

***Construction Impacts*—**Modifications to existing MFC facilities at INL and construction of the new buildings and road would require a peak construction employment level of 245 workers (INL 2005c). This level of employment would generate about 237 indirect jobs in the region around INL. The potential total employment increase of 482 direct and indirect jobs represents an approximate 0.4 percent increase in the workforce and would occur only during the 22 months of construction. It would have little to no noticeable impact on the socioeconomic conditions of the ROI. Since the employment requirements in support of construction at INL would be relatively small, the increase in traffic volume would also be small and not likely to be noticed by commuters in the vicinity of INL.

***Operations Impacts*—**The consolidation of RPS nuclear production operations at MFC could result in the permanent relocation or hiring of approximately 75 new employees (INL 2005c). This level of employment would generate about 72 indirect jobs in the region around INL. The potential total employment increase of

147 direct and indirect jobs represents an approximate 0.1 percent increase in the workforce. The increase in the number of workers in support of consolidated RPS nuclear operations would have little or no noticeable impact on socioeconomic conditions in the INL ROI. Workers assigned to the new RPS nuclear production facilities at MFC would be drawn for the most part from the existing INL workforce. The contributory effect of the remaining new employment, in combination with potential effects of other industrial and economic sectors within the regional economic area, would serve to reduce or mask any effect on the regional economy. New MFC employees hired to support the production of RPSs would compose a small fraction of the INL workforce (8,100 in 2001) and an even smaller fraction of the regional workforce (more than 92,000 in 1999).

Target fabrication and post-irradiation processing of targets at ORNL's REDC during the bridge period would require up to 41 workers. This level of employment was estimated to generate approximately 105 additional jobs in the region around ORNL. Assuming these are new jobs to the region, the potential increase of 146 jobs would represent a less than 0.1 percent increase in the workforce. An increase in employment of this size and other related economic activity in support of RPS nuclear operations at ORNL would have no noticeable impact on socioeconomic conditions in the Oak Ridge Reservation ROI (DOE 2000f).

There would be no impact on socioeconomic conditions in the LANL region during the bridge period, because operations at the Plutonium Facility are ongoing and continue to utilize nondedicated workers.

Since the employment requirements in support of consolidated RPS nuclear production operations at INL would be small, the increase in traffic volume at INL from RPS nuclear production at MFC would also be small and not likely to be noticed by commuters in the vicinity of INL. Employment in support of RPS nuclear production operations at LANL during the bridge period would not change; therefore, traffic volumes at LANL also would not change. The increase in traffic volume at ORNL from RPS nuclear production at REDC during the bridge period would be small and not likely to be noticed by commuters in the vicinity of ORNL.

At the end of the bridge period, nuclear operations in support of RPS production at REDC at ORNL and at the Plutonium Facility at LANL would cease. As described in Section 4.2.8, cessation of nuclear operations at ORNL and LANL would have minimal impacts on site workforces and regional economies. Section 4.1.8 states that no noticeable impact on socioeconomic conditions in the ORNL ROI would occur during operations under the No Action Alternative. Likewise, there would be no impacts on socioeconomic conditions in the ORNL region from discontinuing these operations. RPS related operations at the Plutonium Facility at LANL currently employ a small number of nondedicated workers. Therefore, there would be no impact on socioeconomic conditions in the LANL region since these workers would continue to be employed handling other radioactive materials.

4.3.9 Public and Occupational Health and Safety

Assessments of radiological and chemical impacts associated with the Consolidation with Bridge Alternative are presented in this section. Supplemental information is provided in Appendix C of this EIS.

4.3.9.1 Construction and Normal Operations

No routine radiological or hazardous chemical releases are expected during construction activities. During normal operations, there could be incremental radiological and hazardous chemical releases to the environment and also incremental direct in-plant exposures. The resulting doses and potential health effects to the public and workers under this alternative are described below. They are divided into two periods; the bridge period (2007 to 2011) and the period when all activities are consolidated at INL (2012 to 2047).

Radiological Impacts

Incremental radiological doses to three receptor groups from operations at INL, ORNL, and LANL are given in **Table 4–27** for the period 2007 to 2011 and **Table 4–28** for the period 2012 to 2047. The tables provide doses to the population within 80 kilometers (50 miles), the MEI, and the average exposed member of the public. The projected number of excess LCFs in the surrounding population and the excess LCF risk to the MEI and average exposed individual are also presented in the tables. The surrounding population for the period 2001 to 2011 is that projected for the year 2010. The surrounding population for the period 2012 to 2047 is that projected for the year 2050. A probability coefficient of 6×10^{-4} LCF per rem is applied for the public and workers.

Table 4–27 Incremental Radiological Impacts on the Public from Operation of Facilities Under the Consolidation with Bridge Alternative (2007 to 2011)

Receptor	*INL*		*ORNL*		*LANL Plutonium Facility*
	MFC [a]	*ATR* [b]	*HFIR* [b]	*REDC*	
Population within 80 kilometers (50 miles) in the year 2010					
Dose (person-rem)	1.2×10^{-6}	No change	No change	4.8×10^{-5}	1.8×10^{-5}
5-year period excess latent cancer fatalities	3.5×10^{-9}	No change	No change	1.4×10^{-7}	5.4×10^{-8}
Maximally exposed individual					
Annual dose (millirem)	1.4×10^{-7}	No change	No change	1.8×10^{-6}	1.0×10^{-6}
5-year excess latent cancer fatality risk	4.2×10^{-13}	No change	No change	5.4×10^{-12}	3.0×10^{-12}
Average exposed individual within 80 kilometers (50 miles)					
Annual dose [c] (millirem)	4.7×10^{-9}	No change	No change	4.2×10^{-8}	3.0×10^{-8}
5-year excess latent cancer fatality risk	1.4×10^{-14}	No change	No change	1.3×10^{-13}	9.0×10^{-14}

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory, LANL = Los Alamos National Laboratory, MFC = Materials and Fuels Complex, ATR = Advanced Test Reactor, HFIR = High Flux Isotope Reactor, REDC = Radiochemical Engineering Development Center.

[a] Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent (DOE 2000f) of the fabrication and processing component of the total neptunium-237 target fabrication, processing, and storage doses at REDC. These values serve as an upper-bound representation of the potential impacts that could be incurred from neptunium-237 storage.

[b] There would be no incremental radiological impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions or contribute a new source of radiological emissions.

[c] Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of the site in the year 2010 (ATR at INL = 118,800; MFC at INL = 245,000; ORNL = 1,129,000; LANL = 357,400).

With respect to Table 4–27, doses at INL would be attributed to storage of the neptunium-237 targets. Assembly and test activities would also be performed at the Assembly and Testing Facility at MFC during the bridge period. However, Assembly and Testing Facility operations are not expected to release any radioactivity on or offsite because the facility would handle only fully encapsulated radioactive material. Doses at ORNL would be attributed to target fabrication and post-irradiation processing at REDC. Doses at LANL are attributed to the purification, pelletization, and encapsulation activities at the Plutonium Facility at TA-55.

During the bridge period, the highest population dose, MEI dose, and average exposed individual dose would occur at ORNL from activities at REDC. The annual population dose at ORNL would be 4.8×10^{-5} person-rem, with a 5-year excess LCF risk of 1.4×10^{-7}. The annual MEI dose would be 1.8×10^{-6} millirem, within a 5-year excess LCF risk of 5.4×10^{-12}. The annual average exposed individual dose would be 4.2×10^{-8} millirem, with an excess LCF risk of 1.3×10^{-13}.

Table 4–28 Incremental Radiological Impacts on the Public from Operation of Facilities at Idaho National Laboratory Under the Consolidation with Bridge Alternative (2012 to 2047)

Receptor	*INL*	
	MFC	*ATR* [a]
Population within 80 kilometers (50 miles) in the year 2050		
Dose (person-rem)	1.9×10^{-5}	No change
5-year period excess latent cancer fatalities	4.1×10^{-7}	No change
Maximally exposed individual		
Annual dose (millirem)	1.6×10^{-6}	No change
35-year excess latent cancer fatality risk	3.4×10^{-11}	No change
Average exposed individual within 80 kilometers (50 miles)		
Annual dose [b] (millirem)	5.4×10^{-8}	No change
5-year excess latent cancer fatality risk	1.1×10^{-12}	No change

INL = Idaho National Laboratory, MFC = Materials and Fuels Complex, ATR = Advanced Test Reactor.

[a] There would be no incremental radiological impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions or contribute a new source of radiological emissions.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of the site in the year 2050 (ATR at INL = 172,200; MFC at INL = 355,000).

There would be no incremental dose to the MEI from HFIR operations because there would be no increase in radiological releases to the environment from the reactor under this alternative.

With respect to Table 4–28, doses at INL would be attributed to all RPS production activities performed at MFC. This includes storage of target materials at FMF; fabrication and post-irradiation processing at the Plutonium-238 Facility at MFC; purification, pelletization, and encapsulation activities at the Plutonium-238 Facility at MFC and assembly and test operations at the Assembly and Testing Facility.

During the bridge period 2012 to 2047, the annual population dose at INL would be 1.9×10^{-5} person-rem, with a 35-year LCF risk of 4.1×10^{-7}. The annual MEI dose would be 1.6×10^{-6} millirem, with a 35-year excess LCF risk of 3.4×10^{-11}. The annual average exposed individual dose would be 5.4×10^{-8} millirem, with an excess LCF risk of 1.1×10^{-12}.

There would be no incremental dose to the MEI from annual ATR operations because there would be no increase in radiological releases to the environment from either of these reactors under this alternative.

Doses to involved workers from normal operations are given in **Table 4–29** for the period 2007 to 2011 and **Table 4–30** for the period 2012 to 2047. These workers are defined as those directly associated with process activities. The incremental annual average dose to workers at ATR at INL and HFIR at ORNL would be negligible; approximately 170 millirem to REDC workers (DOE 2000f), 17 millirem to MFC workers and 240 millirem to Plutonium Facility at TA-55 workers (LANL 2005). Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

Doses at INL would be attributed to all RPS production activities performed at MFC. This includes storage of target materials at FMF; fabrication and post-irradiation processing at the Plutonium-238 Facility at MFC, purification, pelletization, and encapsulation activities at the Plutonium-238 Facility at MFC; and assembly and test operations at the Assembly and Testing Facility.

Table 4–29 Incremental Radiological Impacts on Involved Workers from Operation of Facilities Under the Consolidation with Bridge Alternative (2007 to 2011)

Receptor—Involved Workers [a]	*INL*		*ORNL*		*LANL Plutonium Facility*
	MFC	*ATR* [b]	*HFIR* [b]	*REDC*	
Total dose (person-rem per year)	1.2 [c]	No change	No change	12 [d]	19 [e]
5-year period excess latent cancer fatalities	3.6×10^{-3}	No change	No change	3.6×10^{-2}	5.7×10^{-2}
Average worker dose (millirem per year)	17	No change	No change	170	240 [e]
5-year excess latent cancer fatality risk	5.1×10^{-5}	No change	No change	5.1×10^{-4}	7.2×10^{-4}

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory, LANL = Los Alamos National Laboratory, MFC = Materials and Fuels Complex, ATR = Advanced Test Reactor, HFIR = High Flux Isotope Reactor, REDC = Radiochemical Engineering Development Center.

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, the maximum dose to a worker involved with operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999e). Further, DOE recommends that facilities adopt a more limiting, 500-millirem-per-year, Administrative Control Level (DOE 1999e). To reduce doses to ALARA levels, an effective ALARA program would be enforced.

[b] There would be no incremental radiological impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions or contribute a new source of radiological emissions.

[c] Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent (DOE 2000f) of the total dose from neptunium-237 target fabrication/processing and neptunium-237 storage, and serve as an upper-bound representation of the potential impacts that could be incurred from neptunium-237 storage.

[d] Based on an estimated 75 badged workers.

[e] Based on an estimated 79 badged workers and an average of 0.24 rem per worker average at LANL (LANL 2005).

Table 4–30 Incremental Radiological Impacts on Involved Workers from Operation of Facilities Under the Consolidation with Bridge Alternative (2012 to 2047)

Receptor—Involved Workers [a]	*INL*	
	MFC	*ATR* [b]
Total dose (person-rem per year)	32	No change
35-year period excess latent cancer fatalities	0.68	No change
Average worker dose (rem per year)	0.49[c]	No change
35-year excess latent cancer fatality risk	0.013	No change

INL = Idaho National Laboratory, MFC = Materials and Fuels Complex, ATR = Advanced Test Reactor.

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, the maximum dose to a worker involved with operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999e). Further, DOE recommends that facilities adopt a more limiting, 500-millirem-per-year, Administrative Control Level (DOE 1999e). To reduce doses to ALARA levels, an effective ALARA program would be enforced.

[b] There would be no incremental radiological impacts of operation of ATR or HFIR because the insertion of targets does not affect reactor operating conditions or contribute a new source of radiological emissions.

[c] Based on an estimated 65 badged workers (INL 2005c).

Hazardous Chemical Impacts

Carcinogenic and noncarcinogenic health effects of exposure to hazardous chemicals emitted from operations in REDC at ORNL were evaluated and reported in the *NI PEIS* (DOE 2000f). The hazardous chemical health effects for the bridge period 2007 to 2011 are summarized in **Table 4–31**.

The Hazard Index for activities at ORNL is estimated to be much less than 1 (0.006), and the cancer risk to be less than 1 in 1 million. Therefore, no chemical health effects are anticipated under the Consolidation with Bridge Alternative (2007 to 2011).

Nonradioactive air emissions from activities at the Plutonium Facility at LANL, would be mainly from the glovebox atmospheric gases argon and helium. These are inert and nonhazardous. Ethanol, used as a solvent at LANL, is likewise not hazardous. Vapors of hydrofluoric and nitric acids, used in decontamination, would be emitted at rates well below threshold values (DOE 1991).

Table 4–31 Incremental Hazardous Chemical Impacts on the Public around Oak Ridge National Laboratory Under the Consolidation with Bridge Alternative (2007 to 2011)

Chemical	*Modeled Annual Increment (milligrams per cubic meter)*	*RfC - Inhalation (milligrams per cubic meter)*	*Unit Cancer Risk (risk per milligram per cubic meter)*	*Hazard Quotient*	*Cancer Risk*
REDC at ORNL					
Diethyl benzene	3.37×10^{-5}	1	7.8×10^{-3}	3.37×10^{-5}	2.63×10^{-7}
Methanol	1.23×10^{-6}	1.75	NA	7.03×10^{-7}	NA
Nitric acid	1.53×10^{-6}	0.123	NA	1.25×10^{-5}	NA
Tributyl phosphate	6.34×10^{-5}	0.01	NA	6.34×10^{-3}	NA
			Hazard Index =	6.39×10^{-3}	

RfC = reference concentration, NA = not applicable (the chemical is not a known carcinogen or it is a carcinogen and only unit risk will apply).

Note: For diethyl benzene, the RfC for ethyl benzene and the unit cancer risk for benzene were used to estimate Hazard Quotient and cancer risk because no information was available for diethyl benzene. For tributyl phosphate, the RfC for phosphoric acid was used to estimate the Hazard Quotient because no information was available for tributyl phosphate.

Source: DOE 2000f.

For the period 2012 to 2047, hazardous chemical impacts at INL would be unchanged from baseline site operations because no new chemicals would be emitted to the air from storage of neptunium-237 in FMF at MFC or continued operation of ATR (DOE 2000f).

Impacts of hazardous chemical emissions due to target fabrication; post-irradiation processing; and purification, pelletization, and encapsulation operations are expected to be less than those reported for REDC at ORNL and the Plutonium Facility at LANL during the bridge period because of the new, modern facilities at MFC and the longer distance to a public receptor compared to REDC or the Plutonium Facility at LANL. Therefore, no chemical health effects are anticipated under the Consolidation with Bridge Alternative (2012 to 2047).

4.3.9.2 Facility Accidents

This section discusses potential accident impacts under the Consolidation with Bridge Alternative. Under accident conditions, there could be impacts at INL associated with storage of neptunium-237 in the FMF storage vault; target fabrication, post-irradiation processing, and plutonium-238 purification, pelletization, and encapsulation in the new facility to be constructed; assembly and test operations in the Assembly and Testing Facility; and target irradiation in ATR at INL. Under the bridge period of this alternative, irradiation would take place at HFIR at ORNL; REDC at ORNL would fabricate and process targets; and the Plutonium Facility at LANL would be used for plutonium-238 purification, pelletization, and encapsulation. The accident scenarios chosen for analysis have impacts that bound the suite of accidents that have occurred, and could occur, at the facilities. The selection of accident scenarios described in Appendix C of this EIS included the review of accident history as presented in Sections 3.2.9.4, 3.3.9.4, and 3.4.9.4. The accident scenarios that were analyzed result in higher public and noninvolved worker risks than historic accidents.

Incremental radiological doses to three receptor groups from postulated accidents at INL, ORNL, and LANL are estimated: the population within 80 kilometers (50 miles), the MEI of the public, and the noninvolved worker. The projected number of excess LCFs in the surrounding population and the excess LCF risk to the MEI and noninvolved worker are also presented. A probability coefficient of 6×10^{-4} LCFs per rem is applied for the public and workers.

Radiological Impacts

The sealed design of the plutonium-238 heat sources, which will be shipped from Pantex and LANL to INL, is not expected to cause any radiological risks from credible accidents. Potential impacts of neptunium-237 storage and target irradiation accidents under the Consolidation with Bridge Alternative have been evaluated by DOE in previous NEPA documents (DOE 2000f, 2002c).

Neptunium-237 Storage—Neptunium-237 would be stored in the FMF vault at INL. While the postulated beyond-design-basis earthquake may cause portions of the facility to collapse, the storage cans would not be stressed to a level that would breach the double containment of the can design (DOE 2000f).

Target Irradiation—For HFIR target irradiation accidents, the 5-year increased risk of an LCF to the offsite MEI and a noninvolved worker associated with plutonium-238 production would be 1.40×10^{-9} and 7.3×10^{-9}, respectively. The 5-year accident risk in terms of the increased number of LCFs in the offsite population would be 6.0×10^{-6} (DOE 2000f).

For ATR target irradiation accidents, the 35-year increased risk of an LCF to the offsite MEI and a noninvolved worker associated with plutonium-238 production would be 1.8×10^{-7} and 2.9×10^{-6}, respectively. The 35-year accident risk in terms of the increased number of LCFs in the offsite population would be 7.0×10^{-4} (DOE 2000f).

Assembly and Test Operations—A range of accidents were considered for Assembly and Testing Facility, including welding fire accidents, catastrophic failure of one or more of the fuel elements, and the potential for a wind-driven missile to penetrate a facility wall and glovebox. However, because of the solid ceramic form of the plutonium and the multiple protective features of the Category 3 building, any release to the environment from these accidents would be negligible. Any adverse effects would be mitigated by air filtration systems, room and building barriers, and air locks that contain releases (DOE 2002c). Because the probability of occurrence and release of radioactive materials outside of the building for these accidents was estimated to be less than 1 in 1 million per year, the risks to noninvolved workers and the public were not considered further.

Target Fabrication and Post-irradiation Processing—The consequences and risks of target processing accidents are shown in **Table 4–32**. Four potential accidents were postulated:

- A neptunium-237 target preparation ion exchange explosion. The estimated frequency of this accident is 1.0×10^{-2} per year.
- A plutonium-238 separation tank failure. The estimated frequency of this accident is 1×10^{-2} per year.
- An explosion of a plutonium-238 ion exchange column. The estimated frequency of this accident is 1.0×10^{-2} per year.
- A beyond-evaluation-basis earthquake, resulting in a collapse of the nearby stack and failure of the HEPA filter system intended to mitigate the consequences of releases. The estimated frequency of this accident is 1.0×10^{-5} per year.

The risks of the postulated accidents are shown in **Table 4–33**. The accident with the highest risk for the first 5-year period at REDC of the Consolidation with Bridge Alternative and for the next 35-year period at INL is a beyond-evaluation-basis earthquake. In the first 5 years, if this accident were to occur, the risk of an LCF would be 3.2×10^{-6} and 6.0×10^{-5} for the MEI and noninvolved worker, respectively; for the next 35 years, the risk would be 1.8×10^{-6} and 8.1×10^{-5}, respectively. The first 5-year period risk for the offsite population at REDC would be 8.5×10^{-4}; next 35-year period risk for the offsite population at INL would be 8.4×10^{-4}.

Table 4–32 Target Processing Annual Accident Consequences Under the Consolidation with Bridge Alternative

	Maximally Exposed Individual		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
Accident	***Dose (rem)***	***Latent Cancer Fatality*** [a]	***Dose (person-rem)***	***Latent Cancer Fatalities*** [b]	***Dose (rem)***	***Latent Cancer Fatality*** [a]
Neptunium-237 target preparation ion exchange explosion at INL	5.2×10^{-9}	3.1×10^{-12}	7.9×10^{-7}	4.8×10^{-10}	7.2×10^{-8}	4.3×10^{-11}
Plutonium-238 separation tank failure at INL	1.3×10^{-7}	7.5×10^{-11}	2.8×10^{-5}	1.7×10^{-8}	1.9×10^{-6}	1.1×10^{-9}
Plutonium-238 ion exchange column explosion at INL	4.9×10^{-4}	3.0×10^{-7}	7.4×10^{-2}	4.5×10^{-5}	6.9×10^{-3}	4.1×10^{-6}
Beyond-evaluation-basis earthquake at INL	8.4×10^{0}	5.0×10^{-3}	4.0×10^{3}	2.4×10^{0}	2.0×10^{2}	2.3×10^{-1}
Neptunium-237 target preparation ion exchange explosion at REDC	9.4×10^{-9}	5.6×10^{-12}	1.0×10^{-5}	6.2×10^{-9}	5.5×10^{-9}	3.3×10^{-12}
Plutonium-238 separation tank failure at REDC (neptunium-237 target)	2.2×10^{-7}	1.3×10^{-10}	3.6×10^{-4}	2.2×10^{-7}	1.2×10^{-9}	7.4×10^{-11}
Plutonium-238 ion exchange column explosion at REDC	8.9×10^{-4}	5.4×10^{-7}	9.8×10^{-1}	5.9×10^{-4}	5.2×10^{-4}	3.1×10^{-7}
Beyond-evaluation-basis earthquake at REDC	5.4×10^{1}	6.4×10^{-2}	2.9×10^{4}	1.7×10^{1}	1.0×10^{3}	1.2×10^{0}

INL = Idaho National Laboratory, REDC = Radiochemical Engineering Development Center.

[a] Likelihood of an LCF.

[b] Number of LCFs.

Table 4–33 Target Processing Annual Accident Risks Under the Consolidation with Bridge Alternative

Accident	***Maximally Exposed Individual*** [a]	***Population to 80 Kilometers (50 miles)*** [b]	***Noninvolved Worker*** [a]
Neptunium-237 target preparation ion exchange explosion at INL	3.1×10^{-14}	4.8×10^{-12}	4.3×10^{-13}
Plutonium-238 separation tank failure at INL	7.5×10^{-13}	1.7×10^{-10}	1.1×10^{-11}
Plutonium-238 ion exchange column explosion at INL	3.0×10^{-9}	4.5×10^{-7}	4.1×10^{-8}
Beyond-evaluation-basis earthquake at INL	5.0×10^{-8}	2.4×10^{-5}	2.3×10^{-6}
Neptunium-237 target preparation ion exchange explosion at REDC	5.6×10^{-14}	6.2×10^{-11}	3.3×10^{-14}
Plutonium-238 separation tank failure at REDC (neptunium-237 target)	1.3×10^{-12}	2.2×10^{-9}	7.4×10^{-13}
Plutonium-238 ion exchange column explosion at REDC	5.4×10^{-9}	5.9×10^{-6}	3.1×10^{-9}
Beyond-evaluation-basis earthquake at REDC	6.4×10^{-7}	1.7×10^{-4}	1.2×10^{-5}

INL = Idaho National Laboratory, REDC = Radiochemical Engineering Development Center.

[a] Increased likelihood of an LCF.

[b] Increased number of LCFs.

Plutonium-238 Purification, Pelletization, and Encapsulation—The consequences and risks of plutonium-238 purification, pelletization, and encapsulation accidents are shown in **Table 4–34**. Four potential accidents were postulated:

- An unmitigated evaluation-basis fire during plutonium-238 powder-to-pellet fabrication. Unmitigated conditions assume failure of HVAC and fire suppression systems. The estimated frequency of this accident is 1 × 10^{-5} per year.
- An unmitigated evaluation-basis earthquake (0.3-g acceleration), causing failure of the HVAC, fire safety equipment, nonsafety-class ductwork, and internal nonsafety-grade structures, but not the structure shell itself. The estimated frequency of this accident is 5 × 10^{-4} per year.
- A beyond-evaluation-basis fire similar to the evaluation-basis fire, but involving two gloveboxes and the assumption that exterior doors are open for the duration of the fire, providing a direct unfiltered release to the environment. The estimated frequency of this accident is 1 × 10^{-6} per year.
- A beyond-evaluation-basis earthquake (0.5-g acceleration), with all the same assumed failures as the evaluation-basis earthquake but in addition, a 50-percent degradation in HEPA filter removal efficiency. The estimated frequency of this accident is 1 × 10^{-4} per year.

Table 4–34 Plutonium-238 Purification, Pelletization, and Encapsulation Annual Accident Consequences Under the Consolidation with Bridge Alternative

	Maximally Exposed Individual		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
Accident	*Dose (rem)*	*Latent Cancer Fatality* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b]	*Dose (rem)*	*Latent Cancer Fatality* [a]
Unmitigated evaluation-basis fire at LANL	10.2	0.0061	1,850	1.11	15.9	0.0095
Unmitigated evaluation-basis earthquake at LANL	4.70	0.0028	834	0.50	7.6	0.0046
Beyond-evaluation-basis fire at LANL	5.37	0.0032	675	0.41	8.0	0.0048
Beyond-evaluation-basis earthquake at LANL	0.72	0.00043	165	0.10	1.2	0.0007
Unmitigated evaluation-basis fire at INL	0.70	0.00042	228	0.14	15.6	0.0094
Unmitigated evaluation-basis earthquake at INL	0.27	0.00016	169	0.10	6.38	0.0038
Beyond-evaluation-basis fire at INL	0.42	0.00025	84.2	0.051	7.87	0.0047
Beyond-evaluation-basis earthquake at INL	0.042	0.00025	20.0	0.012	0.98	0.00058

LANL = Los Alamos National Laboratory, INL = Idaho National Laboratory.

[a] Likelihood of an LCF.

[b] Number of LCFs.

The risks of the postulated accidents are shown in **Table 4–35**. The accident with the highest risk for the first 5-year period of the Consolidation with Bridge Alternative and for the next 35-year period is an unmitigated evaluation-basis earthquake. For the first 5 years, if this accident were to occur, the risk of an LCF would be 7.0 × 10^{-6} and 1.2 × 10^{-5} for the MEI and noninvolved worker, respectively, and, for the next 35 years, the risk would be 2.9 × 10^{-6} and 6.7 × 10^{-5}, respectively. For the first 5-year period, the risk for the offsite population would be 1.3 × 10^{-3}; for the next 35-year period, the risk for the offsite population would be 1.8 × 10^{-3}.

Table 4–35 Plutonium-238 Purification, Pelletization, and Encapsulation Annual Accident Risks Under the Consolidation with Bridge Alternative

Accident	*Maximally Exposed Individual* [a]	*Population to 80 Kilometers (50 miles)* [b]	*Noninvolved Worker* [a]
Unmitigated evaluation-basis fire at LANL	6.1×10^{-8}	1.1×10^{-5}	9.5×10^{-8}
Unmitigated evaluation-basis earthquake at LANL	1.4×10^{-6}	2.5×10^{-4}	2.3×10^{-6}
Beyond-evaluation-basis fire at LANL	3.2×10^{-9}	4.1×10^{-7}	4.8×10^{-9}
Beyond-evaluation-basis earthquake at LANL	4.3×10^{-8}	9.9×10^{-6}	7.0×10^{-8}
Unmitigated evaluation-basis fire at INL	4.2×10^{-9}	1.4×10^{-6}	9.4×10^{-8}
Unmitigated evaluation-basis earthquake at INL	8.2×10^{-8}	5.1×10^{-5}	1.9×10^{-6}
Beyond-evaluation-basis fire at INL	2.5×10^{-10}	5.1×10^{-8}	4.7×10^{-9}
Beyond-evaluation-basis earthquake at INL	2.5×10^{-9}	1.2×10^{-6}	5.8×10^{-8}

LANL = Los Alamos National Laboratory, INL = Idaho National Laboratory.

[a] Increased likelihood of an LCF.

[b] Increased number of LCFs.

Hazardous Chemical Impacts

Storage of neptunium-237 in FMF would not involve hazardous chemicals. Thus, no hazardous chemical accidents would be associated with storage of neptunium-237 in FMF (DOE 2000f).

Irradiation of neptunium-237 targets at ATR and HFIR would not introduce any additional operations that require the use of hazardous chemicals. Thus, no postulated hazardous chemical accidents would be attributable to irradiation of targets at ATR or HFIR (DOE 2000f).

Target processing at INL or REDC would involve a variety of chemicals that are potentially hazardous to workers and the public. Based on an anticipated annual inventory for 40 chemicals (DOE 2000f), two—nitric acid and hydrochloric acid—were selected for evaluation of potential impacts based on their large quantities, chemical properties, and health effects. **Table 4–36** shows the estimated stored quantities and levels of concern for these two chemicals.

Plutonium-238 purification, pelletization, and encapsulation would not require use of hazardous chemicals.

Table 4–36 Chemicals of Concern Used in Target Processing Under the Consolidation with Bridge Alternative

Chemical	*Inventory (kilograms)*	*ERPG-1* [a] *Concentration*	*ERPG-2* [b] *Concentration*	*ERPG-3* [c] *Concentration*
Nitric acid	984	1 ppm	6 ppm	78 ppm
Hydrochloric acid	146	3 ppm	20 ppm	150 ppm

ERPG = Emergency Response Planning Guideline, ppm = parts per million.

[a] ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor (NOAA 2005).

[b] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (NOAA 2005).

[c] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (NOAA 2005).

Note: To convert from kilograms to pounds, multiply by 2.2046.

Source: DOE 2000f.

The postulated accident is a catastrophic release of either of the chemicals as a result of a break in a storage vessel or piping. The cause of the break could be mechanical failure, corrosion, mechanical impact, or natural phenomena. The estimated frequency of the accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year. The potential impacts of an accidental chemical release are shown in **Table 4–37**. The distances to the ERPG-2 and -3 levels of concern are 128 and 21 meters (140 and 23 yards), respectively, at INL and 204 and 39 meters (223 and 43 yards), respectively, at REDC for a nitric acid release. The distances to the ERPG-2 and -3 levels of concern are 232 and 80 meters (254 and 87 yards), respectively, at INL and 444 and 142 meters (486 and 155 yards), respectively, at REDC for a hydrochloric acid release. Table 4–37 also shows the estimated concentration of each chemical at a distance of 640 meters (700 yards) from the release point where a representative noninvolved worker is assumed to be located. The seriousness of the exposure of a noninvolved worker at this distance is determined by comparing the concentration at that distance to the ERPG-2 and -3 levels of concern. Table 4–37 also shows the estimated concentration at the nearest site boundary located at a distance of 5.2 kilometers (3.2 miles) at INL and 4.6 kilometers (2.9 miles) at REDC from the release point. The accident evaluation assumes a hypothetical member of the public is located at this site boundary. As in the case of the noninvolved worker, the seriousness of the exposure of a member of the public located at the nearest site boundary is determined by comparing the concentration at that distance to the ERPG-2 and -3 levels of concern. Neither the noninvolved worker nor the hypothetical member of the public would be exposed to chemical concentrations exceeding levels of concern. The direction traveled by the chemical plume would depend upon meteorological conditions at the time of the accident.

Table 4–37 Chemical Accident Impacts at Idaho National Laboratory and the Radiochemical Engineering Development Center Under the Consolidation with Bridge Alternative

		ERPG-2 [a]		*ERPG-3* [b]		*Concentration*	
Chemical	*Quantity Released (kilograms)*	*Limit*	*Distance to Limit (meters)*	*Limit*	*Distance to Limit (meters)*	*Noninvolved Worker at 640 Meters*	*Nearest Site Boundary at 5.2 kilometers (INL) and 46 kilometers (REDC)*
Nitric acid at INL	2,170	6 ppm	128	78 ppm	21	0.33 ppm	0.013 ppm
Hydrochloric acid at INL	321	20 ppm	232	150 ppm	80	2.9 ppm	0.037 ppm
Nitric acid at REDC	2,170	6 ppm	204	78 ppm	39	0.72 ppm	0.027 ppm
Hydrochloric acid at REDC	321	20 ppm	444	150 ppm	142	10 ppm	0.13 ppm

ERPG = Emergency Response Planning Guideline, INL = Idaho National Laboratory, REDC = Radiochemical Engineering Development Center, ppm = parts per million.

[a] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (NOAA 2005).

[b] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (NOAA 2005).

Note: To convert from kilograms to pounds, multiply by 2.2046; from meters to yards, by 1.0936; from kilometers to miles, by 0.62137.

Construction Accidents

New facility construction includes the risk of accidents that could impact workers. Because construction activities do not involve radioactive materials, there would be no radiological impacts. The presence of hazardous flammable, explosive, and other chemical substances could initiate accident conditions that could impact the health and safety of workers. In addition, in the course of their work, construction personnel and site personnel could receive serious or fatal injuries as a result of incidents that are in the category of industrial accidents. The occurrence of these incidents and their impacts cannot be meaningfully predicted. However, DOE and its construction contractors adhere to strict safety standards and procedures to provide a working environment that minimizes the possibility of accidents.

4.3.9.3 Transportation

Transportation impacts consist of: impacts of incident-free or routine transportation and impacts of transportation accidents. Incident-free transportation impacts include radiological impacts on the public and workers from the radiation field surrounding the transportation package. Nonradiological impacts of potential transportation accidents include traffic accident fatalities. See Section D.5.2 for a discussion of the human health risks from pollutants emitted by transport vehicles.

The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing the individual risks from all reasonably conceivable accidents. The analysis of accident risks takes into account a spectrum of accidents ranging from high-probability accidents (fender-bender) of low-consequence to high-consequence accidents that have a low probability of occurrence. The analysis approach and details on modeling and parameter selections are provided in Appendix D of this EIS.

Under this alternative, DOE would use neptunium-237 targets to produce 1 to 2 kilograms (2.2 to 4.4 pounds) of plutonium-238 for about 5 years, up to 2012, when the required facilities at MFC become available for plutonium production. Until 2012, DOE would transport neptunium-237 from INL to the REDC target fabrication facility at ORNL. Neptunium-237 targets would be transported from REDC to HFIR at ORNL for irradiation. Following irradiation in HFIR, the targets would be returned to REDC for processing. The separated plutonium-238 products would be shipped to the Plutonium Facility at LANL for purification of plutonium-238 and its encapsulation within strong cladding material for use in the RPSs. The encapsulated plutonium-238 would be shipped to MFC at INL for RPS assembly and testing. The plutonium materials would be transported between the sites using DOE's SSTs. Transportation impacts of activities within the ORNL site would be very small and enveloped by the operational impacts associated with the target fabrication and irradiation.

After 2012, DOE would use facilities at INL to fabricate and irradiate neptunium-237 targets for producing plutonium-238. The process and activities for plutonium production would be the same as those provided under the Consolidation Alternative.

This alternative would also involve the transportation of existing available inventory of plutonium-238 inside milliwatt generator heat sources from dismantled nuclear weapons. Twenty-eight shipments would occur from LANL or Pantex between 2009 and 2022.

Based on the above assumption, the offsite transportation impacts under this alternative would include those resulting from intersite shipments of neptunium and plutonium between LANL, ORNL, Pantex, and INL. This alternative would involve approximately 43 interstate shipments of radioactive materials. The total distance traveled on public roads would be about 77,200 kilometers (47,980 miles).

Impacts of Incident-Free Transportation

The dose to transportation workers from all transportation activities under this alternative has been estimated to be about 1.33 person-rem, and the dose to the public would be about 0.89 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.00080 LCFs among transportation workers and 0.00053 LCFs in the total affected population over the duration of transportation activities. LCFs associated with radiological releases were estimated by multiplying the occupational (worker) and public dose by 6.0×10^{-4} LCFs per person-rem of exposure.

Impacts of Accidents during Transportation

As stated earlier, two sets of analyses were performed for the evaluation of transportation accident impacts: impacts of maximum reasonably foreseeable severe accidents and impacts of all conceivable accidents (total transportation accidents).

The maximum reasonably foreseeable offsite transportation accident under this alternative (probability of occurrence: more than 1 in 10 million per year) would not breach the transportation package. The consequences of most-severe accidents that could breach the transportation vehicle and its content and release radioactive materials were estimated to have a likelihood of less than 1 in 10 million per year.

As described in Appendix D, Section D.7 of this EIS, estimates of the total transportation accident risks under this alternative are as follows: a radiological dose to the population of 0.0004 person-rem, resulting in 2.44×10^{-7} LCFs, and traffic accidents resulting in 0 (0.00061) fatalities, based on 77,200 kilometers (47,980 miles) traveled.

4.3.9.4 Emergency Preparedness

Under the bridge period of this alternative, transportation of radioactive materials would occur between INL, ORNL, and LANL. Under the consolidation portions of the Consolidation with Bridge Alternative, radioactive materials would be transported only within the boundaries of INL. Radioactive waste shipments would occur to offsite waste management facilities under both portions of the Consolidation with Bridge Alternative. Section 4.1.9.4 describes emergency preparedness measures that apply to the shipment of radioactive materials and waste.

4.3.10 Environmental Justice

***Construction Impacts*—**There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction of RPS nuclear production facilities at MFC and the new road under this alternative. As stated in other subsections of Section 4.2, environmental impacts of construction would be small and are not expected to extend beyond the INL site boundary.

***Operational Impacts*—**No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under this alternative. This conclusion is a result of analyses presented in this EIS that determined there would be no significant impacts on human health, or ecological, cultural, socioeconomic, or other resource areas described in other subsections of Section 4.2.

As discussed in Section 4.3.9.1, radiological and hazardous chemical risks to the public resulting from normal operations would be small. Routine normal operations at these facilities are not expected to cause fatalities or illness among the general population, including minority and low-income populations living within the potentially affected area.

Annual radiological risks to the offsite population that could result from accidents at these facilities are estimated to be less than 2.5×10^{-4} LCFs (see Section 4.3.9.2). Hence, the annual risks of an LCF in the entire offsite population resulting from an accident under the Consolidation with Bridge Alternative would be less than 1 in 4,000.

Subsistence Consumption of Fish, Wildlife, and Game

As previously discussed in Section 4.2.10, no disproportionately high and adverse human health impacts are expected in minority or low-income populations in the INL region as a result of subsistence consumption of fish, wildlife, native plants, or crops.

4.3.11 Waste Management and Pollution Prevention

4.3.11.1 Waste Management

The amount of waste material generated during the bridge period under the Consolidation with Bridge Alternative would be similar to the No Action Alternative, except that the plutonium-238 production rate would be limited to an annual maximum of 2 kilograms (4.4 pounds) of plutonium-238. The waste management impact under the Consolidation with Bridge Alternative would be lower during the bridge period because the production rate of plutonium-238 would be lower.

For target fabrication and post-irradiation processing, the incremental waste management impact is shown in **Table 4–38**. The waste generation in Table 4–38 is modified and reduced by a factor of 2/5, or 0.4 from Table 4–9 for the No Action Alternative, as the production rate of plutonium-238 during the bridge period is reduced by a factor of 2/5. As shown in Tables 4–9 and 4–38, the generation of waste material in both cases would be small, and the impact would be negligible.

Table 4–38 Incremental Waste Management Impacts of Operating the Radiochemical Engineering Development Center at Oak Ridge National Laboratory Under the Consolidation with Bridge Alternative

Waste Type	*Estimated Annual Waste Generation* [a] *(cubic meters, except as noted)*
Transuranic	4.4
Liquid low-level radioactive	10
Solid low-level radioactive	14
Solid mixed low-level radioactive	< 2
Hazardous	2,600 kilograms
Nonhazardous process waste water	9.2
Nonhazardous sanitary wastewater	1,133
Nonhazardous solid	59

[a] The above waste generation is prorated using Table 4–9 and is reduced by a factor of 0.4.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079; from kilograms to pounds, by 2.2046.

For plutonium-238 purification, pelletization, and encapsulation, the incremental impact on waste management is shown in **Table 4–39**. As shown in Tables 4–10 and 4–39, waste generation in both cases would be small, and the impact on waste management would be negligible.

Table 4–39 Incremental Waste Management Impacts of Operating the Plutonium Facility at Los Alamos National Laboratory Under the Consolidation with Bridge Alternative

Waste Type	*Estimated Annual Waste Generation (cubic meters, except as noted)*
Transuranic	13
Low-level radioactive	150
Mixed low-level radioactive	0.34
Hazardous	< 1 kilogram [a]

[a] The amount of hazardous waste generated at the Plutonium Facility at TA-55 for the production of heat sources alone is very small. The hazardous waste generated from TA-55 overall operations is insignificant compared to other facilities at LANL.

Note: To convert from cubic meters to cubic yards, multiply by 1.3079.

In summary, the incremental impact on waste management during the bridge period under the Consolidation with Bridge Alternative would be small, and the impact on waste management at ORNL, LANL, and INL would be negligible. Impacts at INL for the last 35 years of the Consolidation with Bridge Alternative would be the same as those described in Section 4.2.11.1 for the Consolidation Alternative.

4.3.11.2 Waste Minimization and Pollution Prevention

The Consolidation with Bridge Alternative would result in continued waste generation. Waste generation activities would be scrutinized to identity opportunities for waste minimization. Wastes would be minimized where feasible by: (1) recycling; (2) processing waste to reduce its quantity, volume, or toxicity; (3) substituting materials or processes that generate hazardous wastes with others that result in less hazardous wastes; and (4) segregating waste materials to prevent contamination of nonradioactive and nonhazardous materials.

4.3.12 Environmental Restoration Program

The cleanup of past releases of contaminants at INL, ORNL, and LANL is occurring under applicable RCRA and CERCLA regulations and consent agreements. Because current activities at the sites would continue under the bridge period of this alternative, no impacts on the Environmental Restoration Programs are anticipated.

As described in Section 4.2.12, the consolidation of nuclear operations in the support of RPS production at INL under the Consolidation with Bridge Alternative is not expected to impact the Environmental Restoration Program at INL. Cessation of RPS production activities at ORNL and LANL after the consolidation of RPS nuclear production operations at INL would not impact the Environmental Restoration Programs at these sites. REDC at ORNL and the Plutonium Facility at LANL would continue to operate and would not be decommissioned.

4.4 Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations (40 CFR 1500-1508) define cumulative effects as impacts on the environment that result from the Proposed Action 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, no matter what entity (Federal, non-Federal, or private) is taking the action (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. Said another way, the effects of human activities will accumulate when a second perturbation occurs at a site before the system can fully rebound from the effect of the first perturbation.

The cumulative impacts for INL, ORNL, and LANL are presented in this section. Since new facilities and operations would be added to INL under the Consolidation and Consolidation with Bridge Alternatives, the cumulative impact of these new facilities and operations is presented in the following sections. Since no new facilities would be constructed at ORNL and LANL and since REDC and HFIR at ORNL and the Plutonium Facility at LANL are currently operating facilities, the projected incremental contributory effects of RPS nuclear production operations at these facilities on site operations would result in essentially no change in overall site impacts. In addition, most of the ongoing and reasonably foreseeable future actions planned for ORNL and LANL have already been addressed in the No Action Alternative presented in Section 4.1. Cumulative impacts were evaluated only for those ”resources” that could be affected by RPS nuclear production operations at ORNL and LANL. These include site infrastructure requirements, air quality, human health, and waste management.

Cumulative Impacts at Oak Ridge National Laboratory and Oak Ridge Reservation

Site Infrastructure Requirement Impacts—Infrastructure requirements at ORNL would remain well within ORR's site capacities. If the No Action and Consolidation with Bridge Alternatives were implemented, the REDC and HFIR would require essentially no change in the site's use of electricity or water.

Air Quality Impacts—ORNL and ORR are currently in compliance with all Federal and State ambient air quality standards, and would continue to be in compliance even if the cumulative effects of all activities are included. The contributions from RPS nuclear production operations to overall site concentrations would be very small.

Public and Occupational Health and Safety – Normal Operations Impacts—There would be no increase expected in the number of latent cancer fatalities in the population from operations at ORNL and ORR if RPS nuclear production operations were to occur at HFIR and REDC. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. The dose to the MEI would be expected to remain well within the regulatory limits. Onsite workers would be expected to see an increase of approximately 0.0036 latent cancer fatalities due to radiation from RPS nuclear production operations over the 35-year operational period.

Waste Management Impacts—It is unlikely that there would be major impacts on waste management at ORNL and ORR because sufficient capacity would exist to manage the site wastes. Neither the No Action nor Consolidation with Bridge Alternatives would generate more than a small amount of additional waste at ORNL.

Cumulative Impacts at Los Alamos National Laboratory

Site Infrastructure Requirement Impacts—Infrastructure requirements at LANL would remain within site capacities. No infrastructure capacity constraints are anticipated, as LANL operational demands to date on key infrastructure resources, including electricity and water, have been well below projected levels and well within site capacities. The ongoing use of LANL's Plutonium Facility at TA-55 would require essentially no change in the site's use of electricity or water.

Air Quality Impacts—LANL is currently in compliance with all Federal and State ambient air quality standards, and would continue to be in compliance even if the cumulative effects of all activities are included. The contributions from RPS nuclear production operations to overall site concentrations would be very small.

Public and Occupational Health and Safety – Normal Operations Impacts—There would be no increase expected in the number of latent cancer fatalities in the population from the Plutonium Facility at LANL from RPS nuclear production operations. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. The dose to the MEI would be expected to remain well within the regulatory limits. Onsite workers would be expected to see an increase of approximately 0.005 latent cancer fatalities due to radiation from RPS nuclear production operations over the 35-year operational period. Approach to Cumulative Impacts at Idaho National Laboratory

This *Consolidation EIS* adopts, and updates where needed, the cumulative impacts analyses presented in the *Idaho HLW and Facilities Disposition EIS* (DOE 2002e), and the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (*TA-18 Relocation EIS*) (DOE 2002d). In general, the following approach was used:

- The ROIs for impacts associated with projects analyzed in this EIS were defined.
- The affected environment and baseline conditions were identified.
- 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.

As described above, cumulative impacts were assessed by combining the smallest and largest potential effects of *Consolidation 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, the set of actions that impact air quality occurs at different times and locations across the ROI, and, therefore, it is unlikely that the impacts are completely additive. The effects were combined irrespective of the time and location of the impact, even though they do not necessarily occur in the same timeframe, to envelop any uncertainties in the projected activities and their effects. This approach produces a maximum estimation of cumulative impacts for the activities considered. The detailed description of the cumulative impacts methodology is presented in Section B.13.

4.4.1 Past and Present Actions at Idaho National Laboratory

To determine the baseline impacts on a resource, the impacts of past and present actions need to be identified. For most resource areas, baseline impacts can be culled from information on the affected environment provided in Chapter 3 of this EIS. For example, the current air quality in the region as described in Chapter 3 reflects both past and present activities occurring in the region. In contrast, current resource use alone may not adequately account for past resource loss and, therefore, would not be a good indicator of baseline impacts.

Past and present actions that may contribute to cumulative impacts include those conducted by government agencies, businesses, or individuals that are within the ROIs considered. Examples of past INL activities include operation of fuel fabrication plants, research and test reactors, and fuel processing and research facilities; spent fuel treatment and storage; and treatment and disposal of waste. Current INL activities include operation of research and test reactors; spent fuel treatment and storage; waste treatment and disposal; site cleanup; and research and development. **Table 4–40** lists activities included in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Spent Nuclear Fuel EIS).* As noted in this table, some of these actions were later cancelled. Therefore, it is likely that the cumulative impact analyses presented in the *Spent Nuclear Fuel EIS* are conservative.

Examples of offsite activities that may contribute to cumulative impacts include clearing land for agriculture and urban development, grazing, water diversion and irrigation projects, power generation projects, waste management activities, industrial emissions, and development of transportation and utility networks.

4.4.2 Reasonably Foreseeable Actions at Idaho National Laboratory

As stated in principle of cumulative effects analysis (CEQ 1997) No. 1, *"Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions."* Principle No. 2 further states, *"Cumulative effects are the total effect….of all actions taken, no matter who (Federal, non-Federal, or private) has taken the actions."* Therefore, it is important to identify future actions that may appreciably degrade the resources or can add to the impacts of other actions, regardless of the agency or individual undertaking the action. Past, present, and reasonably foreseeable onsite actions included in the cumulative impacts analysis are presented in **Table 4–41**. Future actions that are speculative or not well defined were not analyzed.

Table 4–40 Activities Included in the *Spent Nuclear Fuel EIS* Assessment of Cumulative Impacts

Activity	*Activity*
Borrow Source Silt Clay	Partnership Natural Disaster Reduction Test Station
Calcine Transfer Project	Nonincinerable Mixed Waste Treatment
Central Liquid Waste Processing Facility D&D	Pit 9 Retrieval
Dry Fuels Storage Facility	Private Sector Alpha-Mixed Low-Level Waste Treatment
Environmental Assessment Determination for CPP-627	Radioactive Scrap/Waste Facility
EBR-II Blanket Treatment	Remediation of Groundwater Facilities
EBR-II Plant Closure	Remote Mixed Waste Treatment Facility
Expended Core Facility Dry Cell Project	Radiological and Environmental sciences Laboratory Replacement
Engineering Test Reactor D&D	RWMC Modification for Private Sector Treatment of Alpha-Mixed Low-Level Waste [a]
Fuel Processing Complex (CPP-601) D&D	Sodium Processing Plant
Fuel Receiving, Canning, Characterization, and Shipping	Test Area North Pool Fuel Transfer
Gravel Pit Expansions (New Borrow Source)	Tank Farm Heel Removal Project
Greater than Class C Dedicated Storage	Treatment of Alpha-Mixed Low-Level Waste
Headend Processing Plant (CPP-640) D&D	Transuranic Storage Area Enclosure and Storage Project
Health Physics Instrument Lab	Vadose Zone Remediation
High-Level Waste Tank Farm Replacement (upgrade phase) [a]	Waste Calcine Facility (CPP-633) D&D
Increased Rack Capacity for CPP-666 [a]	Waste Characterization Facility
Industrial Landfill Expansion	Waste Handling Facility [a]
Material Test Reactor D&D	Waste Immobilization Facility
Mixed Low-Level Waste Disposal Facility [a]	Waste Experimental Reduction Facility Incineration

D&D = decontamination and decommissioning, CPP = Chemical Processing Plant (now known as the Idaho Nuclear Technology and Engineering Center), EBR = Experimental Breeder Reactor, RWMC = Radioactive Waste Management Complex.

[a] These activities were later cancelled (DOE 2002f).

Source: DOE 2002e.

An understanding of expected future land use sets the stage for reasonably foreseeable actions that may occur at INL in the future. The *Environmental Management Performance Management Plan for Accelerating Cleanup of the Idaho National Engineering and Environmental Laboratory* (DOE 2002b), describes DOE's plan to accelerate the reduction of environmental risk at INL by completing its cleanup responsibility faster and more efficiently. The plan describes how DOE will address risk reduction and elimination by stabilizing and dispositioning materials such as sodium-bearing liquid wastes, spent nuclear fuel, and special nuclear materials many years earlier than currently planned. The plan describes nine strategic initiatives DOE proposes to eliminate or reduce environmental risks at INL (DOE 2002b). The strategic initiatives are:

- Accelerate tank farm closure.
- Accelerate high-level radioactive waste calcine removal from Idaho.
- Accelerate consolidation of spent nuclear fuel to the Idaho Nuclear Technology and Engineering Center (INTEC).

Table 4–41 Additional Onsite Actions Included in the *Idaho High-Level Waste and Facilities Disposition Final EIS* Assessment of Cumulative Impacts

Project	*Description*
Spent nuclear fuel management and environmental restoration	Spent nuclear fuel management and environmental restoration activities as described in the *Spent Nuclear Fuel EIS*. Activities included in this EIS are listed in Table 4–40.
Advanced Mixed Waste Treatment Project	Retrieve, sort, characterize, and treat mixed low-level radioactive waste and approximately 65,000 cubic meters of alpha-contaminated mixed low-level radioactive waste and transuranic waste currently stored at the INL Radioactive Waste Management Complex. Package the treated waste for shipment offsite for disposal.
Waste area group 3 remediation	Ongoing activities addressing remediation of past releases of contaminants at INTEC
New silt/clay source development	INL activities require silt/clay for construction of soil caps over contaminated sites, research sites, and landfills; replacement of radioactively contaminated soil with topsoil for revegetation and backfill; sealing of sewage lagoons; and other uses. Silt/clay will be mined from three onsite sources (ryegrass flats, spreading areas A, and Water Reactor Research Test Facility).
Closure of various INTEC facilities unrelated to *Idaho HLW and Facilities Disposition EIS* Alternatives	Reduce the risk of radioactive exposure and release of hazardous constituents and eliminate the need for extensive long-term surveillance and maintenance for obsolete facilities at INTEC.
Percolation pond replacement	DOE intends to replace the existing percolation ponds at INTEC with replacement ponds located approximately 10,200 feet southwest of the existing ponds.
Treatment and management of sodium-bonded spent nuclear fuel	Treatment of sodium-bonded spent nuclear fuel at MFC using the electrometallurgical process.

INL = Idaho National Laboratory, INTEC = Idaho Nuclear Technology and Engineering Center, MFC = Materials and Fuels Complex.
Note: To convert from cubic meters to cubic yards, multiply by 1.3079; from meters to yards, by 1.0936.
Source: DOE 2002e.

- Accelerate offsite shipments of transuranic waste stored at the Transuranic Storage Area.
- Accelerate remediation of miscellaneous contaminated areas.
- Eliminate onsite treatment and disposal of low-level radioactive waste and mixed low-level radioactive waste.
- Transfer all Environmental Management-managed special nuclear material offsite.
- Remediate buried waste at the Radioactive Waste Management Complex.
- Accelerate consolidation of INL facilities and reduce the footprint.

At the 2020 end state in the plan, some activities would continue: shipment of spent nuclear fuel to a repository; retrieval, treatment, packaging, and shipment of calcine high-level radioactive waste to a repository; and final dismantlement of remaining Environmental Management buildings. Additionally, the site will continue with ongoing activities such as groundwater monitoring well beyond the 2020 end state identified in this plan. These activities will be complete by 2035, with the exception of some minor activities leading to long-term stewardship (DOE 2002b).

An environmental assessment (EA) is currently being prepared for the Remote Treatment Facility, which would be located in MFC and would treat large pieces of equipment that require remote handling.

A potential future project identified but not considered in the cumulative impacts analysis because of its speculative nature involves the INTEC coal-fired steam heating plant. The plant could be converted to a small commercial power generating facility. The potential for such a conversion is being considered by the Eastern Idaho Community Reuse Organization (DOE 2002e, INL 2005c).

It is also necessary to consider activities implemented by other Federal, state, and local agencies and individuals outside INL, but within the ROI. This may include state or local development initiatives; new industrial or commercial ventures; new utility or infrastructure construction and operation; new waste treatment and disposal; and new residential development. The city of Idaho Falls, Butte, Bingham, Bonneville, Clark, and Jefferson Counties; the Idaho Department of Transportation; and the U.S. Forest Service were contacted for information regarding anticipated future activities that could contribute to cumulative impacts. Bingham and Bonneville Counties did not identify any major future actions (INL 2005c, INL 2005c). Activities in the region surrounding INL that were identified include:

- City of Idaho Falls – identified continued development similar to what has occurred in 2004 (295 homes and 55,742 square meters [600,000 square feet] of retail space built) (INL 2005c); and
- Jefferson County – studying possible regionalized wastewater treatment (INL 2005c).

Information on transportation projects was collected to determine if major projects could impact the region around INL (BMPO 2004, ITD 2005a, ITD 2005b, WFLHD 2005). Some of the more substantial transportation projects in the region include:

- New Interstate-15 interchange and bridge over the Snake River at milepost 116 (2004 to 2006) (ITD 2005b),
- Major widening of U.S. Route 20 near Idaho Falls (2005) (ITD 2005a),
- Major widening of State Road 7446 in Idaho Falls (2005) (ITD 2005a),
- Major widening of Interstate-86B near junction with State Highway 39 (2006) (ITD 2005a),
- Add lanes to U.S. Route 26 near Idaho Falls (2007) (BMPO 2004, ITD 2005a),
- Major widening of Interstate-86 near junction with U.S. Route 91 (2007) (ITD 2005a),
- Major widening of U.S. Route 91 near Blackfoot (2007) (ITD 2005a), and
- Major widening of State Road 7401 near Interestate-86 (2008) (ITD 2005a).

Although the transportation infrastructure in the region would continued to be maintained, and some upgrade, expansion, and widening projects are schedule over the next 5 years or so, no new major roadways that could contribute substantially to cumulative impacts are scheduled.

Because of the distance from the MFC and ATR sites at INL; the routine nature and relatively small size of the other actions considered; and the zoning, permitting, environmental review, and construction requirements that these actions must meet, they are not expected to substantially contribute to cumulative impacts.

4.4.3 Cumulative Impacts at Idaho National Laboratory

The following resource areas have the potential for cumulative impacts: land resources, site infrastructure (i.e., socioeconomics; electricity, and water use), geology and soils, air quality, ecological resources, cultural resources, public health and safety, occupational health and safety, transportation, and waste management. Cumulative impacts for these resource areas are presented below.

4.4.3.1 Land Resources

Cumulative impacts on land use at INL are presented in **Table 4–42**. Cumulative actions are expected to disturb 5,258 to 5,333 hectares (12,993 to 13,178 acres), or 2 percent of the 230,700 hectares (570,000 acres) of land on INL. The alternatives for RPS production would disturb a maximum of 75 hectares (185 acres) of land. This value includes the areas disturbed for construction of the new facilities and road and to obtain sand and gravel. The maximum impact *Consolidation EIS* alternative would occupy less than 0.1 percent of the INL land area. Some of this land could be returned to productive uses after facility decommissioning. Use of land within the RTC and MFC would be consistent with current industrial land uses.

Table 4–42 Cumulative Land Use Impacts at Idaho National Laboratory

Activity		*Land Use Commitment (hectares)*
Past, Present, and Reasonably Foreseeable Future Actions		
Existing site activities [a]		4,600
Spent nuclear fuel management and INL environmental restoration and waste management (DOE 2002e)		545
High-level radioactive waste and facilities disposition (DOE 2002e)		9
New silt/clay source development (DOE 1997a)		97
Percolation pond replacement (DOE 2002e)		7
Subtotal Baseline Plus Other Actions		5,258
Consolidation EIS Alternatives [b]	No Action	0
	Consolidation	75
	Consolidation with Bridge	75
Total [c]		5,258 to 5,333
Total Site Capacity [d]		230,700

INL = Idaho National Laboratory.

[a] From Chapter 3 of this EIS.

[b] Impact indicator values from this Chapter 4. Includes borrow area disturbed to supply sand and gravel.

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

[d] Total of INL land areas from Chapter 3 of this EIS.

Note: To convert from hectares to acres, multiply by 2.471.

4.4.3.2 Site Infrastructure

Cumulative impacts on site infrastructure at INL are presented in **Table 4–43**. *Consolidation EIS* alternatives would use from approximately 2,039 to 10,639 megawatt-hours per year of electricity and 28 to 75 million liters (7.4 to 20 million gallons) of water per year. Table 4–43 indicates that INL would remain within its capacity to deliver electricity and water. Cumulatively, up to 52 percent of the electrical energy capacity and 11 percent of the water supply capacity could be used.

4.4.3.3 Geology and Soils

Construction of the new facilities and new road would require use of borrow materials such as gravel, silt and clay. Sources of sand, gravel, and aggregate in support of remedial activities and INL operations were evaluated in the *Spent Nuclear Fuel EIS*. The need for sand and gravel is estimated to be 1,354,740 cubic meters (1,772,000 cubic yards) (DOE 1995).

Table 4–43 Cumulative Site Infrastructure Impacts at Idaho National Laboratory

Activity		*Peak Site Employment (persons)*	*Electricity Consumption (megawatt-hours per year)*	*Water Usage (million liters per year)*
Past, Present, and Reasonably Foreseeable Future Actions				
Existing site activities [a]		8,100	156,639	4,200
Spent nuclear fuel management and INL environmental restoration and waste management (DOE 2002d)		(b)	2,200	2
Foreign research reactor spent nuclear fuel management (DOE 2002d)		(b)	1,000	2
Waste management (DOE 2002d)		(b)	13,980	194
High-level radioactive waste and facilities disposition (DOE 2002d and 2002e)		870	33,000	394
Advanced Mixed Waste Treatment Project (DOE 2002d)		(b)	33,000	16
Subtotal Baseline Plus Other Actions		8,970	239,819	4,808
Consolidation EIS Alternatives [c]	No Action	0	2,039	28
	Consolidation	245/75	10,639	75
	Consolidation with Bridge	245/75	10,639	75
Total [d]		8,970 to 9,215	241,858 to 250,458	4,836 to 4,883
Total Site Capacity [a]		Not applicable	481,800	43,000

INL = Idaho National Laboratory.

[a] From Chapter 3 of this EIS.

[b] Employment for this activity is included in the 8,100 existing employees.

[c] Impact indicator values from this chapter. Peak site employment includes 245 short-term construction workers. Seventy-five workers are associated with long-term operation of the new facilities.

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

Note: To convert from liters to gallons, multiply by 0.26418.

Anticipated requirements for geologic materials were identified in an EA addressing impacts of developing new sources of silt and clay to support INL actions (DOE 1997a). The EA identified a need for 3,516,820 cubic meters (4,600,000 cubic yards) of silt/clay material over a period of 10 years. Most of these resources would be obtained from the areas of INL set aside for removal of borrow material (i.e., ryegrass flats, spreading areas A, and the Water Reactor Research Test Facility). Silt and clay required for construction activities associated with waste processing and facilities disposition, as well as material for all other INL activities, including ongoing operations and remediation of contaminated sites, would be obtained from sources analyzed in the EA. The development or expansion of borrow material sources would be within the boundaries of INL; the acreage used would be small and subject to standard cultural resource protection measures and site restoration, including revegetation with native plant species.

As shown in **Table 4–44**, some 4,871,560 to 5,126,560 million cubic meters (6,372,000 to 6,705,540 million cubic yards) of geologic resources could be extracted from the areas set aside for this purpose. As described in this chapter, *Consolidation EIS* alternatives would use up to 255,000 cubic meters (333,540 cubic yards) of geologic materials. It is expected that the geologic resources available in the areas set aside for this purpose could satisfy these demands. Therefore, cumulative impacts on site geology and soils are anticipated to be minor.

Table 4–44 Cumulative Geologic Material Requirements at Idaho National Laboratory

Activity		*Geologic Materials Needed (cubic meters)*
Past, Present, and Reasonably Foreseeable Future Actions		
Spent nuclear fuel management and Idaho National Laboratory environmental restoration and waste management (DOE 2002e)		1,354,740
New silt/clay source development (DOE 2002e)		3,516,820
Subtotal Other Actions		4,871,560
Consolidation EIS Alternatives [a]	No Action	0
	Consolidation	255,000
	Consolidation with Bridge	255,000
Total [b]		4,871,560 to 5,126,560

[a] Impact indicators from this Chapter 4.

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

Note: To convert from cubic meters to cubic yards, multiply by 1.3079.

4.4.3.4 Air Quality

Cumulative impacts of criteria pollutants are shown in **Table 4–45**. Cumulative impacts of radiological air pollutants are discussed in Section 4.4.4.8 on Public Health and Safety. Table 4–45 indicates that air quality standards for carbon monoxide, nitrogen oxides, PM, and sulfur oxides would not be exceeded at the INL boundary or along public roadways.

The cumulative impacts analysis is very conservative because many of the air pollutant releases would occur at different times and locations and may not be additive. Activities that would cause air quality standards to be exceeded would not be allowed.

4.4.3.5 Ecological Resources

Cumulative impacts on INL ecology of habitat loss as a result of any alternative analyzed in this EIS would be small. Measurable impacts on populations on or off INL have not occurred and are not expected as a result of the incremental increase in exposure to radionuclides or chemicals that could result under alternatives analyzed in this EIS. Additional deposition resulting from any of the alternatives analyzed in this EIS is not expected to lead to levels of contaminants that would exceed the historically reported range of concentrations. Therefore, DOE anticipates minimal cumulative impacts on the INL ecology and/or plant and animal populations as a result of any alternative analyzed in this EIS.

4.4.3.6 Cultural Resources

As stated above, the majority of reasonably foreseeable INL actions would occur within previously disturbed areas contained within or adjacent to developed areas. The likelihood that these areas contain cultural materials intact or in their original context is small. Nevertheless, there is the potential to unearth or expose cultural materials during excavation. Standard measures to avoid or minimize the impacts on cultural materials discovered during site development are in place. Cultural resource surveys would be conducted prior to construction or surface disturbance outside the MFC fence, and along the proposed new road, and appropriate standard measures, such as avoidance or scientific documentation and tribal consultation, would be implemented prior to development. No decision would be made relative to construction of any proposed facilities or the new road prior to completion of the consultation process. Implementation of these measures would minimize the potential for impacts, including cumulative impacts, on cultural resources. The contribution of activities evaluated in this EIS to cumulative impacts on cultural and historic resources on INL or in southeastern Idaho is expected to be minimal.

Table 4–45 Cumulative Air Quality Impacts of Criteria Pollutants at Idaho National Laboratory

		Maximum Average Concentration (micrograms per cubic meter)			
Activity		***Carbon Monoxide***	***Nitrogen Oxides***	***Particulate Matter*** **(PM_{10})**	***Sulfur Oxides***
Past, Present, and Reasonably Foreseeable Future Actions					
INL site baseline [a]		71	2.3	20	140
Treatment and management of sodium-bonded spent nuclear fuel (DOE 2002d)		0	0	0	0
High-level radioactive waste and facilities disposition (DOE 2002d) [b]		4.0	0.10	0	10
New silt/clay source development (DOE 1997a)		No data	No data	18	No data
Subtotal Baseline Plus Other Actions		75	2.4	38	150
Consolidation EIS Alternatives [c]	No Action	Negligible	Negligible	Negligible	Negligible
	Consolidation	0.076	0.025	0.016	0.74
	Consolidation with Bridge	0.076	0.025	0.016	0.74
Total [d]		75	2.4	35	151
Most Stringent Standard or Guideline		10,000 (8 hours)	100 (annual)	150 (24 hours)	1,300 (3 hours)

PM_{10} = particulate matter less than or equal to 10 micrometers in aerodynamic diameter, INL = Idaho National Laboratory.

[a] From Chapter 3, including reasonably foreseeable sources, Advanced Mixed Waste Treatment Project (DOE 1999b), and the *Idaho HLW and Facilities Disposition EIS* Continued Operations Alternative (DOE 2002e) (to account for steam boilers).

[b] Difference between Planning Basis Alternative and Continued Operations Alternative.

[c] Impact indicator values from this Chapter 4.

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

4.4.3.7 Socioeconomics

As shown in Table 4–43, cumulative employment at INL could reach 9,215 persons. This value is a conservative estimate of future employment at INL. Some of the employment would occur at different times and may not be additive. It is likely that some employees are being counted twice; once as part of the baseline, and again as part of new projects. In addition, this estimate assumes that baseline employment would continue at current levels; this is highly unlikely. The projected baseline for INL shows declining employment. Overall, INL employment may decline at an even faster rate than presently forecast, depending on the success of accelerated site cleanup (DOE 2002b). Future employment for RPS fabrication may act to reduce the adverse effects of a reduction in baseline employment. Considering that direct employment at INL was approximately 11,000 workers in 1990 (DOE 1995) and approximately 8,100 workers in 2001 (see Section 3.2.8), future changes in employment as a result of activities described in this EIS would be within normal workforce fluctuations.

A maximum of 245 new employees could move into the area to support construction activities. As described earlier in this chapter, these new arrivals would not strain the capacities of housing or community services or the transportation network. Only 75 employees would be required for operation of the new facilities.

4.4.3.8 Public Health and Safety

A summary of cumulative radiological impacts on public health due to radiological air emissions from past, present, and reasonably foreseeable future activities at INL is provided in **Table 4–46**. The cumulative population dose from INL operations is estimated to be 0.35 person-rem per year. The number of LCFs from this population dose would be much less than 1.

Table 4–46 Cumulative Population Health Effects of Exposure to Contaminants in Air at Idaho National Laboratory

Activity		*General Population* [a]		*Maximally Exposed Individual*	
		Dose (person-rem per year)	*Latent Cancer Fatalities* [b]	*Dose (millirem per year)*	*Latent Cancer Fatalities* [b]
Past, Present, and Reasonably Foreseeable Future Actions					
Existing site activities [c]		0.022	1.3×10^{-5}	0.035	2.1×10^{-8}
Spent nuclear fuel management and INL environmental restoration and waste management (DOE 2002d)		0.19	1.1×10^{-4}	0.008	4.8×10^{-9}
Foreign research reactor spent nuclear fuel management (DOE 2002d)		0.0045	2.7×10^{-6}	5.6×10^{-4}	3.4×10^{-10}
Treatment and management of sodium-bonded spent nuclear fuel (DOE 2002d)		0.012	7.2×10^{-6}	0.002	1.2×10^{-9}
Storage and disposition of weapons-usable fissile materials (DOE 2002d)		1.8×10^{-5}	1.1×10^{-8}	1.6×10^{-6}	9.6×10^{-13}
High-level radioactive waste and facilities disposition (DOE 2002e)		0.11	6.6×10^{-5}	0.0018	1.1×10^{-9}
Advanced Mixed Waste Treatment Project (DOE 2002d)		0.009	5.4×10^{-6}	0.022	1.3×10^{-8}
Subtotal Baseline Plus Other Actions		0.35	2.1×10^{-4}	0.069	4.1×10^{-8}
Consolidation EIS Alternatives [d]	No Action	6.0×10^{-5}	3.6×10^{-8}	1.4×10^{-7}	2.9×10^{-12}
	Consolidation	6.7×10^{-4}	4.1×10^{-7}	1.6×10^{-6}	3.4×10^{-11}
	Consolidation with Bridge	7.1×10^{-4}	4.2×10^{-7}	1.6×10^{-6}	3.4×10^{-11}
Total [e]		0.35	2.1×10^{-4}	0.069 [f]	4.1×10^{-8} [f]

INL = Idaho National Laboratory.

[a] The exposed population used to estimate population dose varies over time. As described in Section 3.2.9.1, the population living within 80 kilometers (50 miles) of any INL facility is estimated to be 276,979 in 2003.

[b] LCFs calculated using a conversion of 0.0006 LCFs per person-rem.

[c] From Chapter 3 of this EIS.

[d] Impact indicators from this Chapter 4.

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

[f] The same individual is not expected to be the MEI for all activities at INL. The location of the MEI depends upon where on the site an activity is performed. However, to provide an upper bound of the cumulative impacts on the MEI, the impacts of each activity have been summed.

As described in this chapter, *Consolidation EIS* alternatives would range from 6.0×10^{-5} to 7.1×10^{-4} person-rem and 3.6×10^{-8} to 4.2×10^{-7} LCFs. For perspective, the doses to the local population (276,979 persons in 2003) from naturally occurring radioactive sources (359 millirem-per-person-per-year) would result in about 99,000 person-rem per year, from which about 60 LCFs would be inferred.

Table 4–46 indicates that the cumulative dose to the MEI is estimated to be 0.069 millirem per year. This is a very conservative estimate of potential dose to an MEI because the activities contributing to the dose are not likely to occur at the same time and location. These estimates of cumulative dose to the MEI are well below the 10-millirem-per-year EPA limit.

Other regional sources of atmospheric radioactivity have the potential to contribute to the dose received by the public near INL. The primary non-INL source of airborne radioactivity is emissions from phosphate processing operations in Pocatello, Idaho. The number of fatal cancers in the population within 80 kilometers (50 miles) of the Pocatello phosphate processing operations is estimated to be about 1 over a 10-year period. INL and the Pocatello phosphate plants are separated by enough distance that the population evaluated does not completely overlap the population evaluated in this EIS. The population exposed to the cumulative impact of both facilities would be minimal (DOE 2002e).

In addition to radiation dose from atmospheric emissions, there is a potential for impacts on the public of exposure to carcinogenic chemicals released to the air. INL operations are not anticipated to exceed applicable standards when emissions under the alternatives analyzed in this EIS are considered in conjunction with existing and anticipated emissions. The highest risks calculated indicate less than one fatal cancer in the exposed population. Therefore, minimal health effects of chemical carcinogen releases are anticipated. No basis for use in evaluating risks from chemical exposure due to other regional commercial, industrial, and agricultural sources, such as combustion of diesel or gasoline fuels and agricultural use of pesticides, herbicides, and fertilizers, is available. Therefore, the cumulative health effects in the general population of INL activities combined with other sources of chemical exposure cannot be estimated (DOE 2002e).

4.4.3.9 Occupational Health and Safety

As shown in **Table 4–47**, the maximum cumulative annual INL worker dose, could total 390 to 422 person-rem, which would result in less than one (0.23 to 0.25) LCF. As described in this chapter, *Consolidation EIS* alternatives could produce annual worker doses of 1.2 to 33 person-rem, resulting in 0.00072 to 0.020 LCFs. Note that DOE regulations limit routine worker exposure to 5 rem per year (10 CFR 835) and recommend a lower Administrative Control Level of 0.5 rem per year.

Table 4–47 Cumulative Health Effects on the Idaho National Laboratory Worker

Activity		*Dose (person-rem per year)*	*Latent Cancer Fatalities* [b]
Past, Present, and Reasonably Foreseeable Future Actions			
Existing site activities [a]		240	0.14
Spent nuclear fuel management and INL environmental restoration and waste management (DOE 2002d)		5.4	0.0032
Foreign research reactor spent nuclear fuel (DOE 2002d)		33	0.020
Treatment and management of sodium-bonded spent nuclear fuel (DOE 2002d)		22	0.013
Storage and disposition of weapons-usable fissile materials (DOE 2002d)		25	0.015
High-level radioactive waste and facilities disposition (DOE 2002d)		59	0.035
Advanced Mixed Waste Treatment Project (DOE 2002d)		4.1	0.0025
Subtotal Baseline Plus Other Actions		389	0.23
Consolidation EIS Alternatives [c]	No Action	1.2	0.00072
	Consolidation	32	0.019
	Consolidation with Bridge	33	0.020
Total [d]		390 to 422	0.23 to 0.25

INL = Idaho National Laboratory.

[a] From Chapter 3 of this EIS.

[b] LCFs calculated using a conversion of 0.0006 LCFs per person-rem.

[c] Impact indicators from this Chapter 4.

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

4.4.3.10 Transportation

The cumulative health effects to the transportation workers (truck or rail crew) and population over approximately 100 years of radioactive material and waste transport are shown in **Table 4–48**. One hundred years is approximately the period of time from the start of operations at INL in the 1940s to the end of the period of analysis for this EIS in the 2040s. Cumulative transportation impacts are predicted to result in approximately 180 worker (truck crew) LCFs, 183 LCFs in the general population, and 74 traffic fatalities. Most of the estimated health effects are associated with general radioactive waste and materials transport related to non-DOE activities such as medical isotope transport, and commercial low-level radioactive waste transport. *Consolidation EIS* alternatives are expected to result in a very small number (less than one) of worker and public LCFs and a very small number (less than one) of traffic fatalities and therefore would not contribute substantially to cumulative impacts.

Table 4–48 Cumulative Truck Transportation Impacts

Activity		*Worker*		*General Population*		*Traffic Fatalities* [a]
		Dose (person-rem)	*Latent Cancer Fatalities*	*Dose (person-rem)*	*Latent Cancer Fatalities*	
Past, Present, and Reasonably Foreseeable Future Actions						
Historical transportation of waste and spent nuclear fuel (DOE 2002e)		109	0.065	60	0.036	No data
Spent nuclear fuel (DOE 1995, 2002e)		1,200	0.72	1,300	0.78	0.77
Treatment and management of sodium-bonded spent nuclear fuel (DOE 2004a)		1.7	0.001	1.7	0.001	0.001
Surplus plutonium disposition (DOE 2004a)		60	0.036	67	0.040	0.053
DOE-wide waste management (DOE 2004a)		16,667	10	20,000	12	36
High-level radioactive waste and facilities disposition (DOE 2002e)		520	0.31	2,900	1.7	0.98
Reasonably foreseeable actions, including transport to WIPP and Yucca Mountain (DOE 2002e)		11,000	6.6	50,000	30	ND
General transportation 1953-2037 (DOE 2002e)		270,000	162	230,000	138	36
New silt/clay source development (DOE 1997a)		Not applicable	Not applicable	Not applicable	Not applicable	0.13
Subtotal Other Actions		299,558	180	304,329	183	74
Consolidation EIS Alternatives [b]	No Action	15	0.009	22	0.013	0.036
	Consolidation	0.77	0.00046	0.43	0.00026	0.00042
	Consolidation with Bridge	1.48	0.00089	1.0	0.00060	0.00068
Total [c]		299,561 to 299,573	180	304,334 to 304,351	183	74

WIPP = Waste Isolation Pilot Plant.

[a] Traffic fatalities associated with transporting radioactive materials and waste.

[b] Transportation impact indicators from this Chapter 4.

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

Note: LCFs calculated using a conversion of 0.0006 LCFs per person-rem.

Facilities that involve shipment of radioactive materials were surveyed for 1971 through 1993 using accident data from the DOT, NRC, DOE, and state radiation control offices. During this period, there were 21 vehicular accidents involving 36 fatalities. These fatalities resulted from the vehicular accidents and were not associated with the radioactive nature of the cargo; no radiological fatalities due to transportation accidents have ever occurred in the United States (DOE 2002e). For perspective, it may be noted that several million traffic fatalities from all causes are expected nationwide during the period from 1943 to 2047 (DOE 2004a).

4.4.3.11 Waste Management

Expected cumulative waste generation at INL is presented in **Table 4–49**. It is unlikely that there would be major impacts on the waste management infrastructure at INL because the additional waste generated by the RPS production mission would generally be a small percentage of the total waste that would be generated.

The transuranic waste generated by RPS nuclear production operations would be certified for shipment to WIPP at the generating facility. Although transuranic waste is no longer routinely generated at INL, the 700 cubic meters (916 cubic yards) of transuranic waste that would be generated is a small percentage of the approximately 61,553 cubic meters (80,505 cubic yards) of transuranic waste in storage at INL. Therefore, the waste management infrastructure at INL would not be appreciably affected by this additional waste.

Although the volume of industrial waste previously disposed of in the INL landfill complex is unknown, it is estimated that the landfill complex would provide adequate capacity for the next 30 to 50 years, which would accommodate wastes generated for project life cycles evaluated in this cumulative impacts analysis (DOE 2002e).

Table 4–49 Cumulative Waste Generation at Idaho National Laboratory (cubic meters)

Activity (duration)		*Transuranic*	*LLW*	*MLLW*	*Hazardous*	*Nonhazardous*
Past, Present, and Reasonably Foreseeable Future Actions						
Existing site activities (35 years) [a]		0	224,000	8,050	29,225	2,170,000
Treatment and management of sodium-bonded spent nuclear fuel (12 years) (DOE 2000c, 2002d)		14	862	40	0	4,960
High-level radioactive waste and facility disposition (through 2035) (DOE 2002d, 2002e)		0	15,320	12,837	2,457	145,262
Advanced Mixed Waste Treatment Project (9 years) (DOE 1999b)		0	24	29,631	Not reported	Not reported
Subtotal Baseline Plus Other Actions		14	240,206	50,558	31,682	2,320,222
Consolidation EIS Alternatives [b]	No Action [c]	0	0	0	0	0
	Consolidation	700	7,525	189	8,050	5,215
	Consolidation with Bridge [c]	700	7,525	189	8,050	5,215
Total [d]		714	247,731	50,747	39,732	2,325,437

LLW = low-level radioactive waste, MLLW = mixed low-level radioactive waste.

[a] From Chapter 3 of this EIS. Assumes current waste generation rates will continue for 35 years.

[b] Waste generation values at INL for alternatives described in Chapter 4.

[c] Additional waste is generated at LANL and ORNL for these alternatives.

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

4.5 Mitigation Measures

This section summarizes the mitigation measures that could be used to avoid or reduce environmental impacts resulting from implementation of the alternatives as described in the preceding sections. As specified in CEQ's NEPA regulations (40 CFR 1508.20), mitigation includes:

- Avoiding the impact altogether by not taking an 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; or

Compensating for the impact by replacing or providing substitute resources or environments.

As shown throughout Chapter 4, the impacts of the Consolidation and Consolidation with Bridge Alternatives would be small on most resources. Activities associated with the proposed construction and operations of the new RPS nuclear production facilities at MFC and INL would follow standard procedures and best management practices for minimizing environmental impacts. Therefore, no mitigation measures would be necessary for most resources.

Under the Consolidation and Consolidation with Bridge Alternatives, DOE would construct a new road between the MFC and ATR at INL to provide appropriate security measures for the transfer of unirradiated and irradiated targets and preclude the use of public roads. Three possible transportation routes for this new road were evaluated in this EIS. One route (T-3 route) while more direct, would require constructing a new bridge across the Big Lost River. This bridge would impact the floodplain and wetlands along the Big Lost River. The other routes would use an existing bridge crossing. A separate Preliminary Floodplain/Wetlands Assessment has been prepared for the T-3 route.

Following completion of this EIS and its associated Record of Decision, DOE would prepare a Mitigation Action Plan (if needed) that addresses mitigation commitments expressed in the Record of Decision. The Mitigation Action Plan would explain how certain measures would be planned, implemented, and monitored to mitigate those commitments. A Mitigation Action Plan would be prepared before DOE would undertake any activities that would require mitigation.

Proposed Mitigation Measures

- Adhere to standard best management practices for soil erosion and sediment control during construction (e.g., use of mulch and geotextiles to cover denuded areas) to minimize wind and water erosion.
- Reuse topsoil removed during construction for backfill of facility excavations.
- Water roadways and revegetate exposed areas to reduce dust emissions resulting from use of heavy equipment.
- Continue to implement the as low as is reasonably achievable (ALARA) principle during construction and operation to reduce radiological exposure of workers.
- Continue safety training to help protect workers and prepare for possible emergencies and accidents.
- Continue to perform cultural and biological surveys prior to and during construction.
- Provide physical improvements to local and onsite roads to increase capacity and reduce traffic volume impacts.
- Provide programs for employees that include flexible hours or staggered work shifts for workers to reduce peak traffic volumes.
- Continue implementing DOE's pollution prevention and waste minimization awareness program.

4.6 Resource Commitments

4.6.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are impacts that would occur after implementation of all feasible mitigation measures, including those incorporated into the design elements of EIS alternatives. Implementing any of the alternatives considered in this EIS, including the No Action Alternative (status quo), would result in some unavoidable adverse environmental impacts.

Even with application of best management practices, some fugitive dust and noise generation, soil erosion, and increased vehicle traffic would be unavoidable during construction of the new road and the new RPS nuclear production facilities at MFC, but these impacts would be relatively minor and temporary in nature.

Geologic materials would be required for backfilling during excavation and new facility/road construction. Projections of the total volume of geologic resources required range from zero under the No Action Alternative to 307,000 cubic meters (402,000 cubic yards) under the Consolidation and Consolidation with Bridge Alternatives. The impacts of operating onsite borrow areas to support INL activities were previously addressed in the *Environmental Assessment and Plan for New Silt/Clay Source Development and Use at the Idaho National Engineering and Environmental Laboratory* (DOE 1997a). After extraction of geologic materials, borrow areas would be rehabilitated by grading and revegetating the land surface.

Minor unavoidable adverse impacts on air quality would occur due to emission of various chemical and radiological constituents from facility construction and operation. Under all alternatives, nonradiological emissions resulting from construction and operations are not expected to exceed National Ambient Air Quality Standards. Chemical and radiological emissions would not exceed the National Emission Standards for Hazardous Air Pollutants.

Unavoidable adverse impacts would occur due to land disturbance. Total land disturbance would range from zero under the No Action Alternative to 75 hectares (185 acres) under the Consolidation and Consolidation with Bridge Alternatives. Some plants and small animals would be killed during land clearing and excavation activities. Biological surveys conducted for MFC indicate that construction of the new RPS nuclear production facilities at MFC is not expected to disturb sensitive plants or animals, or alter or destroy sensitive habitat near MFC. A biological survey and consultations would be conducted before construction of the new road. No decision would be made relative to construction of any proposed facilities or the new road prior to completion of the consultation process. Although noise levels would be relatively low outside the immediate construction areas, the combination of noise and associated human activity probably would displace small numbers of animals surrounding the construction areas.

Normal facility operations would also result in unavoidable radiation exposure to workers and the general public. Workers would have the highest levels of exposure, but doses would be administratively controlled. The incremental annual dose contributions to the MEI, general population, and workers are discussed in the public and occupational health and safety–normal operations sections of this chapter. These doses are not expected to exceed any standards or administrative control limits.

Also unavoidable would be the generation of some waste products, including transuranic waste, low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste. Wastes generated during construction and operations would be collected, stored, and shipped for suitable treatment, recycling, or disposal in accordance with applicable Federal and State regulations as described in the waste management sections of this chapter. As described above, DOE would conduct all activities and optimize all operations in such a way that generates the smallest amount of waste practical.

4.6.2 Relationship between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

The construction and operation of facilities would result in short-term uses of the environment as described in this chapter. "Short term" for the purposes of analysis in this EIS is the active project phase during which construction and operations activities would take place. Under the No Action Alternative, this timeframe would encompass the 35-year active project period out to 2041. Under the Consolidation Alternative, this timeframe would include the 2-year construction, 1-year preoperational testing, and 35-year operations periods out to 2046. The Consolidation with Bridge Alternative would span the same timeframe as the Consolidation Alternative.

Implementation of the alternatives would necessitate short-term use of the environment and commitments of resources and would commit certain resources (e.g., land and energy) indefinitely or permanently. Certain short-term resource commitments would be substantially greater under the Consolidation and Consolidation with Bridge Alternatives than under the No Action Alternative due to construction of the new road and the new RPS nuclear production facilities at MFC. During operations, all of the alternatives would entail similar relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity, with one exception. Resource commitments related to intersite transportation of materials would be greater under the No Action Alternative. These commitments are not likely to produce additional impacts on the long-term productivity of the terrestrial environment.

Air emissions associated with construction, operation, and deactivation of facilities would introduce small amounts of radiological and nonradiological constituents to the regional airshed around the sites. Over time, these emissions would result in additional loading and exposure, but are not expected to impact air quality or radiation exposure to the extent that the long-term productivity of the environment would be impaired.

Continued employment, expenditures, and tax revenues generated during implementation of any of the alternatives would directly benefit local, regional, and state economies over the short term. Local governments investing project-generated tax revenues into infrastructure and other required services could enhance economic productivity over the long term.

The management and disposal of transuranic waste, low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste would require an increase in energy and would consume space at treatment, storage, or disposal facilities. Regardless of the location, the use of land to meet waste disposal needs would be considered to be a reduction in the long-term productivity of the land.

Buildings would be committed to RPS production over the short term. After completion of their mission, DOE could decontaminate and decommission these facilities and restore the area such that it could be available for other future productive uses.

4.6.3 Irreversible and Irretrievable Commitments of Resources

This section describes the major irreversible and irretrievable commitments of resources that have been identified in this *Consolidation EIS*. A commitment of resources is irreversible when primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources neither renewable nor recoverable for future use. In general, the commitment of capital, energy, labor, and materials would be irreversible.

The implementation of any of the alternatives considered in this EIS would entail the irreversible and irretrievable commitment of energy and fossil fuels, water, and chemicals. These resources would be committed over the entire life cycle of the activities described in this *Consolidation EIS* and would essentially be unrecoverable.

Table 4–50 presents the values for the major commitments of resources for construction and operation of the RPS Nuclear Production Facility and road along the northern most route at INL. Construction of the road along the northern most route would consume the most resources of the three potential routes, since the northern most route is the longest. The values are totals comprising requirements for construction and operation. Resource commitments during construction would be the same for both the Consolidation and Consolidation with Bridge Alternatives; there would be no construction under the No Action Alternative.

Table 4–50 Irreversible and Irretrievable Commitments of Resources for Construction and Operation of the New Radioisotope Power Systems Nuclear Production Facility and Road at Idaho National Laboratory [a]

Resource	*New Facilities and Road*
Utility/Energy Use	
Electricity (megawatt-hours)	309,600
Water (million liters)	1,690
Gasoline (liters)	983,447
Diesel fuel (million liters)	3.4
Propane (liters)	147,631
Construction Materials	
Concrete (cubic meters)	31,576
Crushed stone (cubic meters)	99,162
Sand and gravel (cubic meters)	4,511
Soil (cubic meters)	203,800
Steel (metric tons)	3,974
Asphalt (metric tons)	21,102
Lumber (board-feet)	5,990
Muriatic acid (liters)	4,561
Propylene glycol (liters)	23,091
Oxygen gas (cubic meters)	1,628
Acetylene gas (cubic meters)	433
Argon gas (cubic meters)	526
Nitrogen gas (cubic meters)	813

[a] Calculated as total alternative requirements encompassing the entire duration of the construction and operations periods.
Note: To convert from liters to gallons, multiply by 0.26418; from cubic meters to cubic yards, by 1.3079.
Source: INL 2005c.

Energy expended would be in the form of fuel for equipment, vehicles, and process operations and electricity for equipment and facility operations. As described elsewhere in this chapter, energy consumption to support activities under each alternative would be a small fraction of the total energy used at the sites. Electricity and fuels would be purchased from commercial sources. Water would be obtained via the site's existing water supply system. These resources are readily available, and the amounts required are not expected to deplete available supplies or exceed available system capacities.

Implementation of the Consolidation or Consolidation with Bridge Alternatives would require construction of a new facility for target fabrication and processing and for plutonium purification, pelletization, and encapsulation, and a new road at INL. The irreversible and irretrievable commitment of material resources includes construction materials that cannot be recovered or recycled, materials that are rendered radioactive and cannot be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Principal construction materials would include concrete, crushed stone, soil, steel, and asphalt, although other materials such as wood, sand, gravel, and other chemicals and gases would also be used. For practical purposes, concrete, steel, and other materials incorporated into the framework of new facilities would be unrecoverable and irretrievably lost, regardless of whether the materials would be directly contaminated. However, none of these identified construction resources is in short supply, and all are readily available in the INL region.

The new facilities and road would entail a commitment of land. Over the long term, the land that would be occupied by facilities could ultimately be returned to open spaces if buildings, roads, and other structures were removed, areas cleaned up, and the land revegetated. Alternatively, the facilities could be modified for use in other DOE programs. Thus, the commitment of such land is not necessarily irreversible over the long term.

Various materials and chemicals, including acids and caustics, would be required to support operations activities, including target fabrication and extraction and plutonium purification, pelletization, and encapsulation. These materials would be derived from commercial vendors, and their consumption is not expected to affect local, regional, or national supplies.

The treatment, storage, and disposal of transuranic waste, low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste would require the irretrievable commitment of energy and fuel and would result in the irreversible commitment of space in disposal facilities.

CHAPTER 5

APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

5.0 APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

Chapter 5 presents the applicable laws, regulations, and other requirements that apply to the Proposed Action and alternatives. Federal laws and regulations are summarized in Section 5.3; Executive Orders in Section 5.4; U.S. Department of Energy (DOE) regulations and Orders in Section 5.5; and state environmental laws, regulations, and agreements in Section 5.6. Radioactive material packaging and transportation laws and regulations are discussed in Section 5.7. Emergency management and response laws, regulations, and Executive Orders are discussed in Section 5.8. Consultations with Federal, state, and local agencies and federally-recognized American Indian Nations are discussed in Section 5.9.

5.1 Introduction

As part of the National Environmental Policy Act (NEPA) process, an agency must consider whether an action could threaten a violation of any Federal, state, or local law or requirements (40 *Code of Federal Regulations* [CFR] 1508.27) or require a Federal permit, license, or other entitlements (40 CFR 1502.25). This chapter identifies and summarizes the major Federal, state, and local laws and environmental requirements, agreements, and permits that could be required to support the proposed consolidation of nuclear operations related to the production of radioisotope power systems (RPSs).

There are a number of Federal environmental laws that affect environmental protection, health, safety, compliance, and consultation at every DOE location. In addition, certain environmental requirements have been delegated to state authorities for enforcement and implementation. Furthermore, state legislatures have adopted laws to protect health and safety and the environment. It is DOE policy to conduct its operations in a manner that ensures the protection of public health, safety, and the environment through compliance with all applicable Federal and state laws, regulations, orders, and other requirements.

The various action alternatives analyzed in this *Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (*Consolidation EIS*) involve either the operation of existing DOE facilities or the construction and operation of new DOE facilities, and the transportation of materials. Actions required to comply with statutes, regulations, and other Federal and state requirements may depend on whether a facility is newly built (preoperational) or is incorporated in whole or in part into an existing facility. Requirements vary among alternatives and different states. The alternatives considered in this environmental impact statement (EIS) involve DOE facilities located in the States of Tennessee, New Mexico, and Idaho. Chapter 2 of this EIS provides a detailed discussion of the alternatives.

5.2 Background

Requirements governing the consolidation of RPS nuclear production operations arise primarily from six sources: Congress, Federal agencies, Executive Orders, legislatures of the affected states, state agencies, and local governments. In general, Federal statutes establish national policies, create broad legal requirements, and authorize Federal agencies to create regulations that conform to the statutes. Detailed implementation of these statutes is delegated to various Federal agencies such as DOE, the U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA). For many environmental laws under EPA jurisdiction, state agencies may be delegated responsibility for the majority of program implementation activities, such as permitting and enforcement, but EPA usually retains oversight of the delegated program.

Some applicable laws such as NEPA, the Endangered Species Act, and the Emergency Planning and Community Right-To-Know Act require specific reports and/or consultations rather than ongoing permits or activities. These would be satisfied through the legal/regulatory process, including the preparation of the *Consolidation EIS*, leading to the consolidation of RPS nuclear production operations.

Other applicable laws establish general requirements that must be satisfied, but do not include processes (such as the issuance of permits or licenses) to consider compliance prior to specific instances of violations or other events that trigger their provisions. These include the Toxic Substances Control Act (affecting polychlorinated biphenyl transformers and other designated substances); the Federal Insecticide, Fungicide, and Rodenticide Act (affecting pesticide/herbicide applications); the Hazardous Materials Transportation Act; and (if there were to be a spill of a hazardous substance) the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund).

Executive Orders establish policies and requirements for Federal agencies. Executive Orders are applicable to Executive branch agencies, but do not have the force of law or regulation.

In addition to implementing some Federal programs, state legislatures develop their own laws. State statutes supplement as well as implement Federal laws for protection of air and water quality and for groundwater. State legislation may address solid waste management programs; locally rare or endangered species; and local resource, historic, and cultural values. The laws of local governments add a level of protection for the public, often focusing on zoning, utilities, and public health and safety concerns.

Regulatory agreements and compliance orders may also be initiated to establish responsibilities and timeframes for Federal facilities to come into compliance with provisions of applicable Federal and state laws. There are also other agreements, memoranda of understanding, or formalized arrangements that establish cooperative relationships and requirements.

The alternatives being considered for the consolidation of RPS nuclear production operations and materials are all within the States of Tennessee, New Mexico, and Idaho. Each of the alternatives is located on property controlled by DOE. For a broader review of environmental regulations and compliance issues at each site, the reader is referred to recent sitewide or programmatic EISs that include evaluations of activities at those sites.

DOE has authority to regulate some environmental activities, as well as the health and safety aspects of nuclear facilities operations. The Atomic Energy Act of 1954, as amended, is the principal authority for DOE regulatory activities not externally regulated by other Federal or state agencies. Regulation of DOE activities is primarily established through the use of DOE Orders and regulations.

External environmental laws, regulations, and Executive Orders can be categorized as applicable to either broad environmental planning and consultation requirements or regulatory environmental protection and compliance activities, although some requirements are applicable to both planning and operations compliance.

Section 5.3 of this chapter discusses the major applicable Federal laws and regulations that impose nuclear safety and environmental protection requirements on the subject facilities and might require the facilities to obtain a permit or license (or amendment thereof) prior to initiation of the consolidation project. Each of the applicable regulations and statutes establishes how activities are to be conducted or how potential releases of pollutants are to be controlled or monitored. They include requirements for the issuance of permits or licenses for new operations or new emission sources and for amendments to existing permits or licenses to allow new types of operations at existing sources.

Section 5.4 discusses applicable Executive Orders. Section 5.5 identifies applicable DOE regulations and Orders for compliance with the Atomic Energy Act, the Occupational Safety and Health Act, and other environmental, safety, and health requirements. Section 5.6 identifies state environmental laws, regulations, and agreements potentially affecting the consolidation of RPS nuclear production operations. Radioactive material packaging and transportation laws and regulations are discussed in Section 5.7. Section 5.8 discusses emergency management and response laws, regulations, and Executive Orders. Consultations with applicable agencies and federally-recognized American Indian Nations are discussed in Section 5.9.

5.3 Applicable Federal Laws and Regulations

This section describes the Federal environmental, safety, and health laws and regulations that could apply to the Proposed Action and alternatives.

National Environmental Policy Act of 1969, as amended (42 *United States Code* [U.S.C.] 4321 *et seq.*)—NEPA establishes a national policy promoting awareness of the environmental consequences of human activity on the environment and consideration of environmental impacts during the planning and decisionmaking stages of a project. It requires Federal agencies to prepare an EIS for major Federal actions with potentially significant environmental impacts on the human environment.

This EIS has been prepared in accordance with NEPA requirements, Council on Environmental Quality regulations (40 CFR 1500 *et seq.*), and DOE (10 CFR 1021, DOE Order 451.1B) provisions for implementing the procedural requirements of NEPA. It discusses reasonable alternatives and their potential environmental consequences.

Atomic Energy Act of 1954 (42 U.S.C. 2011 *et seq.*)—The Atomic Energy Act authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE's jurisdiction. Through a series of DOE Orders, an extensive system of standards and requirements has been established to ensure safe operation of DOE facilities. DOE regulations are found in 10 CFR.

The Atomic Energy Act establishes regulatory control of the disposal of radioactive waste as well as production, possession, and use of three types of radioactive material: source, special nuclear, and byproduct materials. The Atomic Energy Act authorizes DOE to set radiation protection standards for itself and its contractors at DOE nuclear facilities and provides exclusions from U.S. Nuclear Regulatory Commission (NRC) licensing for defense production facilities.

The Atomic Energy Act authorizes DOE to establish standards that protect health and minimize danger to life and property from activities under DOE's jurisdiction. DOE manages its facilities through regulations (set forth in 10 CFR 830) and issuance of DOE Orders and associated standards and guidance. Requirements for environmental protection, safety, and health are implemented at DOE sites primarily through contractual mechanisms that establish the applicable DOE requirements for management and operating contractors.

Nuclear safety regulations are found in the CFR. Several nuclear safety rules and environmental procedural rules are in effect (for example, 10 CFR 835, "Occupational Radiation Protection"), and more are in final stages of development. Nuclear safety regulations are effective under the schedule and implementing requirements of each rule, regardless of whether they are included in DOE contracts. DOE contractors are also required to comply with all applicable external laws and regulations, regardless of contract language.

Chapter 4 of this EIS discusses the application of DOE procedures to the management and control of radioactive waste for each alternative. Potential occupational radiation doses and doses to the general public would be well within DOE limits.

Clean Air Act of 1970, as amended (42 U.S.C. 7401 *et seq.*)—The Clean Air Act is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." Section 118 of the Clean Air Act (42 U.S.C. 7418) requires that each Federal agency with jurisdiction over any property or facility engaged in any activity that might result in the discharge of air pollutants comply with "all Federal, state, interstate, and local requirements" with regard to the control and abatement of air pollution.

The Clean Air Act requires: (1) EPA to establish National Ambient Air Quality Standards as necessary to protect the public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 U.S.C. 7409 *et seq.*); (2) establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants (42 U.S.C. 7411); (3) specific emission increases to be evaluated so as to prevent a significant deterioration in air quality (42 U.S.C. 7470 *et seq.*); and (4) specific standards for releases of hazardous air pollutants (including radionuclides) (42 U.S.C. 7412). These standards are implemented through implementation plans developed by each state with EPA approval. The Clean Air Act requires sources to meet standards and obtain permits to satisfy those standards.

Emissions of air pollutants are regulated by EPA under 40 CFR, Parts 50 through 99. Radionuclide emissions from DOE facilities are regulated under the National Emission Standards for Hazardous Air Pollutants Program under 40 CFR 61. Approval to construct a new facility or to modify an existing one may be required by these regulations under 40 CFR 61.07.

In compliance with state and Federal programs, the air quality impact analysis conducted for this EIS demonstrated that concentrations of air pollutants during the construction and operation of new RPS nuclear production facilities at Idaho National Laboratory (INL) would not exceed ambient air quality standards, nor contribute to unacceptable increases in pollutant levels. If new facilities were to be located in an area designated as nonattainment for an ambient standard or has a maintenance plan for continuing to meet ambient air quality standards, the Proposed Action would be subject to a Clean Air Act conformity review. A conformity review serves as a means to ensure that a Federal action does not hinder or interfere with programs developed by state and Federal agencies to bring the area into compliance with ambient air quality standards or to continue to meet ambient standards. As described in Section 3.1.5, INL is located in an attainment area for all criteria pollutants. Although construction and operations of new RPS nuclear production facilities would result in criteria pollutant emissions, a conformity review would not be necessary.

Chapter 4 of this EIS compares expected releases at each site with applicable standards. Some releases would result from construction activities. During operations, small releases would result during testing of emergency diesel generators and from other sources. At construction sites, it was found that the magnitude of the releases would not warrant a Prevention of Significant Deterioration analysis. Operations at existing facilities at the Oak Ridge National Laboratory (ORNL) in Tennessee and Los Alamos National Laboratory (LANL) in New Mexico would not exceed ambient air quality standards, nor contribute to unacceptable increases in pollutant levels.

Clean Water Act of 1972, as amended (33 U.S.C. 1251 *et seq.*)—The Clean Water Act, which amended the Federal Water Pollution Control Act, was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The Clean Water Act prohibits the "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the Clean Water Act requires all Branches of the Federal Government engaged in any activity that might result in a discharge or runoff of pollutants to surfacewaters to comply with Federal, state, interstate, and local requirements.

The Clean Water Act provides water quality standards for the Nation's waterways, guidelines and limitations for effluent discharges from point-source discharges, and the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES program is administered by EPA, pursuant to regulations in 40 CFR 122 *et seq.* Sections 401 through 405 of the Water Quality Act of 1987 added Section 402(p) to the Clean Water Act requiring that EPA establish regulations for permits for stormwater discharges associated with industrial activities. Stormwater provisions of the NPDES program are set forth at 40 CFR 122.26. Permit modifications are required if discharge effluent is altered. Section 404 of the Clean Water Act requires permits for the discharge of dredge or fill materials into navigable waters.

Chapter 3 of this EIS discusses existing wastewater treatment facilities and the NPDES status at each site. Chapter 4 of this EIS discusses management of wastewater during construction and operation for each alternative. Sanitary waste would be managed by use of portable toilet facilities during construction. During operation, sanitary wastes would be processed through existing facilities under all alternatives. It is anticipated that there would be no new discharges requiring a new NPDES permit at the Materials and Fuels Complex (MFC, formerly known as Argonne National Laboratory-West) at INL, the Radiochemical Engineering Development Center at ORNL, and the Plutonium Facility at LANL.

Safe Drinking Water Act of 1974, as amended (42 U.S.C. 300(f) *et seq.*)—The primary objective of the Safe Drinking Water Act is to protect the quality of public drinking water supplies and sources of drinking water. The implementing regulations, administered by EPA unless delegated to states, establish standards applicable to public water systems. These regulations include maximum contaminant levels (including those for radioactivity) in public water systems, which are defined as water systems that have at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. The EPA regulations implementing the Safe Drinking Water Act are found at 40 CFR 100 through 149. For radioactive material, the regulations specify that the average annual concentration of manmade radionuclides in drinking water, as delivered to the user by such a system, shall not produce a dose equivalent to the total body or an internal organ greater than 4 millirem per year beta activity (40 CFR Section 141.16[a]). In December 2000, EPA issued revised maximum contaminant levels for radionuclides, effective December 2003 (65 *Federal Register* [FR] 76708). The new rule includes requirements for uranium. Other programs established by the Safe Drinking Water Act include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program.

Chapter 3 of this EIS discusses groundwater resources and current groundwater protection programs at each site. Chapter 4 of this EIS discusses protection of groundwater for each alternative. No alternative would involve a direct discharge to the surface or subsurface of sanitary or industrial effluent.

Low-Level Radioactive Waste Policy Act of 1980, as amended (42 U.S.C. 2021 *et seq.*)—This act amended the Atomic Energy Act to specify that the Federal Government is responsible for disposal of low-level radioactive waste generated by its activities, and that states are responsible for disposal of other low-level radioactive waste. It provides for and encourages interstate compacts to carry out state responsibilities.

Low-level radioactive waste is expected to be generated from activities conducted under each alternative.

Chapter 3 of this EIS discusses existing programs for management of low-level radioactive waste at each site. Chapter 4 of this EIS discusses the volume of low-level radioactive waste and its management for each alternative.

Nuclear Waste Policy Act of 1982, as amended (42 U.S.C. 10101, *et seq*.)—The Nuclear Waste Policy Act directed DOE to characterize and evaluate Yucca Mountain for suitability as a potential repository for disposal of commercial spent nuclear fuel and high-level radioactive waste. The act also directed the President to evaluate the need for a separate repository for high-level radioactive waste resulting from atomic energy defense activities. On April 30, 1985, President Reagan found "no basis to conclude that a defense only repository is required…" (DOE 1985). As a result of this finding, high-level radioactive waste from atomic energy defense activities may be disposed of in the proposed repository along with spent nuclear fuel. Therefore, high-level radioactive waste from the Hanford Site in Washington may be disposed of in the proposed repository. After passage by the House and Senate, on July 23, 2002, the President signed House Joint Resolution 87 approving the site at Yucca Mountain, Nevada, for the development of a repository for the disposal of high-level radioactive waste and spent nuclear fuel, pursuant to the Nuclear Waste Policy Act.

The Nuclear Waste Policy Act requires the NRC to consider and approve or disapprove an application (if DOE submits one) for authorization to construct a repository and for a license to receive and possess spent nuclear fuel and high-level radioactive waste in a repository. NRC promulgated 10 CFR 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada," which contains the site-specific technical criteria for the licensing and operation of the proposed geologic repository at Yucca Mountain. DOE must demonstrate compliance with these standards prior to receiving the necessary licenses to store or dispose of radioactive materials in Yucca Mountain. The Nuclear Waste Policy Act (along with the Energy Policy Act) also provides authority for EPA to develop public health and safety standards for protection of the public from releases of radioactive material stored or disposed of at Yucca Mountain. EPA has promulgated these standards at 40 CFR 197, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV." NRC incorporated these standards in 10 CFR 63. DOE is currently preparing a license application to construct a repository at Yucca Mountain. DOE will need to obtain a license to receive and possess spent nuclear fuel and high-level radioactive waste for Yucca Mountain prior to the shipment of high-level radioactive waste to Yucca Mountain.

Waste Isolation Pilot Plant Land Withdrawal Act, as amended (P.L. 102-579)—The Waste Isolation Pilot Plant Land Withdrawal Act withdrew land from the public domain for the purposes of creating and operating the Waste Isolation Pilot Plant (WIPP), the geologic repository in New Mexico designated as the national disposal site for defense transuranic (TRU) waste. In addition to establishing the location for the facility, the Land Withdrawal Act also defines the characteristics and amount of waste that will be disposed of at the facility. The Amendments to the Waste Isolation Pilot Plant Land Withdrawal Act exempt waste designated by the Secretary of Energy for disposal at WIPP from the Resource Conservation and Recovery Act (RCRA) land disposal restrictions. However, these amendments do not exempt mixed TRU waste from other RCRA requirements. WIPP does have a RCRA permit and can accept mixed TRU waste. On May 15, 2003, EPA Region 6 approved DOE's request to dispose of TRU and mixed TRU waste containing polychlorinated biphenyls at WIPP subject to certain "conditions of approval." Currently, WIPP cannot accept remote-handled TRU waste, but DOE expects that WIPP will receive approval to accept remote-handled TRU waste by Fiscal Year 2006. Any mixed TRU or TRU waste sent to WIPP would have to comply with the waste acceptance criteria for WIPP.

Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 *et seq.*)—The Solid Waste Disposal Act of 1965, as amended, governs the transportation, treatment, storage, and disposal of hazardous and nonhazardous waste. Under the Resource Conservation and Recovery Act of 1976 (RCRA), that 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 (42 U.S.C. 6926) allows states to establish and administer these permit programs with EPA approval. The EPA regulations implementing RCRA are found in 40 CFR, Parts 260 through 283.

Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also impacts the extent and complexity of the requirements.

Chapter 3 of this EIS provides information on the management of hazardous and mixed radioactive waste for each site. Chapter 4 of this EIS discusses the management of this waste for each alternative.

Federal Facility Compliance Act of 1992 (42 U.S.C. 6961 *et seq.*)—The Federal Facility Compliance Act, enacted on October 6, 1992, amended RCRA. Section 102(a)(3) of the Federal Facility Compliance Act waives sovereign immunity for Federal facilities from fines and penalties for violations of RCRA, state, interstate, and local hazardous and solid waste management requirements. This waiver was delayed for 3 years following enactment for violations of the land disposal restrictions on storage and prohibition (RCRA Section 3004[j]) involving mixed radioactive waste at DOE facilities. This legislation further delays the waiver of sovereign immunity beyond the 3-year period at a facility if DOE is in compliance with an approved plan for developing treatment capacity and technologies for mixed radioactive waste generated or stored at the facility, as well as a DOE Order requiring compliance with the plan.

The Waste Management sections of Chapters 3 and 4 of this EIS provide information on the generation and management of mixed radioactive waste and the site-specific Orders for each of the alternatives.

Pollution Prevention Act of 1990 (42 U.S.C. 13101 *et seq.*)—The Pollution Prevention Act establishes a national policy for waste management and pollution control. Source reduction is given first preference, followed by environmentally safe recycling, with disposal or releases to the environment as a last resort. In response to the policies established by the Pollution Prevention Act, DOE committed to participation in the Superfund Amendments and Reauthorization Act, Section 313, EPA 33/50 Pollution Prevention Program. The goal for facilities involved in compliance with Section 313 is to achieve a 33-percent reduction (from a 1993 baseline) in the release of 17 priority chemicals by 1997. On November 12, 1999, U.S. Secretary of Energy Bill Richardson issued 14 pollution prevention and energy efficiency goals for DOE. These goals were designed to build environmental accountability and stewardship into DOE's decisionmaking process. Under these goals, DOE will strive to minimize waste and maximize energy efficiency as measured by continuous cost-effective improvements in the use of materials and energy, using the years 2005 and 2010 as interim measurement points.

Radioactive, hazardous, and nonhazardous waste types may be generated from all the alternatives; if so, efforts would be made to minimize their generation. As discussed in the Waste Management sections of Chapter 3 of this EIS, waste minimization programs are in place at each site to reduce waste and to recycle where possible.

Toxic Substances Control Act of 1976 (15 U.S.C. 2601 *et seq.*)—The Toxic Substances Control Act provides EPA with the authority to require testing of chemical substances entering the environment and to regulate them as necessary. The law complements and expands existing toxic substance laws such as Section 112 of the Clean Air Act and Section 307 of the Clean Water Act. The Toxic Substances Control Act requires compliance with inventory reporting and chemical control provisions of the legislation to protect the public from the risks of exposure to chemicals. The Toxic Substances Control Act also imposes strict limitations on the use and disposal of polychlorinated biphenyls, chlorofluorocarbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium.

Activities under each of the alternatives would need to be conducted in compliance with the Toxic Substances Control Act.

Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 *et seq.*)—This legislation regulates the use, registration, and disposal of several classes of pesticides to ensure they are applied in a manner that protects the public, workers, and the environment. Implementing regulations include recommended procedures for the disposal and storage of pesticides (40 CFR 165 [proposed regulation]) and worker protection standards (40 CFR 170).

Activities under each of the alternatives would need to be conducted in compliance with this Act.

National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 *et seq.*)—The National Historic Preservation Act provides that sites with significant national historic value be placed on the *National Register of Historic Places*, maintained by the Secretary of the Interior. The major provisions of the Act for DOE consideration are Sections 106 and 110. Both sections aim to ensure that historic properties are appropriately considered in planning Federal initiatives and actions. Section 106 is a specific, issue-related mandate to which Federal agencies must adhere. It is a reactive mechanism driven by a Federal action. Section 110, in contrast, sets out broad Federal agency responsibilities with respect to historic properties. It is a proactive mechanism with emphasis on ongoing management of historic preservation sites and activities at Federal facilities. No permits or certifications are required under the act.

Section 106 requires the head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally-assisted undertaking to ensure compliance with the provisions of the Act. It compels Federal agencies to “take into account” the effect of their projects on historical and archaeological resources and to give the Advisory Council on Historic Preservation the opportunity to comment on such effects. Section 106 mandates consultation during Federal actions if the undertaking has the potential to affect a historic property. This consultation normally involves State and/or Tribal Historic Preservation Officers and may include other organizations and individuals such as local governments, American Indian tribes, and Native Hawaiian organizations. If an adverse effect is found, the consultation often ends with the execution of a memorandum of agreement that states how the adverse effect will be resolved.

The regulations implementing Section 106, found in 30 CFR 800, were revised on December 12, 2000 (65 FR 77697), and became effective January 11, 2001. This revision modified the process by which Federal agencies consider the effects of their undertakings on historic properties and provides the Advisory Council on Historic Preservation with a reasonable opportunity to comment with regard to such undertakings, as required by Section 106 of the National Historic Preservation Act. In promulgating the new regulations, the Council has sought to better balance the interests and concerns of various users of the Section 106 process, including Federal agencies, State Historic Preservation Officers, Tribal Historic Preservation Officers, American Indians and Native Hawaiians, industry, and the public.

Chapter 3 of this EIS describes cultural and paleontological resources at each site. Chapter 4 of this EIS discusses the potential impacts to those resources.

Antiquities Act of 1906, as amended (16 U.S.C. 431 to 433)—This act protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on federally-controlled lands from appropriation, excavation, injury, and destruction without permission.

Chapter 3 of this EIS describes cultural and paleontological resources at each site. Chapter 4 of this EIS discusses the potential impacts to those resources.

Archaeological and Historic Preservation Act of 1974, as amended (16 U.S.C. 469 to 469c)—This act protects sites that have historic or prehistoric importance.

Chapter 3 of this EIS describes cultural and paleontological resources at each site. Chapter 4 of this EIS discusses the potential impacts to those resources.

Archaeological and Resources Protection Act of 1979, as amended (16 U.S.C. 470 *et seq.*)—This act requires a permit for any excavation or removal of archaeological resources from Federal or American Indian lands. Excavations must be undertaken for the purpose of furthering archaeological knowledge in the public interest, and resources removed remain the property of the United States. The law requires that whenever any Federal agency finds that its activities may cause irreparable loss or destruction of significant scientific, prehistoric, or archaeological data, the agency must notify the U.S. Department of the Interior and may request that the Department undertake the recovery, protection, and preservation of such data. Consent must be obtained from the American Indian tribe or the Federal agency having authority over the land on which a resource is located before issuance of a permit; the permit must contain the terms and conditions requested by the tribe or Federal agency.

Chapter 3 of this EIS describes cultural and paleontological resources at each site. Chapter 4 of this EIS discusses the potential impacts to those resources.

Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)—The Endangered Species Act is intended to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7 of the Act requires Federal agencies having reason to believe that a prospective action may affect an endangered or threatened species or its critical habitat to consult with the U.S. Fish and Wildlife Service (USFWS) of the U.S. Department of the Interior or the National Marine Fisheries Service of the U.S. Department of Commerce to ensure that the action does not jeopardize the species or destroy its habitat (50 CFR 17). Despite reasonable and prudent measures to avoid or minimize such impacts, if the species or its habitat would be jeopardized by the action, a formal review process is specified.

Threatened or endangered species in the regions of each site have been identified and listed in Chapter 3 of this EIS. Chapter 4 of this EIS discusses the potential impact to these species.

Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703 *et seq.*)—The Migratory Bird Treaty Act, as amended, is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying conditions such as the mode of harvest, hunting seasons, and bag limits. The act stipulates that it is unlawful at any time, by any means, or in any manner, to "kill ... any migratory bird unless and except as permitted by regulation." Although no permit for this project is required under the act, DOE is required to consult with the USFWS regarding impacts to migratory birds, and to avoid or minimize these effects in accordance with the USFWS Mitigation Policy. There is currently a split of authority between Federal courts as to whether this act applies to Federal agencies. Chapter 3 of this EIS identifies species known at each site. Chapter 4 of this EIS discusses impacts to ecological resources for each alternative.

Bald and Golden Eagle Protection Act of 1973, as amended (16 U.S.C. 668 through 668d)—The Bald and Golden Eagle Protection Act, as amended, makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States (Section 668, 668c). A permit must be obtained from the U.S. Department of the Interior to relocate a nest that interferes with resource development or recovery operations.

The bald eagle occupies or uses portions of LANL and INL. Chapter 4 of this EIS discusses the impacts to ecological resources of each alternative.

Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq*.)—The Fish and Wildlife Coordination Act promotes more effectual planning and cooperation among Federal, state, public, and private agencies for the conservation and rehabilitation of the Nation's fish and wildlife and authorizes the U.S. Department of the Interior to provide assistance. This act requires consultation with the USFWS on the possible effects on wildlife if there is construction, modification, or control of bodies of water in excess of 4 hectares (10 acres) in surface area.

Chapter 3 of this EIS describes the water resources at each site.

Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 *et seq*.)—The Farmland Protection Policy Act requires Federal agencies to consider prime or unique farmlands when planning major projects and programs on Federal lands. Federal agencies are required to use prime and unique farmland criteria developed by the U.S. Department of Agriculture's Soil Conservation Service. Under the Farmland Protection Policy Act, the Soil Conservation Service is authorized to maintain an inventory of prime and unique farmlands in the United States to identify the location and extent of rural lands important in the production of food, fiber, forage, and oilseed crops (7 CFR 657).

Chapter 3 of this EIS identifies agricultural activities at each site. No cultivated farming is reported at any of the sites evaluated in the EIS.

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)—This act reaffirms American Indian religious freedom under the First Amendment and sets U.S. policy to protect and preserve the inherent and constitutional right of American Indians to believe, express, and exercise their traditional religions. The act requires that Federal actions avoid interfering with access to sacred locations and traditional resources that are integral to the practice of tribal religions.

Chapter 3 of this EIS describes Traditional Cultural Properties resources known to exist at each site. Chapter 4 of this EIS discusses the potential impacts to the Traditional Cultural Properties resources of each alternative.

Religious Freedom Restoration Act of 1993 (42 U.S.C. 2000(bb) *et seq*.)—This act prohibits the U.S. Government, including Federal Departments, from substantially burdening the exercise of religion unless the Government demonstrates a compelling Governmental interest, the action furthers a compelling Governmental interest, and the action is the least restrictive means of furthering that interest.

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001)—This act establishes a means for American Indians to request the return or repatriation of human remains and other cultural items presently held by Federal agencies or federally-assisted museums or institutions. The act also contains provisions regarding the intentional excavation and removal of, inadvertent discovery of, and illegal trafficking in American Indian human remains and cultural items. Major actions under this law include: (a) establishing a review committee with monitoring and policymaking responsibilities; (b) developing regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims; (c) providing oversight of museum programs designed to meet the inventory requirements and deadlines of this law; and (d) developing procedures to handle unexpected discoveries of graves or grave goods during activities on Federal or tribal lands. All Federal agencies that manage land and/or are responsible for archaeological collections obtained from their lands or generated by their activities must comply with the Act. DOE managers of ground-disturbing activities on Federal and tribal lands should make themselves aware of the statutory provisions treating inadvertent discoveries of

American Indians remains and cultural objects. Regulations implementing the Act are found at 43 CFR 10.

Chapter 3 of this EIS describes American Indian resources known to exist at each site. Chapter 4 of this EIS discusses the potential impacts to American Indian resources of each alternative.

Occupational Safety and Health Act of 1970 (29 U.S.C. 651 *et seq.*)—The Occupational Safety and Health Act establishes standards for safe and healthful working conditions in places of employment throughout the United States. The Act is administered and enforced by the Occupational Safety and Health Administration (OSHA), a U.S. Department of Labor agency. Although OSHA and EPA both have a mandate to reduce exposure to toxic substances, OSHA's jurisdiction is limited to safety and health conditions that exist in the workplace environment.

Under the Act, it is the duty of each employer to provide a workplace free of recognized hazards that are likely to cause death or serious physical harm. Employees have a duty to comply with the occupational safety and health standards and rules, regulations, and orders issued under the Act. OSHA regulations (29 CFR 1910) establish specific standards telling employers what must be done to achieve a safe and healthful working environment. Government agencies, including DOE, are not technically subject to OSHA regulations, but are required under 29 U.S.C. 668 to establish their own occupational safety and health programs for their places of employment consistent with OSHA standards. DOE emphasizes compliance with these regulations at its facilities and prescribes, through DOE Orders, the OSHA standards that contractors must meet, as applicable to their work at Government-owned, contractor-operated facilities (DOE Order 440.1A). DOE keeps and makes available the various records of minor illnesses, injuries, and work-related deaths as required by OSHA regulations.

Activities under all alternatives would be conducted in compliance with this act.

Noise Control Act of 1972, as amended (42 U.S.C. 4901 *et seq*.)—Section 4 of the Noise Control Act of 1972, as amended, directs all Federal agencies to carry out "to the fullest extent within their authority" programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise jeopardizing health and welfare.

DOE programs to promote control of noise at each site are discussed in Chapter 3 of this EIS. Chapter 4 of this EIS discusses the potential noise impact of each of the alternatives.

5.4 Applicable Executive Orders

Executive Order 11514 (Protection and Enhancement of Environmental Quality, March 5, 1970), as amended by Executive Order 11991 (May 24, 1977)—This Order requires Federal agencies to continually monitor and control their activities to: (1) protect and enhance the quality of the environment, and (2) develop procedures to ensure the fullest practicable provision of timely public information and understanding of the Federal plans and programs that may have potential environmental impacts so that the views of interested parties can be obtained. DOE has issued regulations (10 CFR 1021) and DOE Order 451.1B for compliance with this Executive Order.

As previously discussed in Section 5.3, this EIS has been prepared in accordance with NEPA requirements (specifically, 40 CFR 1500 through 1508, 10 CFR 1021, and DOE Order 451.1B).

Executive Order 11593 (National Historic Preservation, May 13, 1971)—This Order directs Federal agencies to locate, inventory, and nominate qualified properties under their jurisdiction or control to the *National Register of Historic Places.* This process requires DOE to provide the Advisory Council on

Historic Preservation the opportunity to comment on the possible impacts of the proposed activity on any potential eligible or listed resources.

Chapter 3 of this EIS identifies historic resources at each site. Chapter 4 of this EIS discusses potential impacts to historic resources at each site.

Executive Order 11988 (Floodplain Management, May 24, 1977)—This Order (implemented by DOE in 10 CFR 1022) requires Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain, and that floodplain impacts be avoided to the extent practicable.

Chapter 3 of this EIS identifies the delineated floodplains at each site.

Executive Order 11990 (Protection of Wetlands, May 24, 1977)—This Order (implemented by DOE in 10 CFR 1022) requires Federal agencies to avoid any short- or long-term adverse impacts on wetlands wherever there is a practicable alternative. Each agency must also provide opportunity for early public review of any plans or proposals for new construction in wetlands.

Chapter 3 of this EIS identifies the wetlands at each site. Chapter 4 of this EIS discusses the measures to be taken to protect wetlands where applicable.

Executive Order 12088 (Federal Compliance with Pollution Control Standards, October 13, 1978, as amended by Executive Order 12580, Superfund Implementation, January 23, 1987)—This Order directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act, Noise Control Act, Clean Water Act, Safe Drinking Water Act, Toxic Substances Control Act, and RCRA.

Activities under each alternative would need to comply with this Order.

Executive Order 12699, *Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction* (January 5, 1990)—This Order requires Federal agencies to reduce risks to occupants of buildings owned, leased, or purchased by the Federal Government or buildings constructed with Federal assistance and to persons who would be affected by failures of Federal buildings in earthquakes; to improve the capability of existing Federal buildings to function during or after an earthquake; and to reduce earthquake losses of public buildings, all in a cost-effective manner. Each Federal agency responsible for the design and construction of a Federal building shall ensure that the building is designed and constructed in accordance with appropriate seismic design and construction standards.

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994)—This 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 and low-income populations.

The Environmental Justice sections of Chapters 3 and 4 of this EIS provide information that demonstrates compliance with this Order.

Executive Order 12902, *Energy Efficiency and Water Conservation at Federal Facilities* (March 8, 1994)—This Order requires Federal agencies to develop and implement a program for conservation of energy and water resources. As part of this program, agencies are required to conduct comprehensive facility audits of their energy and water use.

Executive Order 13007 (Indian Sacred Sites, May 24, 1996)—This Order requires: "In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sites."

Chapter 3 of this EIS identifies American Indian resources at each site. Chapter 4 of this EIS discusses the potential impacts to American Indian resources. A cultural resource survey and Traditional Cultural Properties consultation, as necessary, would be conducted prior to any construction activity.

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (April 21, 1997), as amended by Executive Order 13229 (October 9, 2001)—This Order requires each Federal agency to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Executive Order 13101 (Greening the Government through Waste Prevention, Recycling, and Federal Acquisition, September 14, 1998)—This Order requires each Federal agency to incorporate waste prevention and recycling in its daily operations and to work to increase and expand markets for recovered materials. It also states that it is national policy to prefer pollution prevention, whenever feasible. Pollution that cannot be prevented should be recycled wherever possible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner. Disposal should be employed only as a last resort.

Activities under each alternative would need to comply with this Order.

Executive Order 13112 (Invasive Species, February 3, 1999)—This Order requires Federal agencies to prevent the introduction of invasive species, to provide for their control, and to minimize their economic, ecological, and human health impacts.

Activities under each alternative would need to comply with this Order.

Executive Order 13123 (Greening the Government through Efficient Energy Management, June 3, 1999)—This Order directs Federal agencies to improve energy management in order to save taxpayer dollars and reduce emissions that contribute to air pollution and global climate change.

Activities under each alternative would need to comply with this Order.

Executive Order 13148 (Greening the Government through Leadership in Environmental Management, April 21, 2000)—This Order sets new goals for pollution prevention, requires all Federal facilities to have an environmental management system, and requires compliance or environmental management system audits.

Activities under each alternative would need to comply with this Order.

Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments* (November 6, 2000)—This Order supplements the Executive Memorandum (dated April 29, 1994) entitled "Government-to-Government Relations with Native American Tribal Governments" and states that each Executive Department and agency shall consult, to the greatest extent practicable and to the extent permitted by law, with tribal governments prior to taking actions that affect federally-recognized tribal governments. This Order also states that each Executive Department and agency shall assess the impact of Federal Government plans, projects, programs, and activities on tribal trust resources and assure that tribal government rights and concerns are considered during the development of such plans, projects, programs, and activities.

5.5 Applicable U.S. Department of Energy Regulations and Orders

The Atomic Energy Act of 1954, as amended, authorizes DOE to establish standards to protect health and/or minimize the dangers to life or property from activities under DOE's jurisdiction. Through a series of DOE Orders and regulations, an extensive system of standards and requirements has been established to ensure safe operation of DOE facilities.

DOE regulations are found in 10 CFR. These regulations address such areas as energy conservation, administrative requirements and procedures, nuclear safety, and classified information. For the purpose of this EIS, relevant regulations include: "Procedural Rules for DOE Nuclear Activities" (10 CFR 820), "Nuclear Safety Management" (10 CFR 830), "Occupational Radiation Protection" (10 CFR 835), "Compliance with the National Environmental Policy Act" (10 CFR 1021), and "Compliance with Floodplains/Wetlands Environmental Review Requirements" (10 CFR 1022).

DOE Orders are issued in support of environmental, safety, and health programs. Many DOE Orders have been revised and reorganized to reduce duplication and eliminate obsolete provisions. The new DOE Directives System is organized by series, with each Order identified by three digits, and is intended to include all DOE Orders, policies, manuals, requirement documents, notices, and guides. Existing DOE Orders, that are identified by four digits, are expected to be revised and converted to the new DOE numbering system. The major DOE Orders pertaining to the alternatives of this EIS are listed in **Table 5–1**.

5.6 State Environmental Laws, Regulations, and Agreements

Certain environmental requirements, including some discussed in Section 5.3, have been delegated to state authorities for implementation and enforcement. It is DOE policy to conduct its operations in an environmentally safe manner that complies with all applicable laws, regulations, and standards, including state laws and regulations. A list of applicable state environmental laws, regulations, and agreements is provided in **Table 5–2**.

5.7 Radioactive Material Packaging and Transportation Regulations

Transportation of hazardous and radioactive materials and substances is governed by DOT and NRC. The Hazardous Material Transportation Act of 1975 (49 U.S.C. 5105 *et seq*.) requires DOT to prescribe uniform national regulations for transportation of hazardous materials (including radioactive materials). Most state and local regulations regarding such transportation that are not substantively the same as DOT regulations are preempted (i.e., rendered void) (49 U.S.C. 5125). This in effect allows state and local governments only to enforce the Federal regulations, not to change or expand upon them.

This program is administered by the DOT Research and Special Programs Administration, which coordinates its regulations with those of NRC (under the Atomic Energy Act) and EPA (under RCRA) when covering the same activities.

DOT regulations, are found in 49 CFR 171 through 178, and 49 CFR 383 through 397, contain requirements for identifying a material as hazardous or radioactive. These regulations interface with the

NRC regulations for identifying material, but DOT hazardous material regulations govern the hazard communication (e.g., marking, hazard labeling, vehicle placarding, emergency response telephone number) and shipping requirements.

Table 5–1 Applicable DOE Orders and Directives

DOE Order/Number	*Subject (date)*
Leadership/Management/Planning	
O 151.1B	Comprehensive Emergency Management System (10/29/03)
Information and Analysis	
O 231.1A	Environment, Safety, and Health Reporting (08/19/03; Change 1, 06/03/04)
Work Process	
O 413.3	Program and Project Management for the Acquisition of Capital Assets (10/13/00; Change 1, 01/03/05)
O 414.1B	Quality Assurance (04/29/04)
O 420.1A	Facility Safety (05/20/02)
O 425.1C	Startup and Restart of Nuclear Facilities (03/13/03)
O 430.1B	Real Property Asset Management (09/24/03)
O 433.1	Maintenance Management Program for DOE Nuclear Facilities (06/01/01)
O 435.1	Radioactive Waste Management (07/09/99; Change 1, 08/28/01)
O 440.1A	Worker Protection Management for DOE Federal and Contractor Employees (03/27/98)
O 450.1	Environmental Protection Program (01/15/03; Change 1, 01/24/05)
O 451.1B	National Environmental Policy Act Compliance Program (10/26/00; Change 1, 09/28/01)
O 460.1B	Packaging and Transportation Safety (04/04/03)
O 460.2A	Departmental Materials Transportation and Packaging Management (12/22/04)
O 461.1A	Packaging and Transfer or Transportation of Materials of National Security Interest (04/26/04)
O 470.1	Safeguards and Security Program (09/28/95; Change 1, 06/21/96)
O 470.2B	Independent Oversight and Performance Assurance Program (10/31/02)
O 473.2	Protective Force Program (06/30/00)
O 474.1A	Control and Accountability of Nuclear Materials (11/22/00)
External Relationships	
1230.2	American Indian Tribal Government Policy (04/08/92)
Environmental Quality and Impact	
5400.5	Radiation Protection of the Public and the Environment (02/08/90; Change 2, 01/07/93)
5480.4	Environmental Protection, Safety, and Health Protection Standards (05/15/84; Change 4, 01/07/93)
5480.19	Conduct of Operations Requirements for DOE Facilities (07/09/90; Change 1, 05/18/92; Change 2, 10/23/01)
5480.20A	Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities (11/15/94; Change 1, 07/12/01)
5480.30	Nuclear Reactor Safety Design Criteria (01/19/93; Change 1, 03/14/01)
Emergency Preparedness	
5530.3	Radiological Assistance Program (01/14/92; Change 1, 04/10/92)
5530.5	Federal Radiological Monitoring and Assessment Center (07/10/92; Change 1, 12/02/92)
Office of National Nuclear Security Administration	
5660.1B	Management of Nuclear Materials (05/26/94)

Table 5–2 Applicable State Environmental Laws, Regulations, and Tribal Agreements

Law/Regulation/Agreement	*Citation*	*Requirements*
Idaho National Laboratory, Idaho		
Idaho Environmental Protection and Health Act	Idaho Code (IC), Title 39, Health and Safety, Chapter 1, Department of Health and Welfare, Sections 39-105	Provides for development of air pollution control permitting regulations.
Rules for the Control of Air Pollution in Idaho	Idaho Administrative Procedure Act (IDAPA) 58, Department of Environmental Quality, Title 1, Chapter 1 (58.01.01)	Enforces national ambient air quality standards.
Idaho Water Pollution Control Act	IC, Title 39, Chapter 36, Water Quality	Establishes a program to enhance and preserve the quality and value of water resources.
Water Quality Standards and Wastewater Treatment Requirements	IDAPA 58.01.02	Establishes water quality standards and wastewater treatment requirements.
Transportation of Hazardous Waste	IC, Title 18, Crimes and Punishment, Chapter 39, Highways and Bridges, Section 18-3905; IC, Title 49, Motor Vehicles, Chapter 22, Hazardous Materials/Hazardous Waste Transportation Enforcement	Regulates transportation of hazardous materials/hazardous waste on highways.
Idaho Hazardous Waste Management Act	IC, Title 39, Chapter 44, Hazardous Waste Management	Requires permit prior to construction or modification of a hazardous waste disposal facility.
Rules and Standards for Hazardous Waste	IDAPA 58.01.05	Requires permit prior to construction or modification of a hazardous waste disposal facility.
Various Acts Regarding Fish and Game	IC, Title 36, Fish and Game, Chapters 9, Protection of Fish, 11, Protection of Animals and Birds, and 24, Species Conservation	Requires consultation with responsible agency.
Endangered Species Act	IC, Title 67, State Government and State Affairs, Chapter 8, Executive and Administrative Officers, Section 67-818	Requires consultation with Department of Fish and Game.
Rules for Classification and Protection of Wildlife	IDAPA 13, Department of Fish and Game, 13.01.06	Requires consultation with Department of Fish and Game.
Idaho Historic Preservation Act	IC, Title 67, Chapter 46, Preservation of Historic Sites	Requires consultation with responsible local governing body.
Agreement in Principle Between the Shoshone-Bannock Tribes and DOE	December 10, 2002	Establishes understanding and commitment between the tribes and DOE.
Spent Fuel Settlement Agreement (also known as the Governor's Agreement)	October 17, 1995	Allows Idaho National Engineering and Environmental Laboratory (INEEL) (now INL) to receive spent nuclear fuel and mixed radioactive waste from offsite and establishes schedules for the treatment of existing high-level radioactive waste, TRU waste, and mixed radioactive waste, and the removal of spent nuclear fuel from the state. (This agreement is not applicable to the alternative because only new waste will be generated by the Proposed Action. This newly generated waste, if determined to be mixed radioactive waste, will be covered by the INL Site Treatment Plan.)

Law/Regulation/Agreement	*Citation*	*Requirements*
Idaho Site Treatment Plan and Consent Order for Federal Facility Compliance Plan	November 1, 1995 (issued to INEEL [now INL] and Argonne National Laboratory-West [now MFC])	Addresses compliance with the Federal Facility Compliance Act and mixed radioactive waste treatment issues by implementing the INL Site Treatment Plan.
Oak Ridge National Laboratory, Tennessee		
Tennessee Air Pollution Control Act	Tennessee (TN) Code, Title 68, Chapter 201 (Part 1)	Provides for permitting to construct, modify, or operate an air contaminant source.
Tennessee Air Pollution Control Regulations	TN Rule, Chapter 1200-3	Requires a permit to construct, modify, or operate an air contaminant source. Also sets fugitive dust requirements.
Tennessee Water Quality Control Act	TN Code, Title 69, Chapter 3	Provides authority to issue new or modify existing NPDES permits required for a water discharge source.
Tennessee Water Pollution Control Regulations	TN Rule, Chapter 1200-4	Requires a new or modification of an existing NPDES permit for a water discharge source.
Tennessee Hazardous Waste Management Act	TN Code, Title 68, Chapter 212 (Part 1)	Requires permit for any construction or modification of a hazardous waste facility.
Tennessee State Executive Order on Wetlands	TN State Wetlands Conservation Strategy	Provides guidance from the Governor's Interagency Wetlands Committee.
Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act of 1974	TN Code, Title 70, Chapter 8 (Part 1)	Requires consultation with responsible agency.
Tennessee Department of Environmental Conservation Order	October 1, 1995	Requires DOE to comply with the Site Treatment Plan for the management and treatment of mixed radioactive waste.
Los Alamos National Laboratory, New Mexico		
New Mexico Air Quality Control Act	New Mexico Statutes Annotated (NMSA), Chapter 74, Environmental Improvement, Article 2, Air Pollution, and Implementing Regulations at New Mexico Administrative Code (NMAC) Title 20, Environmental Protection, Chapter 2, Air Quality	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.
New Mexico Radiation Protection Act	NMSA, Chapter 74, Article 3, Radiation Control	Establishes state requirements for worker protection.
New Mexico Water Quality Act	NMSA, Chapter 74, Article 6, Water Quality, and Implementing Regulations Found in NMAC, Title 20, Chapter 6, Water Quality	Establishes water quality standards and requires a permit prior to the construction or modification of a water discharge source.
New Mexico Groundwater Protection Act	NMSA, Chapter 74, Article 6B, Groundwater Protection	Establishes state standards for protection of groundwater from leaking underground storage tanks.
New Mexico Solid Waste Act	NMSA, Chapter 74, Article 9, Solid Waste Act, and Implementing Regulations Found in NMAC Title 20, Environmental Protection, Chapter 9, Solid Waste	Requires permit prior to construction or modification of a solid waste disposal facility.
New Mexico Hazardous Waste Act	NMSA, Chapter 74, Article 4, Hazardous Waste, and Implementing Regulations Found in NMAC Title 20, Environmental Protection, Chapter 4, Hazardous Waste	Requires a permit prior to construction or modification of a hazardous waste disposal facility.

Law/Regulation/Agreement	*Citation*	*Requirements*
New Mexico Hazardous Chemicals Information Act	NMSA, Chapter 74, Article 4E-1, Hazardous Chemicals Information	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.
New Mexico Wildlife Conservation Act	NMSA, Chapter 17, Game and Fish, Article 2, Hunting and Fishing Regulations, Part 3, Wildlife Conservation Act	Requires permit and coordination if a project could disturb habitat or otherwise affect threatened or endangered species.
New Mexico Raptor Protection Act	NMSA, Chapter 17, Article 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.
New Mexico Endangered Plant Species Act	NMSA, Chapter 75, Miscellaneous Natural Resource Matters, Article 6, Endangered Plants	Requires coordination with the state.
Threatened and Endangered Species of New Mexico	NMAC, Title 19, Natural Resources and Wildlife, Chapter 33, Endangered and Threatened Species, 19.33.6.8	Establishes the list of threatened and endangered species.
Endangered Plant Species	NMAC, Title 19, Chapter 21, Endangered Plants	Establishes plant species list and rules for collection.
New Mexico Cultural Properties Act	NMSA, Chapter 18, Libraries and Museums, Article 6, Cultural Properties	Establishes State Historic Preservation Office and requirements to prepare an archaeological and historic survey and consult with the State Historic Preservation Office.
Environmental Oversight and Monitoring Agreement	Agreement in Principle Between DOE and the state of New Mexico, renewed October 1, 2000	Provides DOE support for state activities in environmental oversight, monitoring, access, and emergency response.
Pueblo Accords	DOE 1992 Cooperative Agreements with each of four Pueblos	Sets forth the government-to-government relationship between DOE and the four closest Pueblos.
Los Alamos County Noise Restrictions	Los Alamos County Code, Chapter 8.28	Imposes noise restrictions and makes provisions for exceedances.
New Mexico Hazardous Waste Act and New Mexico Solid Waste Act	Compliance Order on Consent March 1, 2005	Determine the nature and extent of releases of contaminants at or from LANL; identify and evaluate alternatives for corrective measures, including interim measures, to cleanup contaminants in the environment, and to prevent or mitigate the migration of contaminants at or from LANL; and implement corrective measures.

The NRC regulations applicable to radioactive materials transportation are found in 10 CFR 71. These regulations include detailed packaging design certification testing requirements. Complete documentation of design and safety analysis and the results of the required testing are submitted to NRC to certify the packaging for use. This certification testing involves the following components: heat, free drop onto an unyielding surface, immersion in water, puncture by dropping the package onto a steel bar, and gas tightness.

The transportation casks used to transport radioactive material are subject to numerous inspections and tests (10 CFR 71.87). These tests are designed to ensure that cask components are properly assembled and meet applicable safety requirements. Tests and inspections are clearly identified in the Safety Analysis Report for Packaging and/or the Certificate of Compliance for each cask. Casks are loaded and inspected by registered users in compliance with approved quality assurance programs. Operations involving the casks are conducted in compliance with 10 CFR 71.91. Reports of defects or accidental mishandling are submitted to NRC.

Chapter 4 of this EIS discusses the potential transportation impacts of each alternative.

5.8 Emergency Management and Response Laws, Regulations, and Executive Orders

This section discusses the laws, regulations, and Executive Orders that address the protection of public health and worker safety and require the establishment of emergency plans. These laws, regulations, and Executive Orders relate to the operation of facilities, including DOE facilities, that engage directly or indirectly in the production of special nuclear material.

5.8.1 Federal Emergency Management and Response Laws

Emergency Planning and Community Right-to-Know Act of 1986 (U.S.C. 11001 *et seq.*) (also known as "SARA Title III")—This act requires emergency planning and notice to communities and government agencies concerning the presence and release of specific chemicals. EPA implements this act under regulations found in 40 CFR 355, 370, and 372. Under Subtitle A of this act, Federal facilities are required to provide various information (such as inventories of specific chemicals used or stored and releases that occur from these sites) to the state emergency response commission and to the local emergency planning committee to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. Implementation of the provisions of this act began voluntarily in 1987, and inventory and annual emissions reporting began in 1988. DOE requires compliance with Title III as a matter of DOE policy at its contractor-operated facilities.

Chapter 3 of this EIS describes emergency planning for INL, ORNL, and LANL. Each site has established an emergency management program that would be activated in the event of an accident. The program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management plan includes emergency planning, training, preparedness, and response.

Chapter 4 of this EIS discusses the impacts of potential accidents for each alternative.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9604(I) (also know as "Superfund")—This act provides authority for Federal and state governments to respond directly to hazardous substance incidents. The act requires reporting of spills, including radioactive spills, to the National Response Center.

It will be necessary to comply with this requirement for each alternative.

Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (42 U.S.C. 5121)—This act, as amended, provides an orderly, continuing means of providing Federal Government assistance to state and local governments in managing their responsibilities to alleviate suffering and damage resulting from disasters. The President, in response to a state governor's request, may declare an "emergency" or "major disaster" to provide Federal assistance under this act. The President, in Executive Order 12148, delegated all functions except those in Sections 301, 401, and 409 to the Director of the Federal Emergency Management Agency. The Act provides for the appointment of a Federal coordinating officer who will operate in the designated area with a state coordinating officer for the purpose of coordinating state and local disaster assistance efforts with those of the Federal Government.

Justice Assistance Act of 1984 (42 U.S.C. 3701-3799)—This act establishes Emergency Federal law enforcement assistance to state and local governments in responding to a law enforcement emergency. The Act defines the term "law enforcement emergency" as an uncommon situation that requires law enforcement, that is or threatens to become of serious or epidemic proportions, and with respect to which state and local resources are inadequate to protect the lives and property of citizens or to enforce the criminal law. Emergencies that are not of an ongoing or chronic nature (for example, the Mount Saint Helens volcanic eruption) are eligible for Federal law enforcement assistance including funds, equipment, training, intelligence information, and personnel.

Price-Anderson Act (42 U.S.C. 2210)—This act allows DOE to indemnify its contractors if the contract involves the risk of public liability from a nuclear incident.

5.8.2 Federal Emergency Management and Response Regulations

Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release (10 CFR 30.72, Schedule C)—This section of the regulations provides a list that is the basis for both the public and private sector to determine whether the radiological materials they handle must have an emergency response plan for unscheduled releases, and is one of the threshold criteria documents for DOE hazards assessments required by DOE Order 5500.3A, "Planning and Preparedness for Operational Emergencies." The "Federal Radiological Emergency Response Plan," dated November 1995, primarily discusses offsite Federal response in support of state and local governments with jurisdiction during a peacetime radiological emergency.

Chapter 3 of this EIS describes emergency preparedness at each site.

Occupational Safety and Health Administration Emergency Response, Hazardous Waste Operations, and Worker Right to Know (29 CFR 1910)—This regulation establishes OSHA requirements for employee safety in a variety of working environments. It addresses employee emergency and fire prevention plans (Section 1910.38), hazardous waste operations and emergency response (Section 1920.120), and hazards communication (Section 1910.1200) to make employees aware of the dangers they face from hazardous materials in their workplace. These regulations do not directly apply to Federal agencies. However, Section 19 of the Occupational Safety and Health Act (29 U.S.C. 668) requires all Federal agencies to have occupational safety programs "consistent" with Occupational Safety and Health Act standards.

Chapter 3 of this EIS describes DOE emergency response programs.

Emergency Management and Assistance (44 CFR Section 1.1)—This regulation contains the policies and procedures for the Federal Emergency Management Act, National Flood Insurance Program, Federal Crime Insurance Program, Fire Prevention and Control Program, Disaster Assistance Program, and Preparedness Program, including radiological planning and preparedness.

Hazardous Materials Tables and Communications, Emergency Response Information Requirements (49 CFR 172)—This regulation defines the regulatory requirements for marking, labeling, placarding, and documenting hazardous material shipments. The regulation also specifies the requirements for providing hazardous material information and training.

Chapter 4 of this EIS discusses transportation impacts for each alternative.

5.8.3 Emergency Response and Management Executive Orders

Executive Order 12148 (Federal Emergency Management, July 20, 1979)—This Order transfers functions and responsibilities associated with Federal emergency management to the Director of the Federal Emergency Management Agency in the Department of Homeland Security. The Order assigns the Director the responsibility to establish Federal policies for, and to coordinate all civil defense and civil emergency planning, management, mitigation, and assistance functions of, Executive agencies.

Executive Order 12656 (Assignment of Emergency Preparedness Responsibilities, November 18, 1988)—This Order assigns emergency preparedness responsibilities to Federal Departments and agencies.

Executive Order 12938 (Proliferation of Weapons of Mass Destruction, November 14, 1994)—This Order states that the proliferation of nuclear, biological, and chemical weapons ("weapons of mass destruction") and the means of delivering such weapons constitutes an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States, and that a national emergency would be declared to deal with that threat.

5.9 Consultations with Agencies and Federally-Recognized American Indian Nations

Certain laws, such as the Endangered Species Act, the Fish and Wildlife Coordination Act, and the National Historic Preservation Act, require consultation and coordination by DOE with other governmental entities including other Federal agencies, state and local agencies, and federally-recognized American Indian Nations. These consultations must occur on a timely basis and are generally required before any land disturbance can begin. Most of these consultations are related to biotic resources, cultural resources, and American Indian rights.

The biotic resource consultations generally pertain to the potential for activities to disturb sensitive species or habitats. Cultural resource consultations relate to the potential for disruption of important cultural resources and archaeological sites. American Indian consultations are concerned with the sovereign rights of tribal Nations pertaining to the potential for disturbance of ancestral American Indian sites and the traditional practices of American Indians.

DOE initiated the required consultations with the appropriate State Historic Preservation Officers, as required by NEPA and Section 106 of the National Historic Preservation Act; the USFWS, and the National Marine Fisheries Service, as required by the Endangered Species Act of 1973, the Bald and Golden Eagle Protection Act, and the Migratory Bird Treaty Act; and the appropriate state regulators, as required by state laws or regulations. DOE also initiated the required consultations with the appropriate American Indian tribal governments, as required by the Executive Memorandum (dated April 29, 1994) entitled "Government-to-Government Relations with Native American Tribal Governments" and DOE Order 1230.2, "American Indian Tribal Government Policy." DOE will report the results of these consultations in the Final *Consolidation EIS*.

CHAPTER 6
REFERENCES

6.0 REFERENCES

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CHAPTER 7
GLOSSARY

7.0 GLOSSARY

absorbed 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. (See rad and gray.)

accident sequence—With regard to nuclear facilities, an initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

actinide—Any member of the group of elements with atomic numbers from 89 (actinium) to 103 (lawrencium) including uranium and plutonium. All members of this group are radioactive.

activation products—Nuclei, usually radioactive, formed by the bombardment and absorption in material with neutrons, protons, or other nuclear particles.

Advanced Test Reactor (ATR)—A light-water-cooled and -moderated test reactor located within the Reactor Technology Complex at Idaho National Laboratory. It is fueled with enriched uranium-235 and has a full-power level of 250 megawatts, but typically operates at 140 megawatts or less.

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 because of potential harmful effects on human health and welfare.

air quality control region—Geographic subdivisions of the United States, designed to deal with pollution on a regional or local level. Some regions span more than one state.

alluvium (alluvial)—Unconsolidated, poorly sorted detrital sediments, ranging from clay-to-gravel sizes, deposited by streams.

alpha activity—The emission of alpha particles by radioactive materials.

alpha particle—A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus and has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). (See alpha radiation.)

alpha radiation—A strongly ionizing, but weakly penetrating, form of radiation consisting of positively charged alpha particles emitted spontaneously from the nuclei of certain elements during radioactive decay. Alpha radiation is the least penetrating of the three common types of ionizing radiation (alpha, beta, and gamma). Even the most energetic alpha particle generally fails to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha radiation is most hazardous when an alpha-emitting source resides inside an organism. (See alpha particle.)

ambient—Surrounding.

ambient air—The surrounding atmosphere as it exists around people, plants, and structures.

ambient air quality standards—The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

aquatic—Living or growing in, on, or near water.

aquatic biota—The sum total of living organisms within any designated aquatic area.

aquifer—An underground geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to wells or springs.

aquitard—A less-permeable geologic unit that inhibits the flow of water.

archaeological sites (resources)—Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

artifact—An object produced or shaped by human workmanship of archaeological or historical interest.

as low as is 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.

Assembly and Testing Facility—A facility that was commissioned in October 2004, located at the Materials and Fuels Complex in the Idaho National Laboratory that assembles and tests radioisotope power systems.

atmospheric dispersion—The process of air pollutants being dispersed in the atmosphere. This occurs by the wind that carries the pollutants away from their source, by turbulent air motion that results from solar heating of the Earth's surface, and air movement over rough terrain and surfaces.

Atomic Energy Act—A law originally enacted in 1946 and amended in 1954 that placed nuclear production and control of nuclear materials within a civilian agency, originally the Atomic Energy Commission. The functions of the Atomic Energy Commission were replaced by the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

Atomic Energy Commission—A five-member commission, established by the Atomic Energy Act of 1946, to supervise nuclear weapons design, development, manufacturing, maintenance, modification, and dismantlement. In 1974, the Atomic Energy Commission was abolished, and all functions were transferred to the Nuclear Regulatory Commission and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated, and functions vested by law in the Administrator were transferred to the Secretary of Energy.

atomic number—The number of positively charged protons in the nucleus of an atom or the number of electrons on an electrically neutral atom.

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 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.)

backfill—The replacement of excavated earth or other material into an open trench, cavity, or other opening in the earth.

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.

barrier—Any material or structure that prevents or substantially delays movement of pollutants or materials containing radionuclides toward the accessible environment.

basalt—The most common volcanic rock, dark gray to black in color, high in iron and magnesium and low in silica. It is typically found in lava flows.

baseline—The existing environmental conditions against which impacts of the Proposed Action and its alternatives can be compared. For this *Consolidation EIS*, the environmental baseline is the site environmental conditions as they exist or are estimated to exist in the absence of the Proposed Action.

basin—Geologically, a circular or elliptical downwarp or depression in the Earth's surface that collects sediment. Younger sedimentary beds occur in the center of basins. Topographically, a depression into which water from the surrounding area drains.

becquerel—A unit of radioactivity equal to one disintegration per second. Thirty-seven billion becquerels is equal to 1 curie.

bedrock—The solid rock that lies beneath soil and other loose surface materials.

BEIR V—Biological Effects of Ionizing Radiation; referring to the fifth in a series of committee reports from the National Research Council.

benthic—Plants and animals dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

beryllium—An extremely light-weight element with the atomic number 4. It is metallic and is used in reactors as a neutron reflector.

best management practices (BMPs)—Structural, nonstructural, and managerial techniques, other than effluent limitations, to prevent or reduce pollution of surface water. They are the most effective and practical means to control pollutants that are compatible with the productive use of the resource to which they are applied. BMPs are used in both urban and agricultural areas. BMPs can include schedules of activities; prohibitions of practices; maintenance procedures; treatment requirements; operating procedures; and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

beta emitter—A radioactive substance that decays by releasing a beta particle.

beta particle—A particle emitted in the radioactive decay of many radionuclides. A beta particle is identical to an electron. It has a short range in air and a small ability to penetrate other materials.

beyond-design-basis accident—An accident postulated for the purpose of generating large consequences by exceeding the functional and performance requirements for safety structures, systems, and components. (See design-basis accident.)

beyond-design-basis events—Postulated disturbances in process variables due to external events or multiple component or system failures that can potentially lead to beyond-design-basis accidents. (See design-basis events.)

biota (biotic)—The plant and animal life of a region (pertaining to biota).

block—U.S. Bureau of the Census term describing small areas bounded on all sides by visible features or political boundaries; used in tabulation of census data.

boron-10—An isotope of the element boron that has a high capture cross section for neutrons. It is used in reactor absorber rods for reactor control.

borrow—Excavated material that has been taken from one area to be used as raw material or fill at another location.

bounded—Producing the greatest consequences of any assessment of impacts associated with normal or abnormal operations.

cancer—The name given to a group of diseases characterized by uncontrolled cellular growth, with cells having invasive characteristics such that the disease can transfer from one organ to another.

canister—A general term for a container, usually cylindrical, used in handling, storage, transportation, or disposal of waste.

capable fault—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 instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; (3) a structural relationship to a capable fault according to characteristic (1) or (2) above, 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; it results from fossil fuel combustion, and is an expiration production.

carbon monoxide—A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

cask—A heavily shielded container used to store or ship radioactive materials.

cation—A positively charged ion.

cell—See hot cell.

Chalfont container 9975—A shielded Type B container with primary and secondary containment features that is used to store or ship radioactive materials. (See cask and Type B packaging.)

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.

clay—The name for a family of finely crystalline sheet silicate minerals that commonly form as a product of rock weathering. Also, any particle smaller than or equal to about 0.002 millimeters (0.00008 inches) in diameter.

Class I areas—A specifically designated area where the degradation of air quality is stringently restricted (e.g., many national parks, wilderness areas). (See Prevention of Significant Deterioration.)

Class II areas—Most of the country not designated as Class I is designated as Class II. Class II areas are generally cleaner than air quality standards require, and moderate increases in new pollution are allowed after a regulatory mandated impacts review.

Clean Air Act—This Act mandates and provides for enforcement of regulations to control air pollution from various sources.

Clean Air Act Amendments of 1990—Expands the U.S. Environmental Protection Agency's enforcement powers, and adds restrictions on air toxics, ozone depleting chemicals, stationary and mobile emissions sources, and emissions implicated in acid rain and global warming.

Clean Water Act of 1972, 1987—This Act regulates the discharge of pollutants from a point source into navigable waters of the United States in compliance with a National Pollutant Discharge Elimination System permit, and regulates discharges to or dredging of wetlands.

***Code of Federal Regulations* (CFR)—**All Federal regulations in effect are published in codified form in the CFR.

collective dose—The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. Collective dose is expressed in units of person-rem or person-sievert.

committed dose equivalent—The dose equivalent to organs or tissues that will be received by an individual during the 50-year period following the intake of radioactive material. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rems or sieverts.

committed effective dose equivalent—The dose value obtained by: (1) multiplying the committed dose equivalents for the organs or tissues that are irradiated and the weighting factors applicable to those organs or tissues, and (2) summing all the resulting products. Committed effective dose equivalent is expressed in units of rem or sievert. (See committed dose equivalent and weighting factor.)

community (biotic)—All plants and animals occupying a specific area under relatively similar conditions.

community (environmental justice definition)—A group of people or a site within a spatial scope exposed to risks that potentially threaten health, ecology, or land values; or are exposed to industry that stimulates unwanted noise, smell, industrial traffic, particulate matter, or other nonaesthetic impacts.

conformity—Conformity is defined in the Clean Air Act as the action's compliance with an implementation plan’s purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards, and achieving expeditious attainment of such standards; and that such activities will not: (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard or any required interim emission reduction, or other milestones in any area.

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, (e.g., waste with a surface dose rate not greater than 200 millirem per hour). (See remote-handled waste.)

container—With regard to radioactive wastes, the metal envelope in the waste package that provides the primary containment function of the waste package, and which is designed to meet the containment requirements of 10 CFR 60.

contamination—The deposition of undesirable radioactive material on the surfaces of structures, areas, objects, or personnel.

control rod—A rod containing material such as boron that is used to control the power of a nuclear reactor. By absorbing excess neutrons, a control rod prevents the neutrons from causing further fissions, i.e., increasing power.

coolant—A substance, either gas or liquid, circulated through a nuclear reactor or processing plant to remove heat.

cooperating agency—Federal and non-Federal Governmental bodies other than the lead agency that has jurisdiction by law or special expertise with respect to environmental impacts involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment.

criteria pollutants—An air pollutant that is regulated by 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, less than or equal to 10 micrometers (0.0004 inch) in diameter, and less than or equal to 2.5 micrometers (0.0001 inch) 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 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 424). (See endangered species and threatened species.) The lists of Critical Habitats can be found in 50 CFR 17.95 (fish and wildlife), 50 CFR 17.96 (plants), and 50 CFR 226 (marine species).

criticality—The condition in which a system is capable of sustaining a nuclear chain reaction.

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.

critical mass: The smallest mass of fissionable material that will support a self-sustaining nuclear chain reaction.

cultural resources—Archaeological sites, historical sites, architectural features, traditional use areas, and American Indian sacred sites.

cumulative impacts—The impacts on the environment that result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency or person who undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

curie—A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

day-night average sound level—The 24-hour, A-weighted equivalent sound level expressed in decibels. A 10-decibel penalty is added to sound levels between 10:00 p.m. and 7:00 a.m. to account for increased annoyance due to noise during night hours.

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).

decay heat (radioactivity)—The heat produced by the decay of radionuclides.

decibel—A unit for expressing the relative intensity of sounds on a logarithmic scale where zero is below human perception and 130 is above the threshold of pain to humans. For traffic and industrial noise measurements, the A-weighted decibel, 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.

deciduous—Trees that shed leaves at a certain season.

decommissioning—Retirement of a facility, including any necessary decontamination and/or dismantlement.

decontamination—The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

depleted uranium—Uranium whose content of the fissile isotope uranium-235 is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium. (See also enriched uranium, highly enriched uranium, natural uranium, low-enriched uranium, and uranium.)

deposition—In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling 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 and/or experiments) 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.)

design-basis events—Postulated disturbances in process variables that can potentially lead to design-basis accidents. (See beyond-design-basis events.)

direct jobs—The number of workers required at a site to implement an alternative.

discharge—In surface water hydrology, the amount of water issuing from a spring or in a stream that passes a specific point in a given period of time.

disposition—The ultimate "fate" or end use of a surplus U.S. Department of Energy facility following the transfer of the facility to the Office of the Assistant Secretary for Environmental Management.

DOE Orders—Requirements internal to the U.S. Department of Energy (DOE) that establish DOE policy and procedures, including those for compliance with applicable laws.

dose (or radiation dose)—A generic term that means absorbed dose, effective dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined elsewhere in this glossary.

dose equivalent—A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. Defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert.

dose rate—The radiation dose delivered per unit of time (e.g., rem per year).

dosimeter—A small device (instrument) carried by a radiation worker that measures cumulative radiation dose (e.g., a film badge or ionization chamber).

drinking water standards—The level of constituents or characteristics in a drinking water supply specified in regulations under the Safe Drinking Water Act as the maximum permissible.

ecology—A branch of science dealing with the interrelationships of living organisms with one another and with their nonliving environment.

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 rems or sieverts. (See committed dose equivalent and committed effective dose equivalent.)

effluent—A waste stream flowing into the atmosphere, surface water, groundwater, or soil. Most frequently the term applies to wastes discharged to surface waters.

electron—An elementary particle with a mass of 9.107×10^{-28} gram (or 1/1,837 of a proton) and a negative charge. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

emission—A material discharged into the atmosphere from a source operation or activity.

emission standards—Legally enforceable limits on the quantities and/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 424). (See threatened species.) 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.

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 also depleted uranium, uranium, natural uranium, low-enriched uranium, and highly enriched uranium.)

Environment, Safety, and Health Program—In the context of the U.S. Department of Energy (DOE), encompasses those requirements, activities, and functions in the conduct of all DOE and DOE-controlled operations that are concerned with impacts to the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting the risks to the well-being of both operating personnel and the general public; and protecting property against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, process and facility safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

environmental impact statement (EIS)—The detailed written statement required by the National Environmental Policy Act (NEPA) section 102(2)(C) 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 National Environmental Policy Act regulations in 40 CFR 1500-1508 and DOE NEPA regulations in 10 CFR 1021. The statement includes, among other information, discussions of the environmental impacts of the Proposed Action and all 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.)

excavation—A cavity in the Earth's surface formed by cutting, digging, or scooping by excavating, such as with the use of heavy construction equipment.

exposure limit—The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur.

Reference dose is the chronic-exposure dose (milligram or kilogram per day) for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur.

Reference concentration is the chronic exposure concentration (milligram per cubic meter) for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur.

fault—A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall has been depressed in relation to the footwall. A reverse fault occurs when the hanging wall has been raised in relation to the footwall.

fissile materials—Although sometimes used as a synonym for fissionable material, this term has acquired a more restricted meaning, namely, any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

fission products—Nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.

fissionable material—Commonly used as a synonym for fissile material, the meaning of this term has been extended to include material that can be fissioned by fast neutrons, such as uranium-238.

floodplain—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 1.0 percent chance of being inundated by a flood in any given year.

The *base floodplain* is defined as the area which has a 1.0 percent or greater chance of being flooded in any given year. Such a flood is known as a 100-year flood.

The *critical action floodplain* is defined as the area which has at least a 0.2 percent chance of being flooded in any given year. Such a flood is known as a 500-year flood. Any activity for which even a slight chance of flooding would be too great (e.g., the storage of highly volatile, toxic, or water reactive materials) should not occur in the critical action floodplain.

The *probable maximum flood* is the hypothetical flood that is considered to be the most severe reasonably possible flood, based on the comprehensive hydrometeorological application of maximum precipitation and other hydrological factors favorable for maximum flood runoff (e.g., sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.

Fluorinel Dissolution Process and Fuel Storage Facility (FDPF)—A processing facility at the Idaho Nuclear Technology and Engineering Center at the Idaho National Laboratory designed to handle highly radioactive material using remote-handling equipment. This facility was originally intended to process spent nuclear fuel.

flux—Rate of flow through a unit area; in reactor operation, the apparent flow of neutrons in a defined energy range. (See neutron flux.)

formation—In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

Fuel Manufacturing Facility (FMF)—FMF is located adjacent to the Zero Power Physics Reactor facility at the Materials and Fuels Complex area at Idaho National Laboratory and is covered with an earthen mound. FMF was used to manufacture fuel for the Experimental Breeder Reactor (EBR)-II. The facility was completed in 1986, and was oversized for the EBR-II mission. The building includes a large special nuclear material vault, which would be used for neptunium-237 storage; an induction furnace; and gloveboxes and hoods, as well as other temporary experimental setups.

g—In measuring earthquake ground motion, the acceleration (the rate of change in velocity) experienced relative to that due to Earth’s gravity (i.e., approximately equal to 980 centimeters per second squared).

gamma radiation—High-energy, short wavelength, electromagnetic radiation emitted from the nucleus of an atom during radioactive decay. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are similar to, but are usually more energetic than, x-rays.

genetic effects—Inheritable changes (chiefly mutations) produced by exposure of the parts of cells that control biological reproductive and inheritance to ionizing radiation or other chemical or physical agents.

geologic repository—A place to dispose of radioactive waste deep beneath the Earth's surface.

geology—The science that deals with the Earth: the materials, processes, environments, and history of the planet, including rocks and their formation and structure.

glovebox—Large 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.

grading—Any stripping, cutting, filling, stockpiling, or combination thereof that modifies the land surface.

gray—The SI (International System of Units) unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (1 gray is equal to 100 rads). (The joule is the SI unit of energy.) (See absorbed dose.)

ground shine—The radiation dose received from an area on the ground where radioactivity has been deposited by a radioactive plume or cloud.

groundwater—Water below the ground surface in a zone of saturation.

habitat—The environment occupied by individuals of a particular species, population, or community.

half-life—The time in which one-half of the atoms of a particular radioactive isotope disintegrate to another nuclear form. Half-lives vary from millionths of a second to billions of years.

Hazard Index—A summation of the Hazard Quotients for all chemicals now being used at a site, and those proposed to be added, to yield cumulative levels for a site. A Hazard Index value of 1.0 or less means that no adverse human health effects (noncancer) are expected to occur.

Hazard Quotient—The value used as an assessment of noncancer associated toxic effects of chemicals, e.g., kidney or liver dysfunction. It is a ratio of the estimated exposure to that exposure at which it would be expected that adverse health effects would begin to be produced. It is independent of a cancer risk, which is calculated only for those chemicals identified as carcinogens.

hazardous air pollutants—Air pollutants not covered by ambient air quality standards but which may present a threat of adverse human health effects or adverse 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, hazardous air pollutants are any of the 189 pollutants listed in or pursuant to the Clean Air Act, Section 112(b). Very generally, hazardous air pollutants are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

hazardous chemical—Under 29 CFR 1910, Subpart Z, hazardous chemicals are defined as “any chemical which is a physical hazard or a health hazard.” Physical hazards include combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, and reactives. A health hazard is any chemical for which there is good evidence that acute or chronic health effects occur in exposed employees. Hazardous chemicals include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

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 substance—Any substance subject to the reporting and possible response provisions of the Clean Water Act and the Comprehensive Environmental Response, Compensation, and Liability Act.

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 (ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31-33.

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. HEPA filters include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.

High Flux Isotope Reactor (HFIR)—A light-water cooled and moderated test reactor located at Oak Ridge National Laboratory in the Oak Ridge Reservation. HIFR is fueled with enriched uranium-235 and has an authorized full-power level of 85 million watts.

high-level radioactive waste (HLW)—HLW is the highly radioactive waste material resulting from the reprocessing of spent 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 is determined, consistent with existing law, to require permanent isolation.

HIGHWAY—A computer code used for predicting routes for transporting radioactive material in the United States and calculating route-specific population density statistics.

highly enriched uranium—Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). (See also uranium, natural uranium, enriched uranium, highly enriched uranium, and depleted uranium.)

historic resources—Archaeological sites, architectural structures, and objects produced after the advent of written history, dating to the time of the first European-American contact in an area.

Holocene—An epoch of the Quaternary period that began at the end of the Pleistocene, or the “Ice Age,” about 10,000 years ago and continuing to the present. It is named from the Greek words “holos” (entire) and “ceno” (new).

hot cell—A shielded facility that requires the use of remote manipulators for handling radioactive materials.

hydrology—The science dealing with the properties, distribution, and circulation of natural water systems.

Idaho National Laboratory (INL)—Formerly known as Idaho National Engineering and Environmental Laboratory, INL is a U.S. Department of Energy (DOE) laboratory complex located in southeast Idaho about 25 miles west of Idaho Falls, that is managed and operated by a private consortium under contract to DOE.

incident-free risk—The radiological or chemical impacts resulting from emissions during normal operations and packages aboard vehicles in normal transport. This includes the radiation or hazardous chemical exposure of specific population groups and workers.

indirect jobs—Within a regional economic area, jobs generated or lost in related industries as a result of a change in direct employment.

injection wells—A well that takes water from the surface into the ground, either through gravity or by mechanical means.

intensity (of an earthquake)—A measure of the effects (due to ground shaking) of an earthquake at a particular location, based on observed damage to structures built by humans, changes in the Earth's surface, and reports of how people felt the earthquake. Earthquake intensity is measured in numerical units on the Modified Mercalli Intensity scale. (See Modified Mercalli Intensity scale and magnitude [of an earthquake].)

ion—An atom that has too many or too few electrons, causing it to be electrically charged.

ion exchange—A unit physiochemical process that removes anions and cations, including radionuclides, from liquid streams (usually water) for the purpose of purification or decontamination.

ion exchange resin—An organic polymer that functions as an acid or base. These resins are used to remove ionic material from a solution. Cation exchange resins are used to remove positively charged particles (cations), and anion exchange resins are used to remove negatively charged particles (anions).

ionizing radiation—Alpha particles, beta particles, gamma rays, high-speed electrons, high-speed protons, and other particles or electromagnetic radiation that can displace electrons from atoms or molecules, thereby producing ions.

irradiated—Exposure to ionizing radiation. The condition of reactor fuel elements and other materials in which atoms bombarded with nuclear particles have undergone nuclear changes.

isotope—Any of two or more variations of an element in which the nuclei have the same number of protons (i.e., 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).

joule—A metric unit of energy, work, or heat, equivalent to one watt-second, 0.737 foot-pound, or 0.239 calories.

landscape character—The arrangement of a particular landscape as formed by the variety and intensity of the landscape features (land, water, vegetation, and structures) and the four basic elements (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 occurring some time after, and postulated to be due to, exposure to ionizing radiation or other carcinogens.

light water—The common form of water (a molecule with two hydrogen atoms and one oxygen atom, H_2O), in which the hydrogen atom consists completely of the normal hydrogen isotope (one proton).

light water reactor—A nuclear reactor in which circulating light water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions.

loam—Soil material that is composed of 7 percent to 27 percent clay particles, 28 percent to 50 percent silt particles, and less than 52 percent sand particles.

long-lived radionuclides—Radioactive isotopes with half-lives greater than 30 years.

Los Alamos National Laboratory (LANL)—A U.S. Department of Energy (DOE) laboratory complex located in northwestern New Mexico about 30 miles northwest of Santa Fe, that is managed and operated by a private consortium under contract to DOE.

loss-of-coolant accident—An accident that results from the loss of reactor coolant because of a break in the reactor coolant system.

low-enriched uranium—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 also depleted uranium, enriched uranium, highly enriched uranium, natural uranium, and uranium.)

low-income population—Low-income populations, defined in terms of Bureau of the Census annual statistical poverty levels (Current Population Reports, Series P-60 on Income and Poverty), may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (such as migrant workers or American Indians), where either group experiences common conditions of environmental exposure or effect. (See environmental justice and minority population.)

low-level radioactive waste—Waste that contains radioactivity but is not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material as defined by Section 11e (2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the concentration of transuranic waste is less than 100 nanocuries per gram.

MACCS2—A computer code used to calculate the radiological consequences to noninvolved workers and the public due to postulated accidental releases of radioactive material using site-specific meteorology and population distribution.

magnitude (of an earthquake)—A quantity characteristic of the total energy released by an earthquake, as contrasted to "intensity," which describes its effects at a particular place. Magnitude is determined by taking the common logarithm (base 10) of the largest ground motion recorded on a seismograph during the arrival of a seismic wave type and applying a standard correction factor for distance to the epicenter. Three common types of magnitude are Richter (or local) (M_L), P body wave (m_b), and surface wave (M_s). Additional magnitude scales, notably the moment magnitude (M_w), have been introduced to increase uniformity in representation of earthquake size. *Moment magnitude* is defined as the rigidity of the rock multiplied by the area of faulting multiplied by the amount of slip. A one-unit increase in magnitude (for example, from magnitude 6 to magnitude 7) represents a 30-fold increase in the amount of energy released. (See intensity [of an earthquake].)

Materials and Fuels Complex (MFC)—Formerly known as Argonne National Laboratory-West, the MFC at the Idaho National Laboratory is used to develop technologies associated with nuclear fuel, including advanced fuel treatment methods, fuel efficiency enhancements, and fuel performance testing. Activities at MFC also include nuclear material characterization technologies, environmental technologies, and technologies and processes requiring remote handling of nuclear materials.

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 (e.g., inhalation, ingestion, direct exposure).

megawatt—A unit of power equal to 1 million watts. Megawatt thermal is commonly used to define heat produced, while megawatt-electric defines electricity produced.

meteorology—The science dealing with the atmosphere and its phenomena, especially as relating to weather.

MeV (million electron volts)—A unit used to quantify energy. In this *Consolidation EIS*, it describes a particle's kinetic energy, which is an indicator of particle speed.

micrometer—One-millionth of 1 meter.

migration—The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

Migratory Bird Treaty Act—This Act states that it is unlawful to pursue, take, attempt to take, capture, possess, or kill any migratory bird, or any part, nest, or egg of any such bird other than permitted activities.

millirem—One-thousandth of 1 rem.

minority population—Minority populations exist where either: (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than 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 either group experiences common conditions of environmental exposure or effect. (See environmental justice and low-income population.)

mitigate—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 waste—Waste that contains both nonradioactive hazardous waste and radioactive waste, as defined in this glossary.

moderator—A material used to decelerate neutrons in a reactor from high energies to low energies.

Modified Mercalli Intensity (MMI) Scale—The Modified Mercalli Intensity Scale is a standard of relative measurement of earthquake intensity, developed to fit construction conditions in most of the United States. It is a 12-step scale, with values from I (not felt except by a very few people) to XII (damage total). A Modified Mercalli Intensity is a numerical value on the Modified Mercalli Scale.

National Ambient Air Quality Standards—Standards defining the highest allowable levels of certain pollutants in the ambient air (i.e., 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 (less than or equal to 10 micrometers [0.0004 inches] in diameter and 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 (e.g., visibility, crops, animals, buildings). (See criteria pollutant.)

National Emission Standards for Hazardous Air Pollutants—Emissions standards set by the U.S. Environmental Protection Agency for air pollutants which are not covered by National Ambient Air Quality Standards and which 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. National Emission Standards for Hazardous Air Pollutants 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 Policy Act (NEPA) of 1969—This Act is the basic national charter for protection of the environment. It establishes policy, sets goals (Section 101), and provides means (Section 102) for carrying out policy. Section 102(2) contains "action-forcing" provisions to ensure that Federal agencies follow the letter and spirit of the act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of the National Environmental Policy Act requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the Proposed Action and other specified information.

National Historic Preservation Act—This Act provides that property resources with significant national historic value be placed on the National Register of Historic Places. It does not require any permits, but pursuant to Federal code, if a Proposed Action might impact a historic property resource, it mandates consultation with the proper agencies.

National Pollutant Discharge Elimination System—A provision of the Clean Water Act which 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 Indian reservation. The National Pollutant Discharge Elimination System permit lists either permissible discharges, the level of cleanup technology required for wastewater, or both.

National Register of Historic Places—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. Buildings, structures, objects, sites, and districts are included in the National Register for their importance in American history, architecture, archaeology, culture, or engineering. Properties included on the National Register 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 National Register are found in 36 CFR 60.

natural phenomena accidents—Accidents that are initiated by phenomena such as earthquakes, tornadoes, floods, etc.

natural uranium—Uranium with the naturally occurring distribution of uranium isotopes (approximately 0.7-weight percent uranium-235, and the remainder essentially uranium-238). (See also uranium, depleted uranium, enriched uranium, highly enriched uranium, and low-enriched uranium.)

neptunium-237—An element, mostly manmade, with the atomic number 93. Pure neptunium is a silvery metal. The neptunium-237 isotope has a half-life of 2.14 million years. When neptunium-237 is bombarded by neutrons, it is transformed to neptunium-238, which in turn undergoes radioactive decay to become plutonium-238. When neptunium-237 undergoes radioactive decay, it emits alpha particles and gamma rays.

neutron—An uncharged elementary particle with a mass slightly greater than that of the proton. Neutrons are found in the nucleus of every atom heavier than hydrogen-1.

neutron flux—The product of neutron number density and velocity (energy), giving an apparent number of neutrons flowing through a unit area per unit time.

nitrogen oxides—Refers to the oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide. These are produced in the combustion of fossil fuels and can constitute an air pollution problem. Nitrogen dioxide emissions contribute to acid deposition and formation of atmospheric ozone.

noise pollution—Any sound that is undesirable because it interferes with speech and hearing, or is intense enough to damage hearing, or is otherwise annoying or undesirable.

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, and particulate matter. An area may be in attainment for some pollutants, but not for others. (See attainment area, National Ambient Air Quality Standards, and particulate matter.)

normal operations—All normal (incident-free) conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency greater than 0.1 events per year.

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 NOI is usually published in the *Federal Register* and 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 or the general public.

nuclear grade—Material of a quality adequate for use in a nuclear application.

nuclear material—Composite term applied to: (1) special nuclear material; (2) source material such as uranium or thorium or ores containing uranium or thorium; and (3) byproduct material, which is any radioactive material that is made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material.

nuclear radiation—Particles (alpha, beta, neutrons) or photons (gamma) emitted from the nucleus of unstable radioactive atoms as a result of radioactive decay.

nuclear reactor—A device that sustains a controlled nuclear fission chain reaction that releases energy in the form of heat.

Nuclear Regulatory Commission (NRC)—The Federal agency that regulates the civilian nuclear power industry in the United States.

nuclide—A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

Oak Ridge National Laboratory (ORNL)—A U.S. Department of Energy (DOE) laboratory complex located in eastern Tennessee about 25 miles west of Knoxville, that is managed and operated by a private consortium under contract to DOE.

Occupational Safety and Health Administration—Oversees and regulates workplace health and safety; created by the Occupational Safety and Health Act of 1970.

offsite—The term denotes a location, facility, or activity occurring outside the site boundary.

outfall—The discharge point of a drain, sewer, or pipe as it empties into a body of water.

ozone—The triatomic form of oxygen; in the stratosphere, ozone protects the Earth from the sun's ultraviolet rays, but in lower levels of the atmosphere, ozone is considered an air pollutant.

package—For radioactive materials, the packaging, together with its radioactive contents, as presented for transport (the packaging plus the radioactive contents equals the package).

packaging—With regard to hazardous or radionuclide materials, the assembly of components necessary to ensure compliance with Federal regulations. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle tie-down system and auxiliary equipment may be designated as part of the packaging.

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.

peak ground acceleration—A measure of the maximum horizontal acceleration (as a percentage of the acceleration due to the Earth's gravity) experienced by a particle on the surface of the earth during the course of earthquake motion.

permeability—In geology, the ability of rock or soil to transmit a fluid.

person-rem—A unit of collective radiation dose applied to populations or groups of individuals (see collective dose); 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.

Physics Package—The nuclear weapon component that is the location of the nuclear fission and/or fusion reactions which create the explosion.

Pleistocene—The geologic time period of the earliest epoch of the Quaternary period, spanning between about 1.6 million years ago and the beginning of the Holocene epoch at 10,000 years ago. It is characterized by the succession of northern glaciations and also called the "Ice Age."

plume—The elongated volume of contaminated water or air originating at a pollutant source such as an outlet pipe or a smokestack. 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. Plutonium has 15 isotopes with atomic masses ranging from 232 to 246 and half-lives from 20 minutes to 76 million years.

Plutonium Facility at LANL—A chemical processing facility located at Los Alamos National Laboratory used for purifying and encapsulating plutonium-238. The Plutonium Facility was constructed beginning in 1972 and has been operating continuously since 1978 as a state-of-the-art laboratory facility for research and development on plutonium processing. The facility is located in a secure area at Technical Area 55.

plutonium-238—An isotope with a half-life of 87.74 years used as the heat source for radioisotope power systems. When plutonium-238 undergoes radioactive decay, it emits alpha particles and gamma rays.

Plutonium-238 Facility at INL—A new facility proposed to be constructed at Idaho National Laboratory. The new Plutonium-238 Facility would be used for target fabrication; post-irradiation processing; and some of the purification, pelletization, and encapsulation activities. Because special nuclear material would be handled in the facility, it would be located within the special security protected area at the Materials and Fuels Complex area at INL. This new facility would be multistory and constructed from reinforced concrete, precast concrete, structural steel, and sheet metal. Due to safeguards and security measures, a major portion or the entire facility would be bermed with earth and other fill.

plutonium-239—An isotope with a half-life of 24,110 years that is the primary radionuclide in weapons-grade plutonium. When plutonium-239 decays, it emits alpha particles.

population dose—See collective dose.

pounds per square inch—A measure of pressure; atmospheric pressure is about 14.7 pounds per square inch.

Prevention of Significant Deterioration—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 Section 51.166. Among other provisions, cumulative increases in sulfur dioxide, nitrogen dioxide, and PM_{10} levels 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 (e.g., 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 Section 51.166 for Class III areas, if any such areas should be so designated by EPA. Class III increments are less stringent than those for Class I or Class II areas. (See National Ambient Air Quality Standards.)

prime farmland—Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oil-seed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, without intolerable soil erosion, as determined by the Secretary of Agriculture (Farmland Protection Act of 1981, 7 CFR Part 7, paragraph 658).

probabilistic risk assessment—A comprehensive, logical, and structured methodology that accounts for population dynamics and human activity patterns at various levels of sophistication, considering time-space distributions and sensitive subpopulations. The probabilistic method results in a more complete characterization of the exposure information available, which is defined by probability distribution functions. This approach offers the possibility of an associated quantitative measure of the uncertainty around the value of interest.

process—Any method or technique designed to change the physical or chemical character of the product.

protactinium—An element that is produced by the radioactive decay of neptunium-237. The pure metal has a bright metallic luster. The protactinium-233 isotope has a half-life of 27 days and emits beta particles and gamma rays during radioactive decay.

proton—An elementary nuclear particle with a positive charge equal in magnitude to the negative charge of the electron; it is a constituent of all atomic nuclei, and the atomic number of an element indicates the number of protons in the nucleus of each atom of that element.

Quaternary—The second geologic time period of the Cenozoic era, dating from about 1.6 million years ago to the present. It contains two epochs: the Pleistocene and the Holocene. It is characterized by the first appearance of human beings on Earth.

rad—See radiation absorbed dose.

radiation (ionizing)—See ionizing radiation.

radiation absorbed dose (rad)—The basic unit of absorbed dose equal to the absorption of 0.01 joules per kilogram (100 ergs per gram) of absorbing material.

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.

Radiochemical Engineering Development Center (REDC)—A chemical extraction facility at the Oak Ridge National Laboratory used for processing highly radioactive materials in hot cells using remote-handling equipment. The REDC complex consists of Buildings 7920 and 7930.

radioisotope or radionuclide—An unstable isotope that undergoes spontaneous transformation, emitting radiation. (See isotope.)

radioisotope heater unit (RHU)—A passive heating device that uses the radioactive decay of plutonium-238 dioxide or other suitable radioisotopes to produce heat; typically used to control and maintain the thermal environmental of temperature-sensitive components.

radioisotope power system (RPS)—Any one of a number of technologies used in spacecraft and in national security technologies that produces heat and/or electricity from the radioactive decay of suitable radioactive substances such as plutonium-238. They are typically used in applications where energy sources such as solar power are undesirable or impractical. They include current and future-generation radioisotope heater units (RHUs) and radioisotope thermoelectric generators (RTGs). Future-generation technology may include use of the Stirling Cycle for producing electricity from radioisotope decay heat and multiple-mission RTGs.

radioisotope thermoelectric generator (RTG)—An electrical generator that derives its electric power from heat produced by the decay of radioactive plutonium-238 dioxide or other suitable isotopes. The heat generated is directly converted into electricity, in a passive process, by an array of thermocouples to power spacecraft components.

Radiological Welding Laboratory—A proposed addition to existing Building 772 within the Materials and Fuels Complex at Idaho National Laboratory. Nonradioactive welding technique and process research and development would be conducted in this addition.

radon—A gaseous, radioactive element with the atomic number 86, resulting from the radioactive decay of radium. Radon occurs naturally in the environment and can collect in unventilated enclosed areas, such as basements. Large concentrations of radon can cause lung cancer in humans.

RADTRAN—A computer code combining user-determined meteorological, demographic, transportation, packaging, and material factors with health physics data to calculate the expected radiological consequences and accident risk of transporting radioactive material.

reactor coolant system—The system used to transfer energy from the reactor core either directly or indirectly to the heat rejection system.

reactor core—The fuel assemblies, fuel and target rods, control rods, blanket assemblies, and coolant/moderator. Fissioning takes place in this part of the reactor.

reactor facility—Unless it is modified by words such as containment, vessel, or core, the term “reactor facility” includes the housing, equipment, and associated areas devoted to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies and research, test, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also considered reactors.

Reactor Technology Complex (RTC)—Formerly known as the Test Reactor Area, the primary mission at RTC is operation of the Advanced Test Reactor, the world’s premier test reactor, which is used to study the effects of radiation on materials. This reactor also produces rare and valuable medical and industrial isotopes.

Record of Decision (ROD)—A document prepared in accordance with the requirements of 40 CFR 1505.2 and 10 CFR 1021.315 that provides a concise public record of the U.S. Department of Energy’s (DOE) decision on a Proposed Action for which an environmental impact statement was prepared. A ROD identifies the alternatives considered in reaching the decision; the environmentally preferable alternative; factors balanced by DOE in making the decision; and whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, the reason why they were not.

reference concentration—An estimate of a toxic chemical daily inhalation of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Those effects are both to the respiratory system (portal-of-entry) and the peripheral to the respiratory system (extra-respiratory effects). It is expressed in units of micrograms per cubic meter.

region of influence (ROI)—A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

regional economic area—A geographic area consisting of an economic node and the surrounding counties that are economically related, and include the places of work and residences of the labor force. Each regional economic area is defined by the U.S. Bureau of Economic Analysis.

rem (roentgen equivalent man)—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. Derived from "roentgen equivalent man," referring 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. (See absorbed dose and dose equivalent.)

remediation—The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

remote-handled waste—In general, refers to radioactive waste that must be handled at a distance to protect workers from unnecessary exposure (e.g., waste with a dose rate of 200 millirem per hour or more at the surface of the waste package). (See contact-handled waste.)

resin—See ion exchange resin.

Resource Conservation and Recovery Act, as Amended—A law that gives the U.S. Environmental Protection Agency the authority to control hazardous waste from "cradle to grave" (i.e., from the point of generation to the point of ultimate disposal), including its minimization, generation, transportation, treatment, storage, and disposal. The Resource Conservation and Recovery Act also sets forth a framework for the management of nonhazardous solid wastes. (See hazardous waste.)

riparian—Of, on, or relating to the banks of a natural course of water.

risk—The probability of a detrimental effect of 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 and/or the environment by the presence or potential presence and/or use of specific chemical or radiological materials.

roentgen—A unit of exposure to ionizing x- or gamma radiation equal to or producing one electrostatic unit of charge per cubic centimeter of air.

runoff—The portion of rainfall, melted snow, or irrigation water that flows across the ground surface, and eventually enters streams.

Safe Drinking Water Act—This Act protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

safe, secure trailer—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—An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized access, possession, use, or sabotage of nuclear materials.

Safety Analysis Report—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 are required for U.S. Department of Energy nuclear facilities and as a part of applications for U.S. Nuclear Regulatory Commission licenses. The U.S. Nuclear Regulatory Commission 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.)

sand—Loose grains of rock or mineral sediment formed by weathering that range in size from 0.0625 to 2.0 millimeters (0.0025 to 0.08 inches) in diameter, and often consists of quartz particles.

sanitary waste—Wastes generated by normal housekeeping activities, liquid or solid (includes sludge), that are not hazardous or radioactive.

Savannah River Site (SRS)—A U.S. Department of Energy (DOE) industrial complex located in southwestern South Carolina about 20 miles southeast of Augusta, Georgia, that is managed and operated by a private consortium under contract to DOE.

scope—In a document prepared pursuant to the National Environmental Policy Act of 1969, the range of actions, alternatives, and impacts to be considered.

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 (EIS) 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 EIS. 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.

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 contractor facilities, property, and equipment.

sediment—Soil, sand, and minerals washed from land into water that deposit on the bottom of a water body.

seismic—Pertaining to any Earth vibration, especially an earthquake.

seismicity—The frequency and distribution of earthquakes.

severe accident—An accident with a frequency rate of less than 10^{-6} per year that would have more severe consequences than a design-basis accident, in terms of damage to the facility, offsite consequences, or both. Also called "beyond-design-basis reactor accidents" in this *Consolidation EIS*.

sewage—The total organic waste and wastewater generated by an industrial establishment or a community.

shielding—With regard to radiation, any material of obstruction (bulkheads, walls, or other construction) that absorbs radiation to protect personnel or equipment.

shutdown—For a U.S. Department of Energy (DOE) reactor, the condition in which a reactor has ceased operation, and DOE has officially declared that it does not intend to operate it further.

sievert—The SI (International System of Units) unit of radiation dose equivalent. The dose equivalent in sieverts equals the absorbed dose in grays multiplied by the appropriate quality factor (1 sievert is equal to 100 rem). (See gray.)

silica gel—An amorphous, highly adsorbent form of silicon dioxide.

silt—A sedimentary material consisting of fine mineral particles, intermediate in size between sand and clay. In general, soils categorized as silt show greater rates of erosion than soils categorized as sand.

sinter—A process in which particles are bonded together by pressure and heating below the melting point.

soils—All unconsolidated materials above bedrock. Natural earthy materials on the Earth's surface, in places modified or even made by human activity, containing living matter, and supporting or capable of supporting plants out of doors.

solvent extraction—A process that uses two solvents that do not mix (usually water and an organic solvent) to separate chemicals. An organic soluble chemical is usually added to the organic solvent to selectively extract a chemical from the aqueous solution into the organic solution when they are mixed. After settling, the two solvents are separated from one another, and the desired chemical is removed from the organic solvent.

source term—The amount of a specific pollutant (e.g., chemical, radionuclide) emitted or discharged to a particular environmental medium (e.g., air, water) from a source or group of sources. It is usually expressed as a rate (i.e., amount per unit time).

Space and Security Power Systems Facility—A facility, commissioned in October 2004 and located at the Materials and Fuels Complex that assembles and tests radioisotope power systems. Also called the Assembly and Testing Facility.

special nuclear material (SNM)—As defined in Section 11 of the Atomic Energy Act of 1954, SNM means: (1) plutonium, uranium enriched in the isotope 233 or 235, or any other material that the U.S. Nuclear Regulatory Commission determines to be SNM; or (2) any material artificially enriched by any of the above.

spectral (response) acceleration—An approximate measure of the acceleration (as a percentage of the acceleration due to Earth's gravity) experienced by a building, as modeled by a particle on a massless vertical rod having the same natural period of vibration as the building.

sulfur oxides—Common air pollutants (primarily sulfur dioxide), a heavy, pungent, colorless gas (formed in the combustion of fossil fuels, considered a major air pollutant) and sulfur trioxide. Sulfur dioxide is involved in the formation of acid rain. It can also irritate the upper respiratory tract and cause lung damage.

supernatant—The liquid that stands over a precipitated material.

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.

target—A tube, rod, or other form containing material that, on being irradiated in a nuclear reactor or an accelerator, would produce a desired end product.

tectonic—Of or relating to motion in the Earth's crust and occurring on geologic faults.

Tertiary—The first geologic time period of the Cenozoic era (after the Mesozoic era and before the Quaternary period), spanning between about 66 million and 1.6 million years ago. During this period, mammals became the dominant life form on Earth.

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 which 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 424). (See endangered species.)

The lists of threatened species can be found at 50 CFR 17.11 (wildlife), 17.12 (plants), and 227.4 (marine organisms).

total effective dose equivalent—The sum of the effective dose equivalent from external exposures and the committed effective dose equivalent from internal exposures.

Toxic Substances Control Act of 1976—This Act authorizes the U.S. Environmental Protection Agency (EPA) to secure information on all new and existing chemical substances and to control any substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the EPA before they are manufactured for commercial purposes.

transients—Events that could cause a change or disruption of plant thermal, hydraulic, or neutronic behavior.

transuranic—Refers to any element whose atomic number is higher than that of uranium (atomic number 92), including neptunium, plutonium, americium, and curium. All transuranic elements are produced artificially and are radioactive.

transuranic (TRU) waste—Radioactive waste that is not classified as high-level radioactive waste and that contains more than 100 nanocuries (3700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years.

Type B packaging—A regulatory category of packaging for transportation of radioactive material. The U.S. Department of Transportation and U.S. Nuclear Regulatory Commission require Type B packaging for shipping highly radioactive material. Type B packages must be designed and demonstrated to retain their containment and shielding integrity under severe accident conditions, as well as under the normal conditions of transport. The current U.S. Nuclear Regulatory Commission testing criteria for Type B package designs (10 CFR Part 71) are intended to simulate severe accident conditions, including impact, puncture, fire, and immersion in water. The most widely recognized Type B packages are the massive casks used for transporting spent nuclear fuel. Large-capacity cranes and mechanical lifting equipment are usually needed to handle Type B packages.

Type B shipping cask—A U.S. Nuclear Regulatory Commission-certified cask with a protective covering that contains and shields radioactive materials, dissipates heat, prevents damage to the contents, and prevents criticality during normal shipment and accident conditions. It is used for transport of highly radioactive materials and is tested under severe, hypothetical accident conditions that demonstrate resistance to impact, puncture, fire, and submersion in water.

unit cancer risk—The likelihood that the substance is a human carcinogen and quantitatively gives an estimate of risk from oral exposure or from inhalation exposure. This estimate can be in terms of either risk per microgram per liter of drinking water or risk per microgram per cubic meter of air breathed.

uranium—A radioactive, metallic element with the atomic number 92; one of the heaviest naturally occurring elements. 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. (See natural uranium, enriched uranium, highly enriched uranium, and depleted uranium.)

viewshed—The extent of an area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

visual resource management class—Any of the classifications of visual resources established through application of the Visual Resources Management process of the Bureau of Land Management. 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; Class IV, areas in which development activities may dominate the view and may be the major focus in the landscape.

volatile organic compounds—A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol. With regard to air pollution, any organic compound that participates in atmospheric photochemical reaction, except for those designated by the U.S. Environmental Protection Agency Administrator as having negligible photochemical reactivity.

waste acceptance criteria—The requirements specifying the characteristics of waste and waste packaging acceptable to a disposal facility, and the documents and processes the generator needs to certify that the waste meets applicable requirements.

waste classification—Wastes are classified according to DOE Order 435.1, *Radioactive Waste Management*, and include high-level, transuranic, and low-level wastes.

Waste Isolation Pilot Plant (WIPP)—A U.S. Department of Energy facility designed and authorized to permanently dispose of defense-related transuranic waste in a mined underground facility in deep geologic salt beds. It is located in southeastern New Mexico, 42 kilometers (26 miles) east of the city of Carlsbad.

waste management—The planning, coordination, and direction of those functions related to generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities.

waste minimization and pollution prevention—An action that economically avoids or reduces the generation of waste and pollution by source reduction, reducing the toxicity of hazardous waste and pollution, improving energy use, or recycling. These actions will be consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

water table—The boundary between the unsaturated zone and the deeper, saturated zone. The upper surface of an unconfined aquifer.

weighting factor—Generally, a method of attaching different importance values to different items or characteristics. In the context of radiation protection, the proportion of the risk of effects resulting from irradiation of a particular organ or tissue to the total risk of effects when the whole body is irradiated uniformly (e.g., the organ dose weighting factor for the lung is 0.12, compared to 1.0 for the whole body). Weighting factors are used for calculating the effective dose equivalent.

Zero Power Physics Reactor (ZPPR)—This facility is a low-power test reactor used to test various reactor design features with different materials and configurations. It is located within the Materials and Fuels Complex at Idaho National Laboratory and is presently maintained in nonoperational standby. Portions of the facility are presently being utilized for experiments, fuel surveillance, and spent fuel treatment program product storage.

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CHAPTER 9
LIST OF PREPARERS

9. LIST OF PREPARERS

TIM FRAZIER, U.S. DEPARTMENT OF ENERGY
EIS RESPONSIBILITIES: NEPA DOCUMENT MANAGER

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EIS RESPONSIBILITIES: CHAPTER 3 AFFECTED ENVIRONMENT LEAD, LAND USE, AND VISUAL RESOURCES

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Experience/Technical Specialty:
Eighteen years. NEPA compliance, regulatory review, public participation support, and land use planning.

ROY KARIMI, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: TRANSPORTATION AND RISK ASSESSMENT, APPENDIX D LEAD

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.Sc., Chemical Engineering, Abadan Institute of Technology

Experience/Technical Specialty:
Twenty-eight 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 assessments.

JASPER G. MALTESE, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: RADIOLOGICAL IMPACTS: ACCIDENT ANALYSIS

Education: M.S., Operations Research, George Washington University
B.S., Mathematics, Fairleigh Dickinson University

Experience/Technical Specialty:
Forty-one years. NEPA assessments, accident analyses, safety analysis report reviews, facility safety audits, and system reliability analyses.

MARGARET C. MCGOVERN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PUBLIC PARTICIPATING FOR SCOPING

Education: M.S., Interdisciplinary Studies (Environmental Science), University of Idaho
B.S., Microbiology, San Diego State University

Experience/Technical Specialty:
Fifteen years. Environmental specialist.

DIANE NEMETH, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CULTURAL RESOURCES

Education: M.S., Urban Planning, Columbia University
B.A., Urban Planning, Miami University

Experience/Technical Specialty:
Thirty-two years. Urban planning.

DOUGLAS A. OUTLAW, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: TECHNICAL EXPERT

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-one years. Nuclear safety.

ARIS PAPADOPOULOS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CHAPTER 2 LEAD, PROJECT DESCRIPTION, ALTERNATIVES, PUBLIC HEALTH AND SAFETY, NORMAL OPERATIONS

Education: M.S., Nuclear Engineering, University of Utah
B.S., Physics, Hamline University

Experience/Technical Specialty:

Thirty-three years. NEPA compliance, safety analysis assessments, regulatory reviews, nuclear facilities safety, radioactive waste management, accident and normal operations, and analysis support.

JAMES PARHAM, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: MEETING FACILITATOR

Education: M.P.A., Public Administration, American University
B.S., Natural Resources/Communications, Ball State

Experience/Technical Specialty:

Twenty-eight years. Meeting facilitation.

WILDA E. PORTNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: TECHNICAL EDITING

Education: A.A. Business Administration, Frederick Community College

Experience/Technical Specialty:

Eighteen years. Technical editing, public outreach.

JEFFREY J. RIKHOFF, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: DEPUTY PROJECT MANAGER, EIS DOCUMENT MANAGER, SUPERVISOR OF NONRADIOLOGICAL RESOURCE AREAS

Education: M.R.P., Regional/Environmental Planning, University of Pennsylvania
M.S., International Economic Development and Appropriate Technology, University of Pennsylvania
B.A., English, DePauw University

Experience/Technical Specialty:

Eighteen years. NEPA compliance, regulatory compliance and permitting, socioeconomics, environmental justice, comprehensive land-use and development planning, and cultural resources.

JAMES R. SCHINNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ECOLOGICAL RESOURCES

Education: Ph.D., Wildlife Management, Michigan State University
M.S., Zoology, University of Cincinnati
B.S., Zoology, University of Cincinnati

Experience/Technical Specialty:

Thirty-one years. Ecological field assessments, NEPA documentation, and regulatory reviews.

EDWARD Y. SHUM, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ENGINEERING SUPPORT, RADIOACTIVE WASTE

Education: Ph.D., Environmental and Nuclear Chemistry, Oregon State University
M.S., Nuclear Chemistry, Oregon state University
B.S., Chemistry, University of California, Berkeley

Experience/Technical Specialty:

Thirty-two years. Licensing, nuclear facilities, spent nuclear fuel, senior safety and environmental project manager, health physics, dose assessments, and decommissioning and emergency planning.

ALAN TOBLIN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: RADIOLOGICAL IMPACTS: ACCIDENT ANALYSIS MODELING

Education: M.S., Chemical Engineering, University of Maryland
B.E., Chemical Engineering, The Cooper Union

Experience/Technical Specialty:

Thirty-four years. Accident risk analysis.

TAMMY L. WAY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PUBLIC PARTICIPATION

Education: B.A., Political Science, Virginia Polytechnic Institute and State University

Experience/Technical Specialty:

Sixteen years. NEPA and public participation.

ROBERT H. WERTH, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: NOISE ANALYSIS, AIR QUALITY MODELING

Education: B.A., Physics, Gordon College

Experience/Technical Specialty:

Twenty-nine years. Acoustics and air quality analysis, regulatory reviews, and NEPA documentation.

CHAPTER 10
DISTRIBUTION LIST

10. DISTRIBUTION LIST

The U.S. Department of Energy (DOE) is providing copies of the *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)* (or Summary) to Federal, state, and local elected and appointed officials and agencies of government; American Indian representatives; Federal, state, and local environmental and public interest groups; and other organizations and individuals listed in this Chapter. Approximately 250 copies of the *Draft Consolidation EIS* and 650 copies of the Summary of the *Draft Consolidation EIS* were sent to interested parties. Copies will be provided to others upon request.

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Defense Nuclear Facilities Safety Board
U.S. Department of the Interior
U.S. Environmental Protection Agency
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1776 Science Center Drive
Idaho Falls, Idaho 83415

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University Avenue and Rayburn Street
Moscow, Idaho 83844

Idaho State University Library
741 South 7th Avenue
Moscow, Idaho 83844

Idaho Falls Public Library
457 Broadway
Idaho Falls, Idaho 83401

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434 2nd Street East
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1619 Central Avenue
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Santa Fe Main Library
145 Washington Avenue
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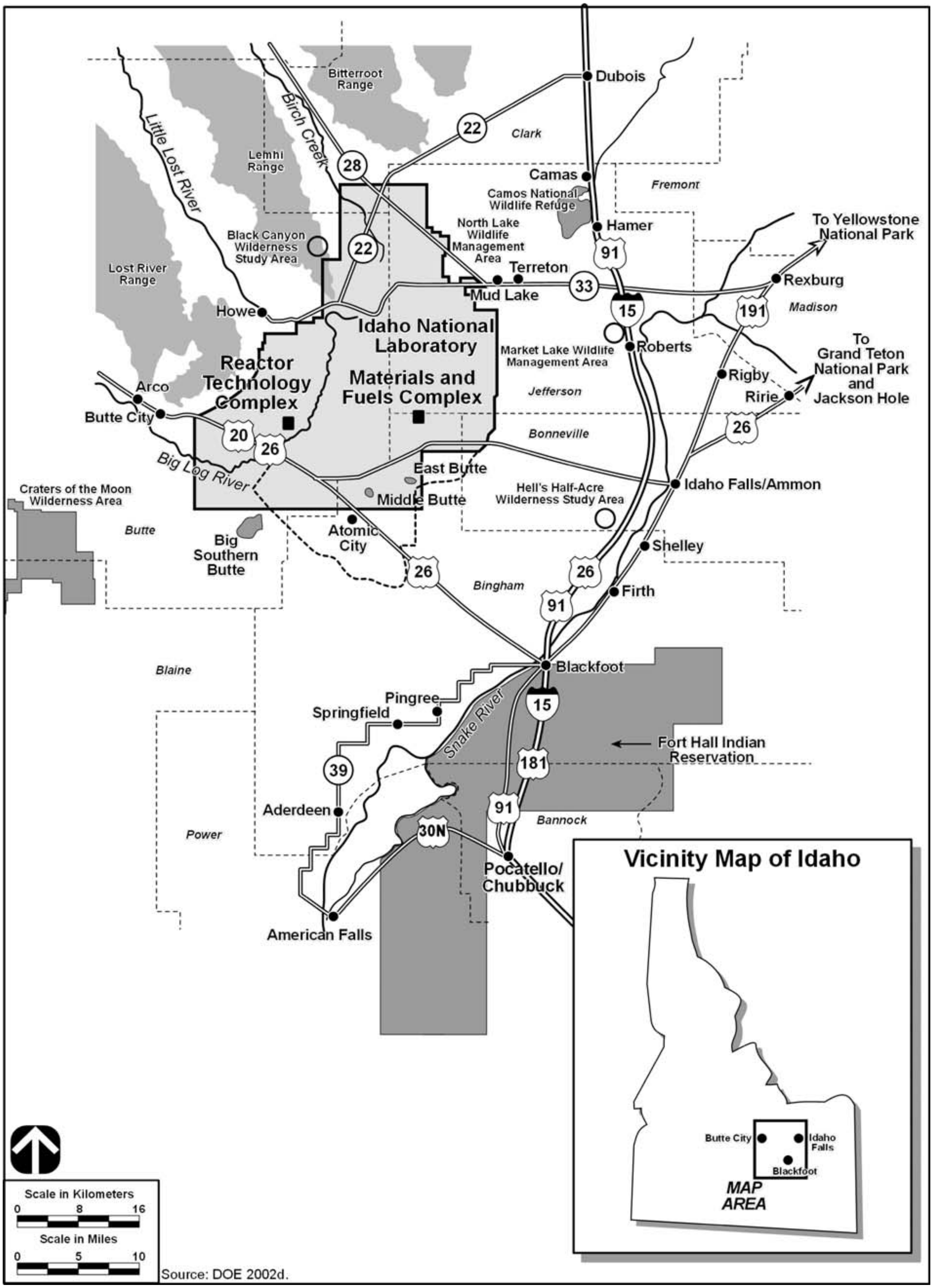


Source: DOE 2002d.

Figure 3–1 Idaho National Laboratory Vicinity

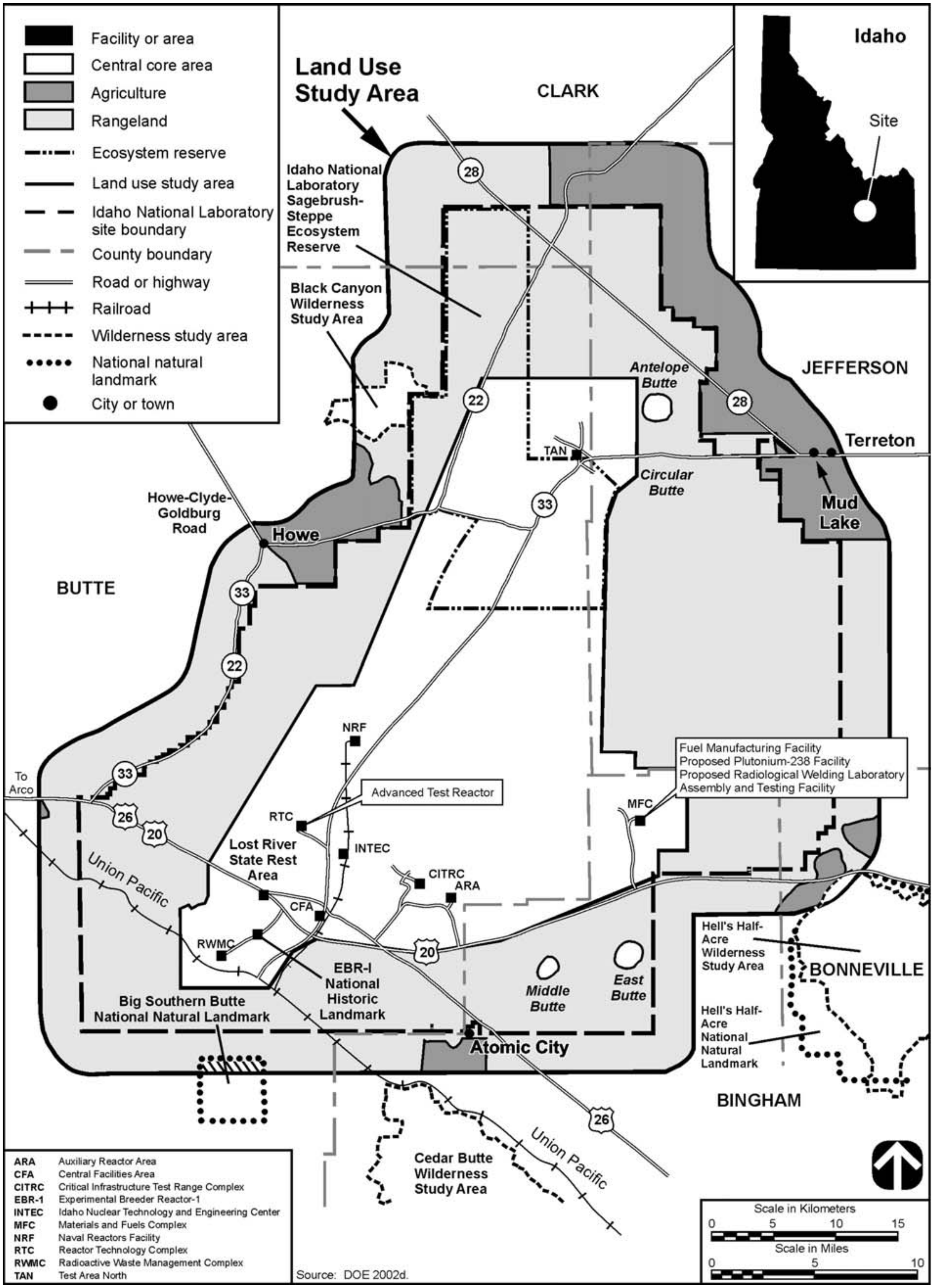
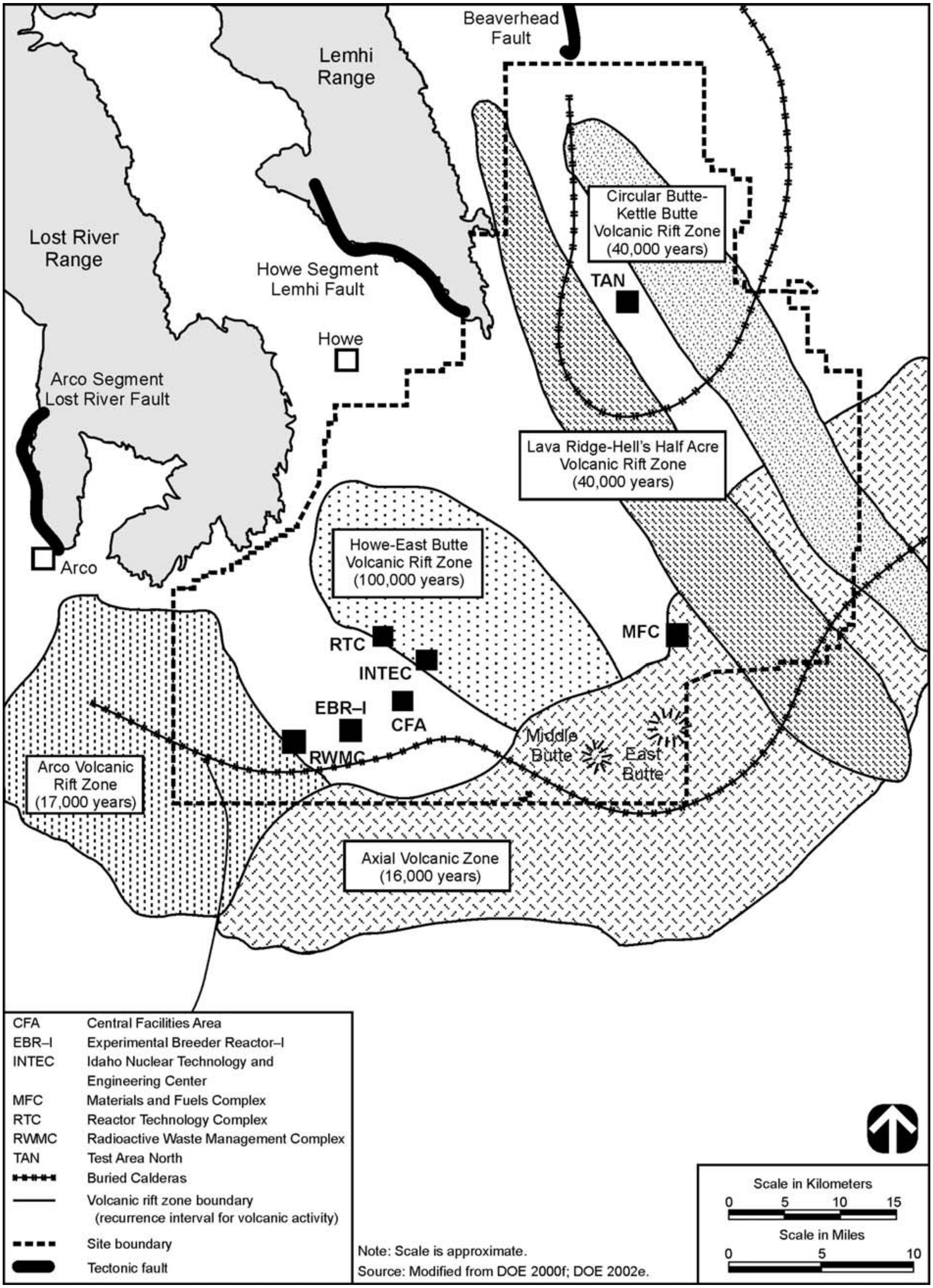


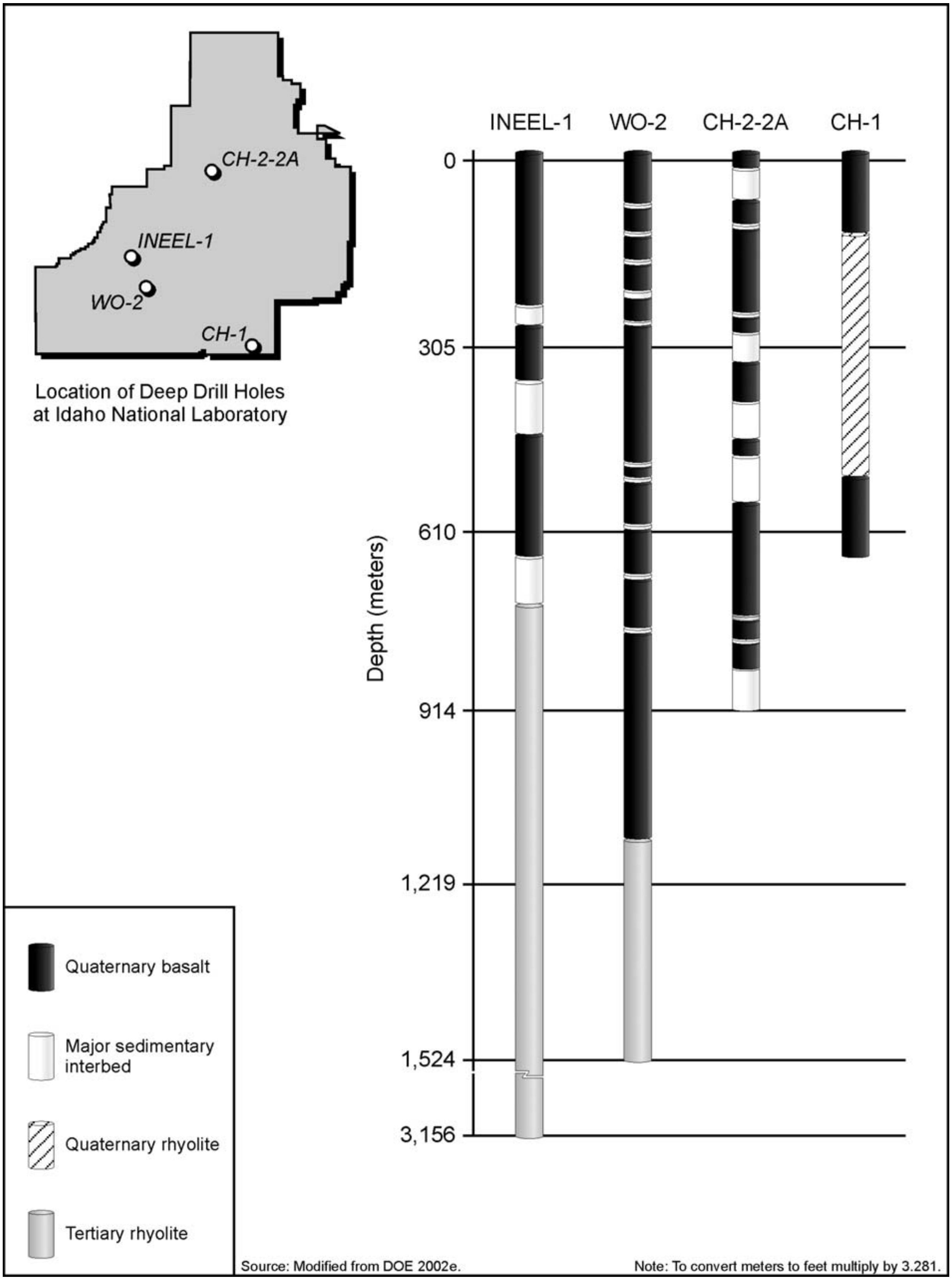
Figure 3–2 Land Use at Idaho National Laboratory and Vicinity



Note: Scale is approximate.

Source: Modified from DOE 2000f; DOE 2002e.

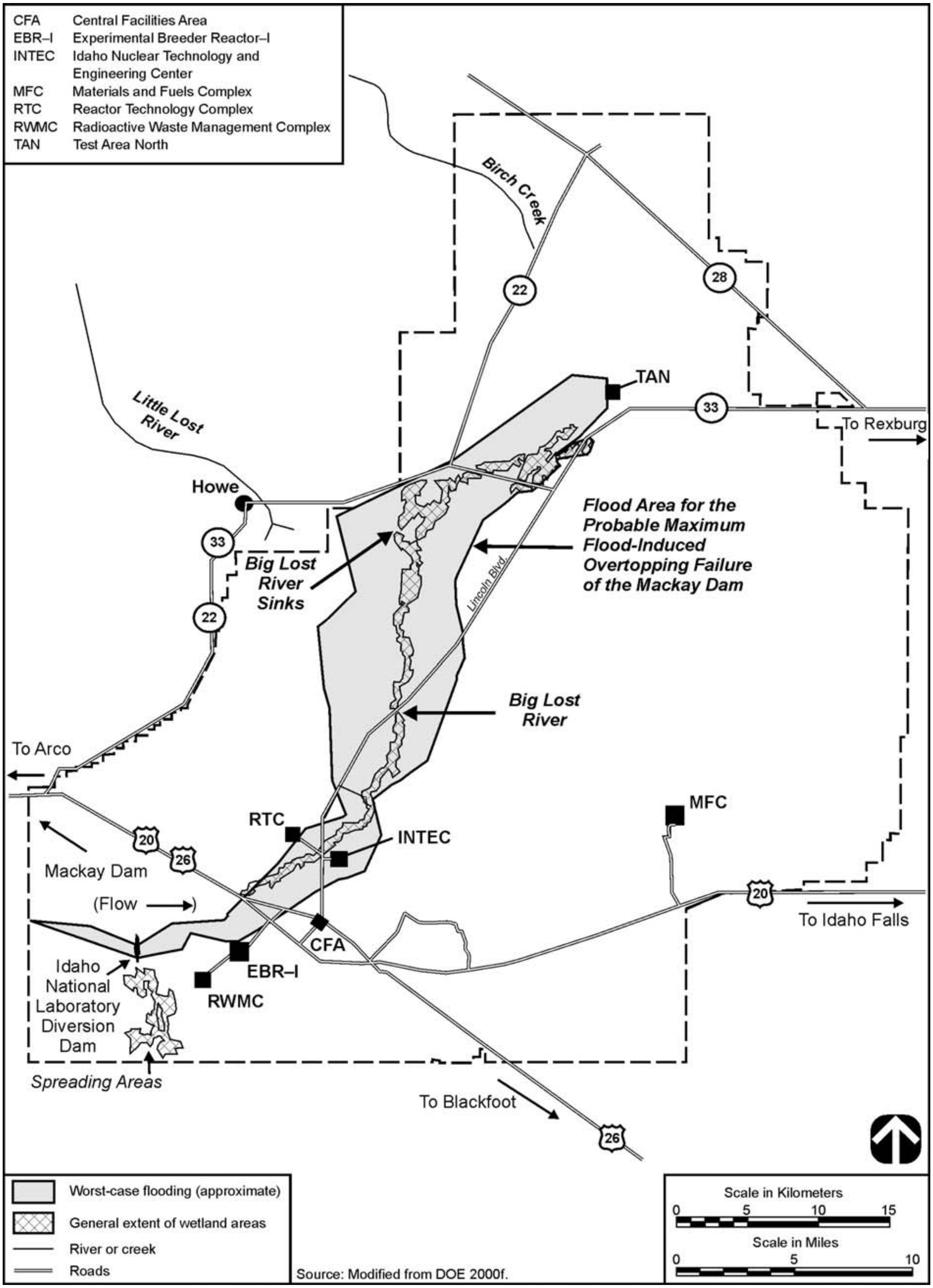
Figure 3–3 Major Geologic Features of Idaho National Laboratory



Source: Modified from DOE 2002e.

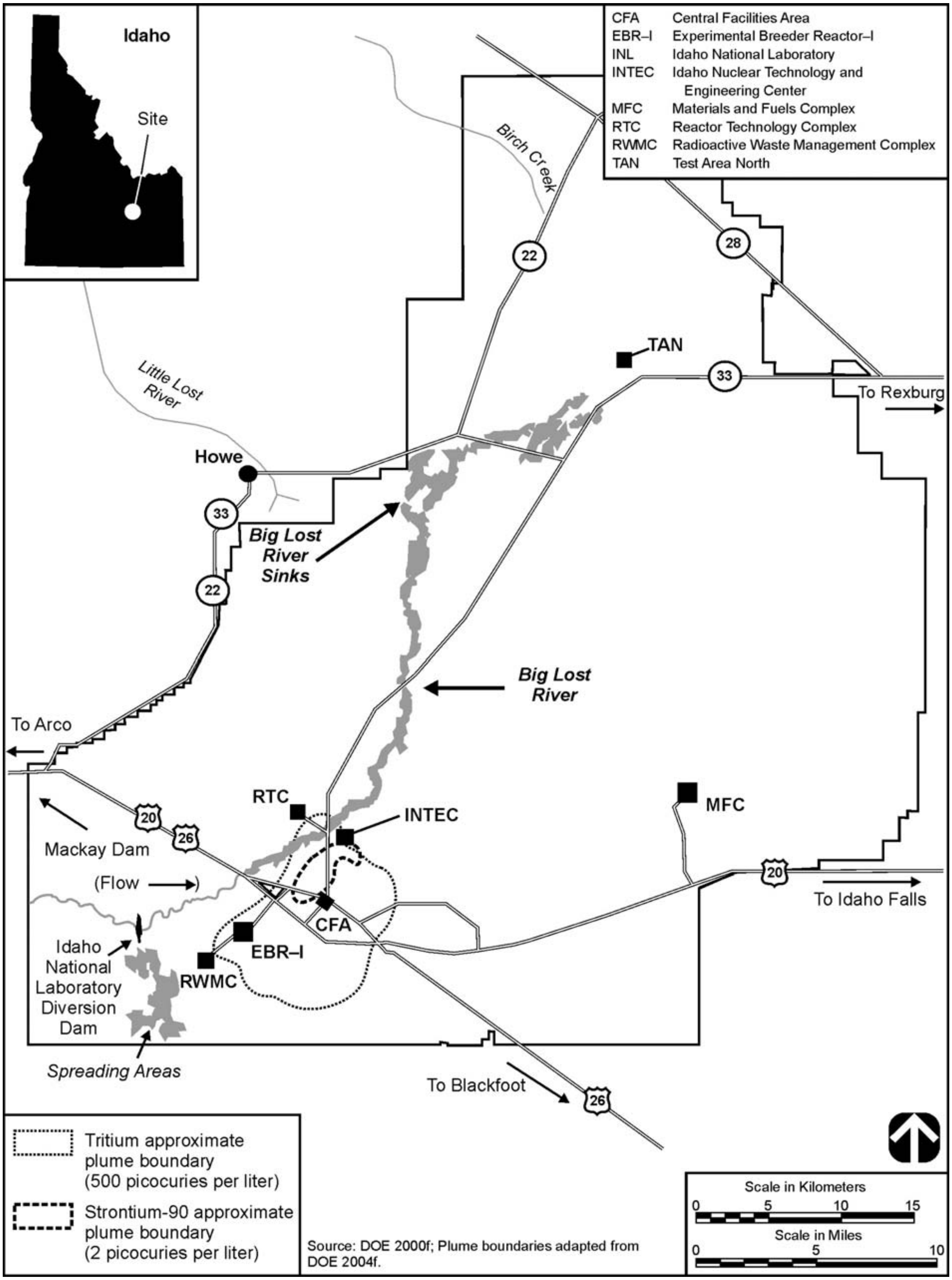
Note: To convert meters to feet multiply by 3.281.

Figure 3–4 Lithologic Logs of Deep Drill Holes on Idaho National Laboratory



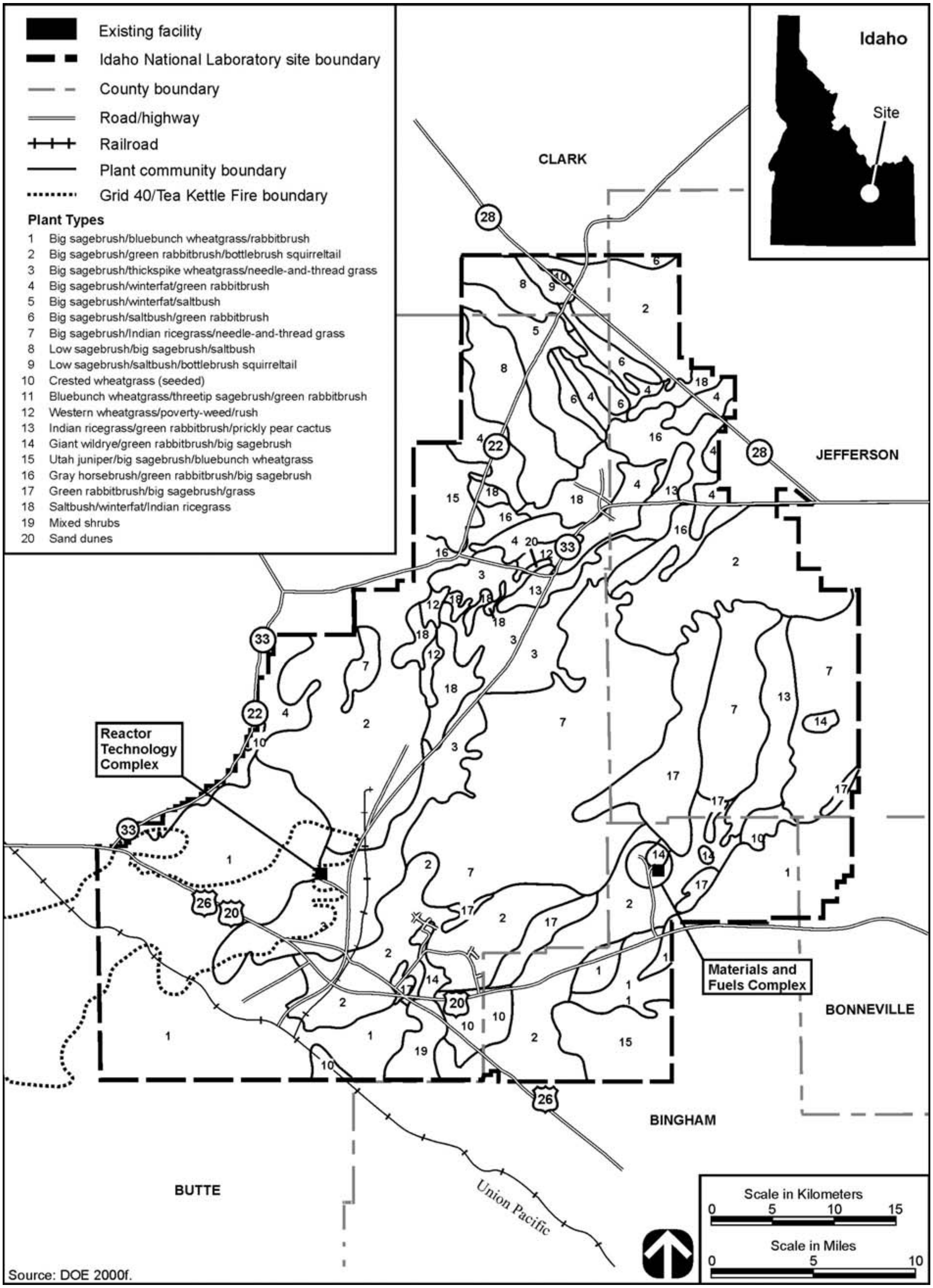
Source: Modified from DOE 2000f.

Figure 3–5 Surface Water Features at Idaho National Laboratory



Source: DOE 2000f; Plume boundaries adapted from DOE 2004f.

Figure 3–6 Extent of Tritium and Strontium-90 Plumes within the Snake River Plain Aquifer at the Idaho National Laboratory



Source: DOE 2000f.

Figure 3–7 Vegetation Association at Idaho National Laboratory

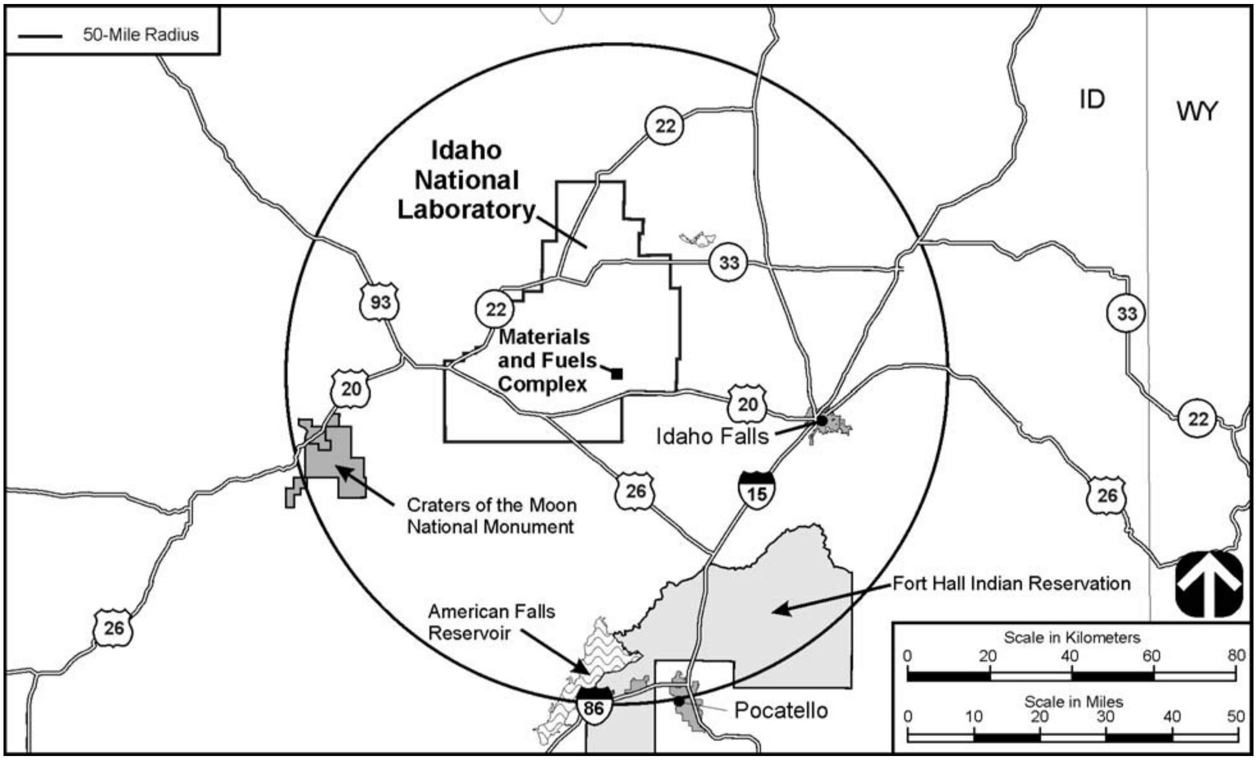


Figure 3–8 Location of the Materials and Fuels Complex and the Fort Hall Indian Reservation

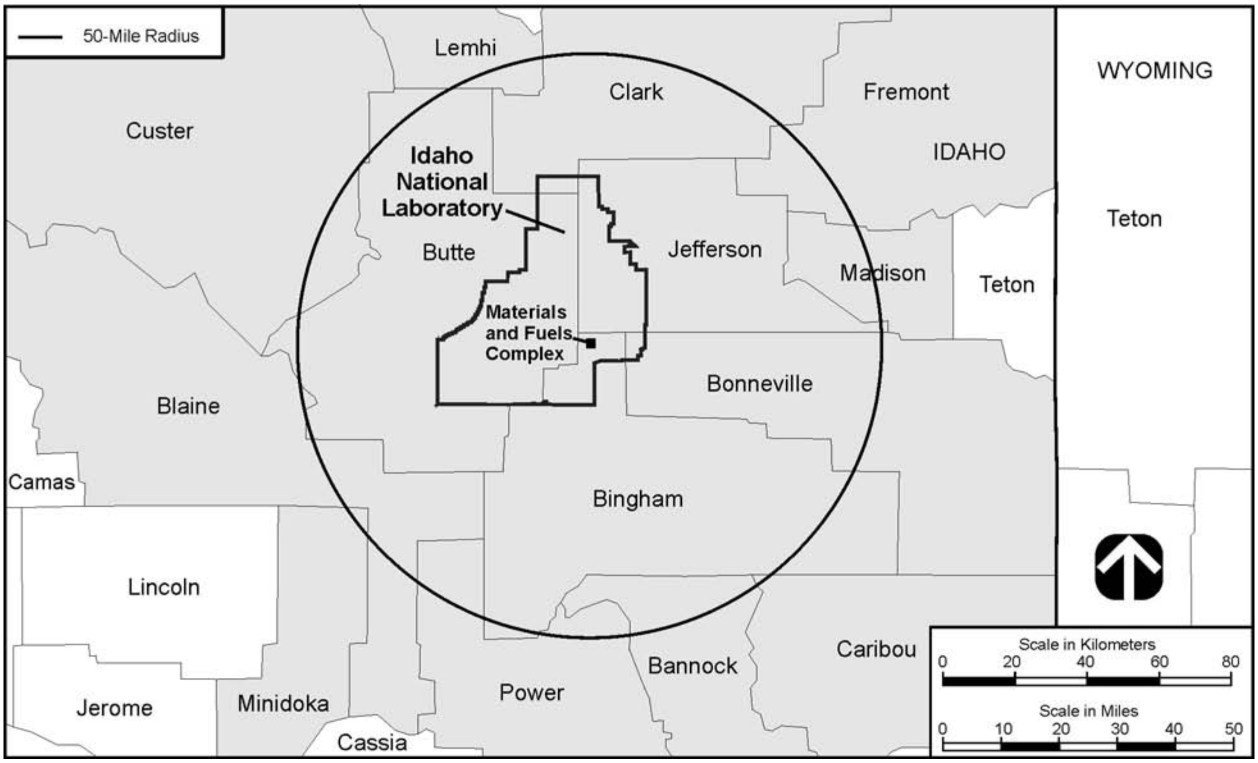


Figure 3–9 Potentially Affected Counties near the Materials and Fuels Complex

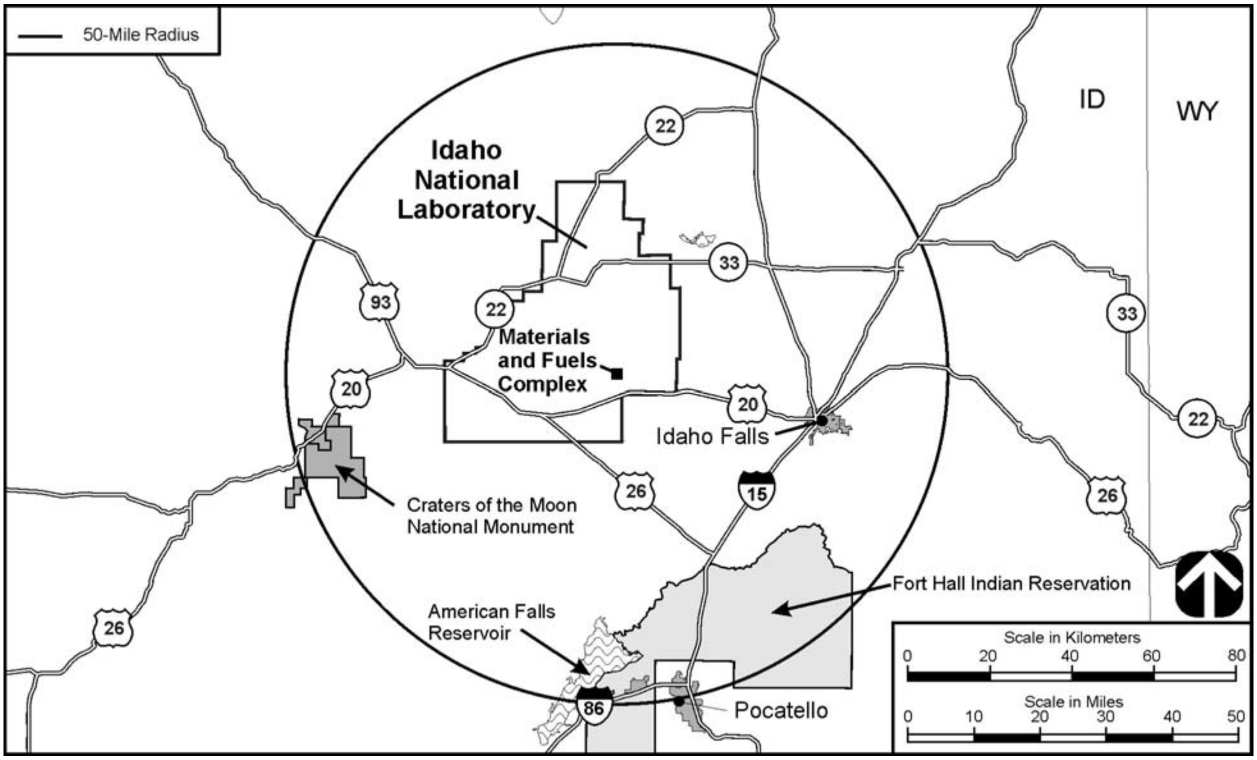


Figure 3–8 Location of the Materials and Fuels Complex and the Fort Hall Indian Reservation

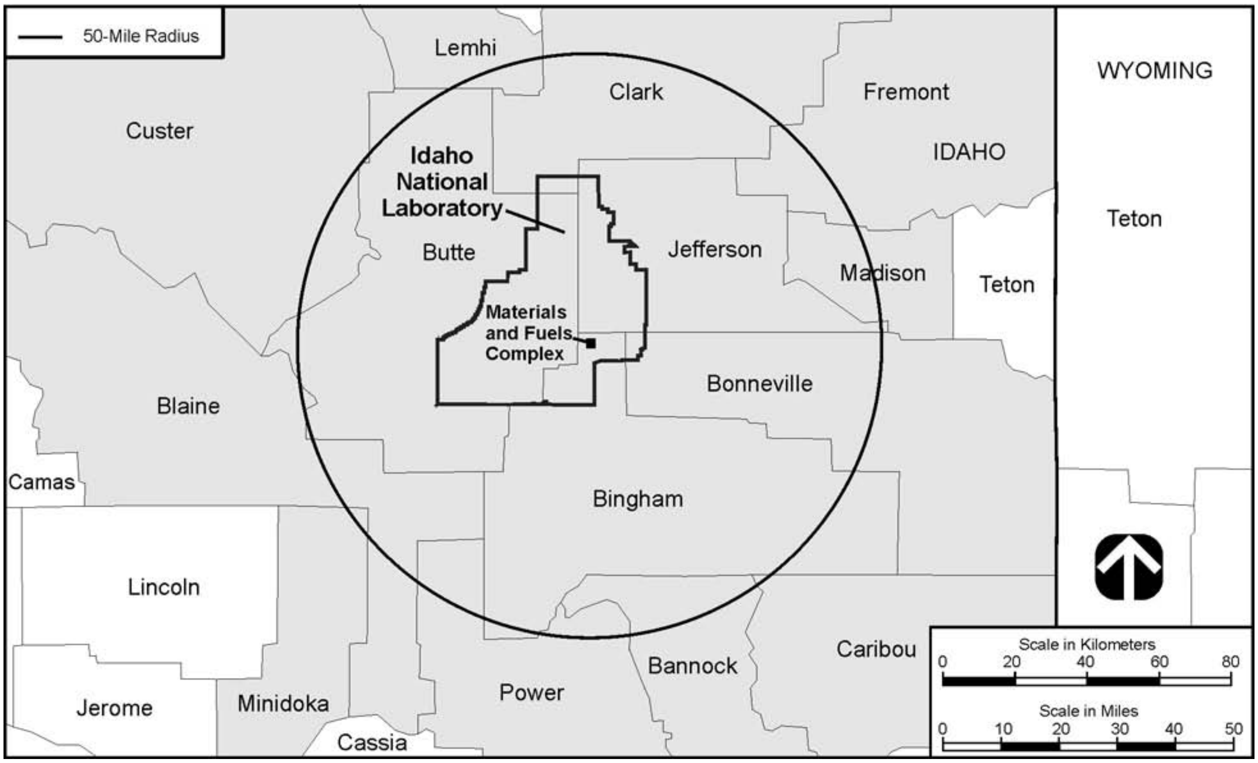
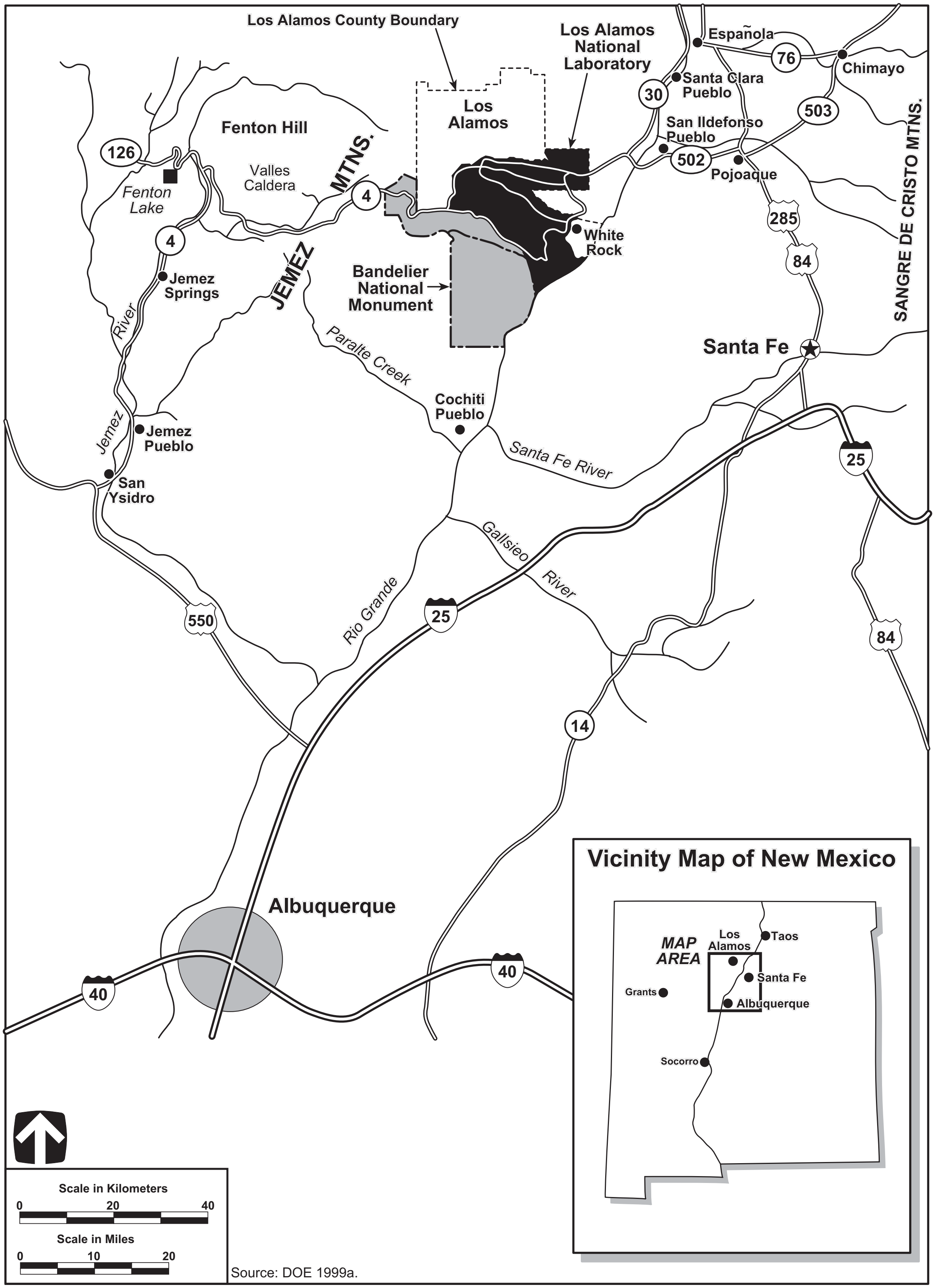
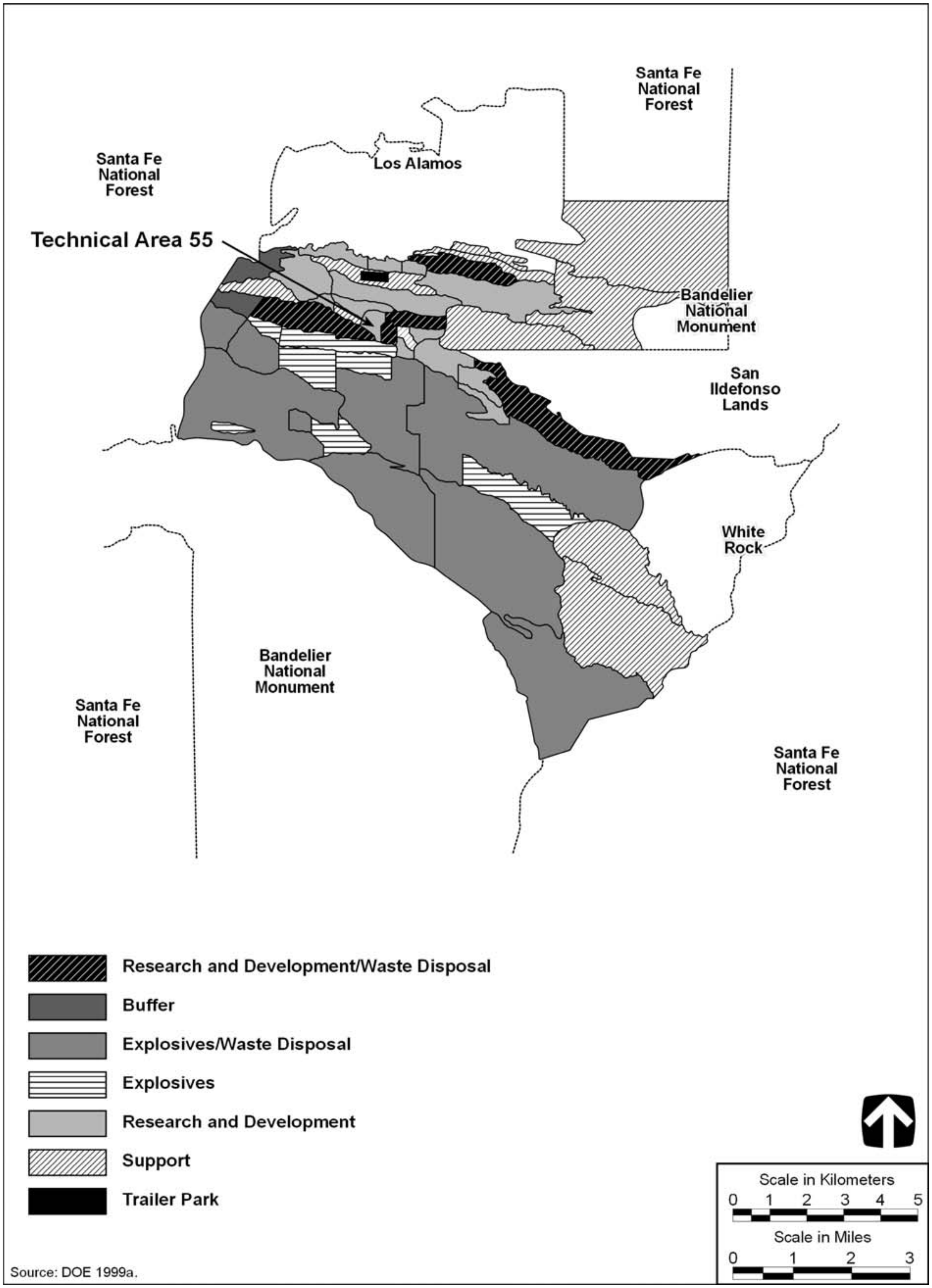


Figure 3–9 Potentially Affected Counties near the Materials and Fuels Complex



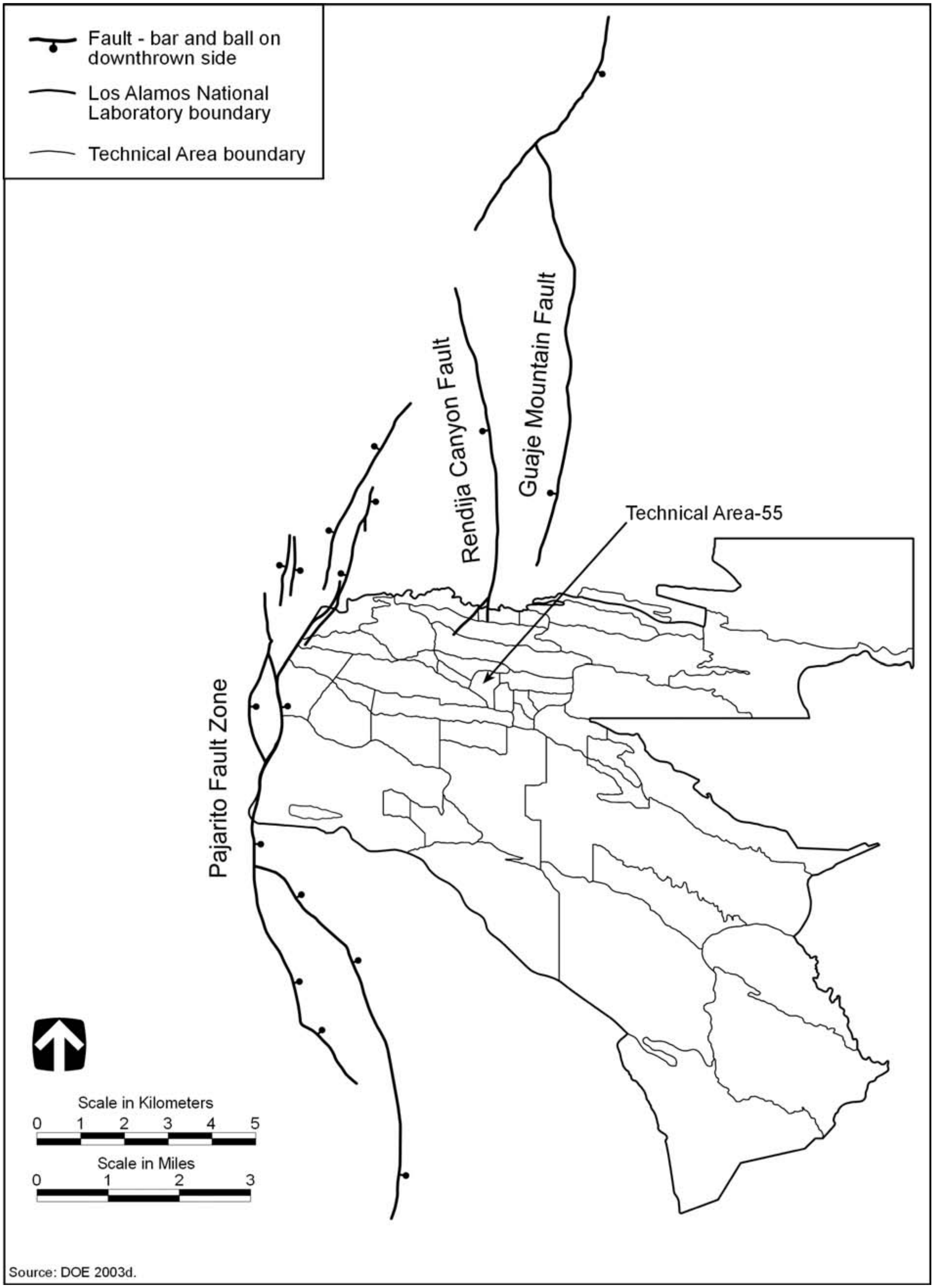
Source: DOE 1999a.

Figure 3–10 Los Alamos National Laboratory Vicinity



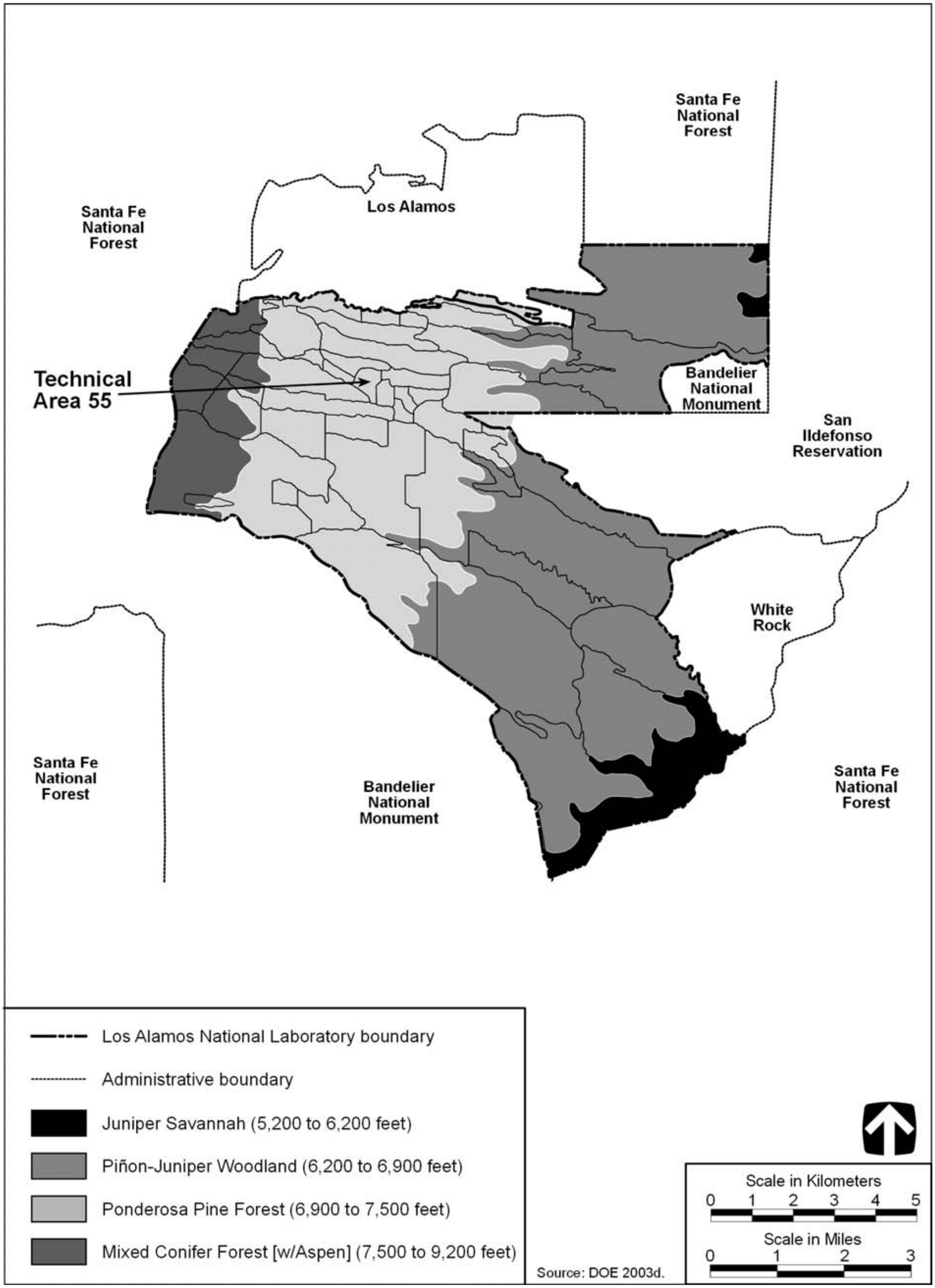
Source: DOE 1999a.

Figure 3–12 Land Use at Los Alamos National Laboratory



Source: DOE 2003d.

Figure 3–14 Major Faults at Los Alamos National Laboratory



Source: DOE 2003d.

Figure 3–16 Los Alamos National Laboratory Vegetation Zones

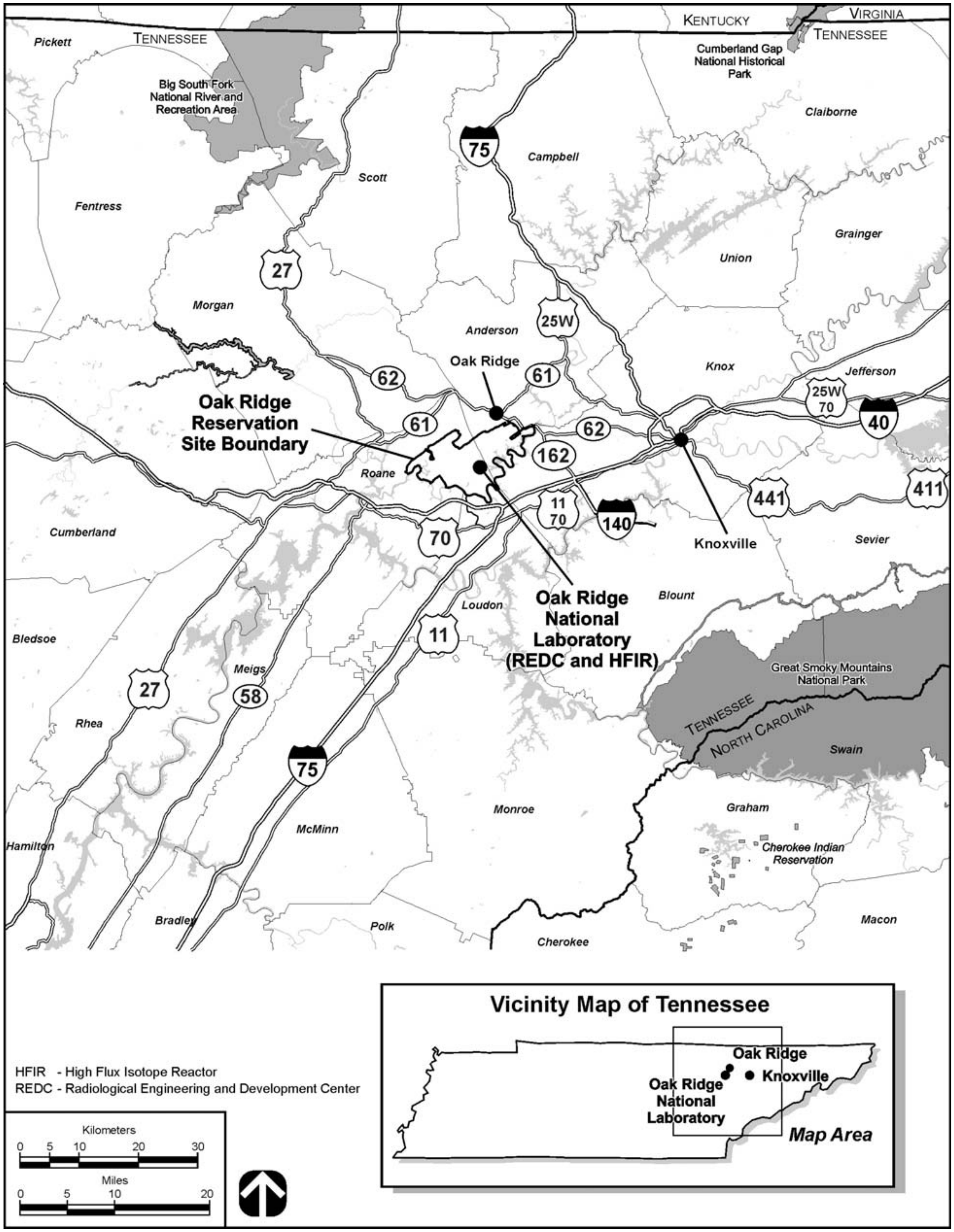
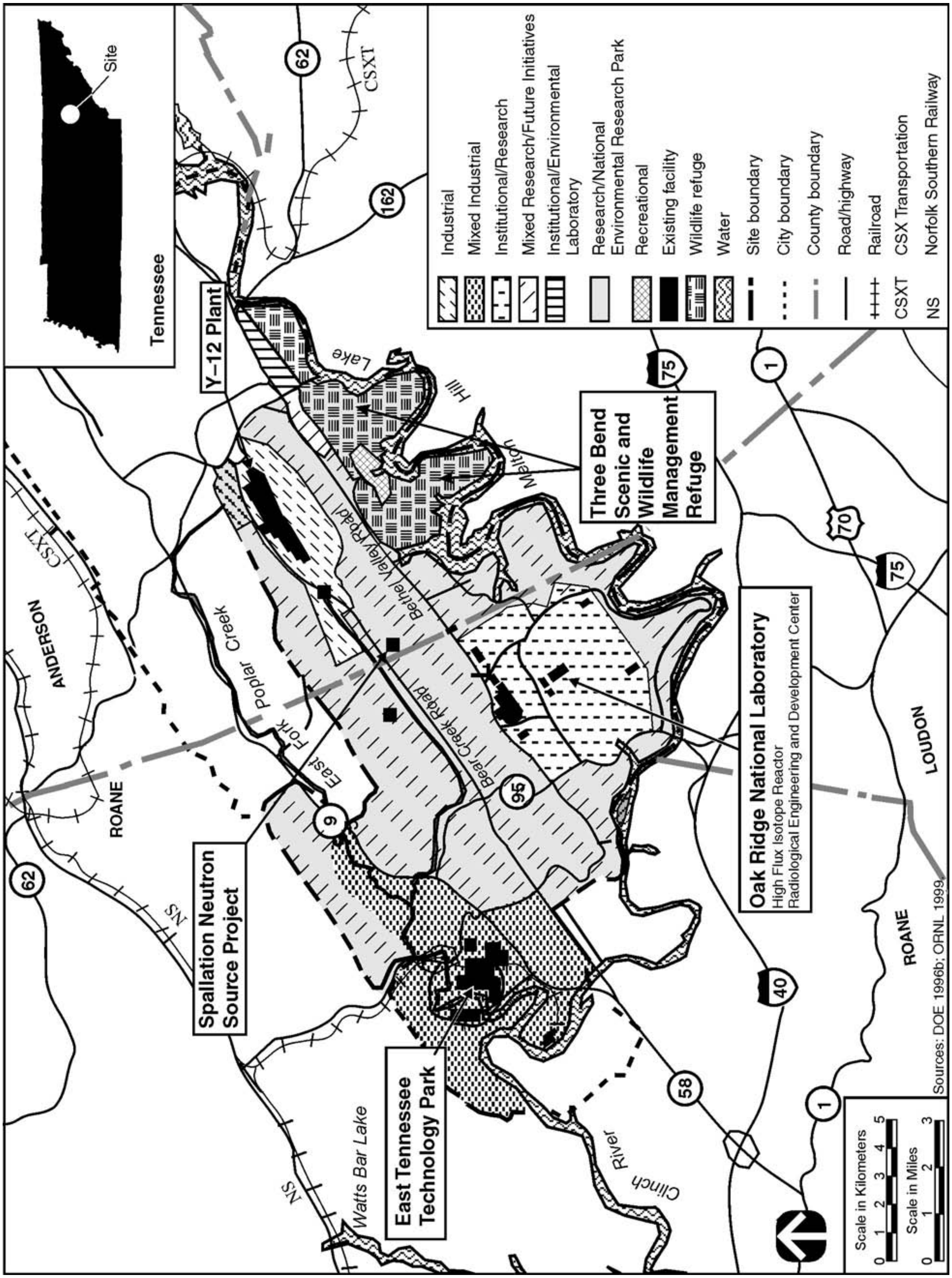
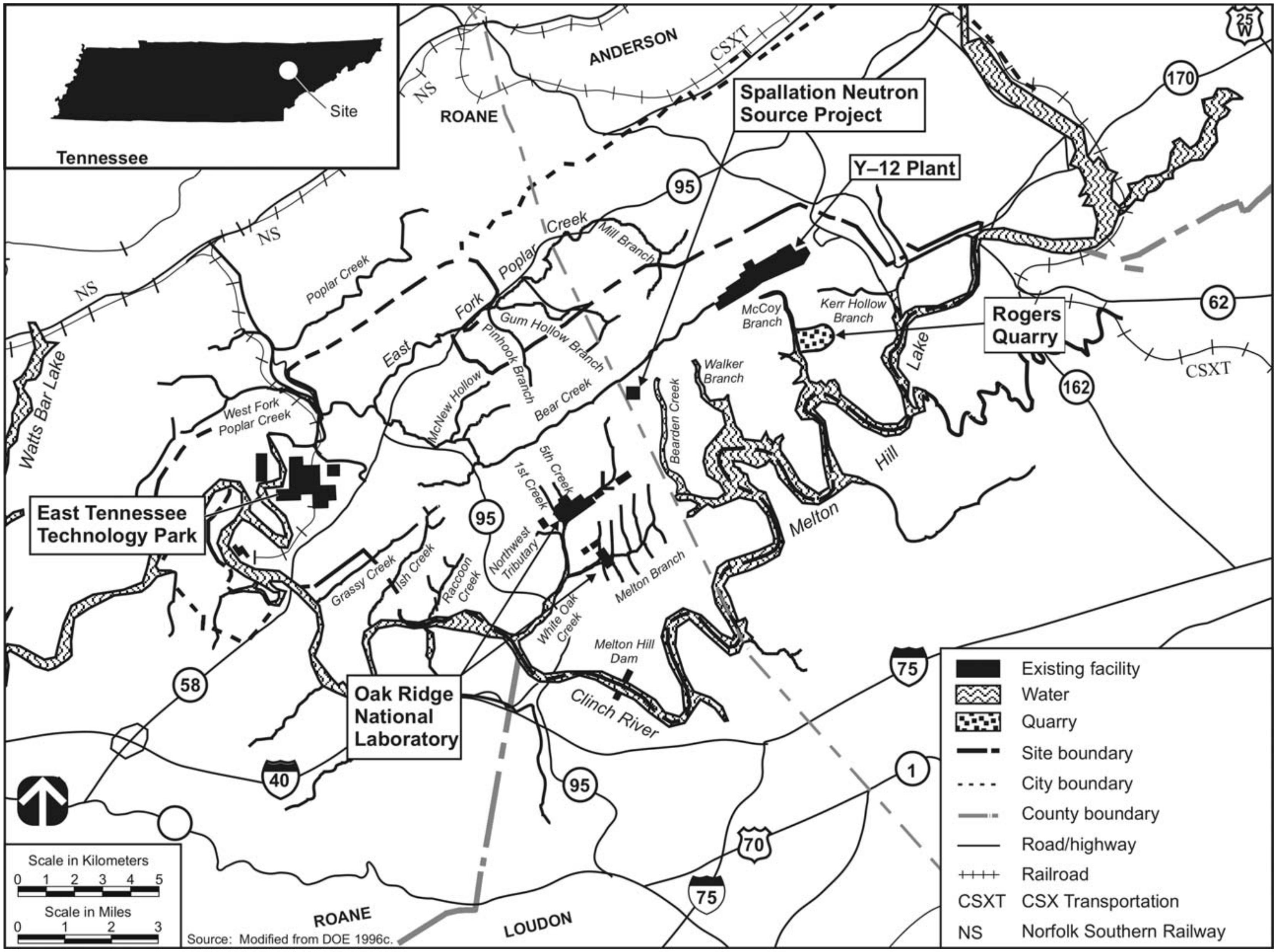


Figure 3–19 Oak Ridge Reservation Vicinity



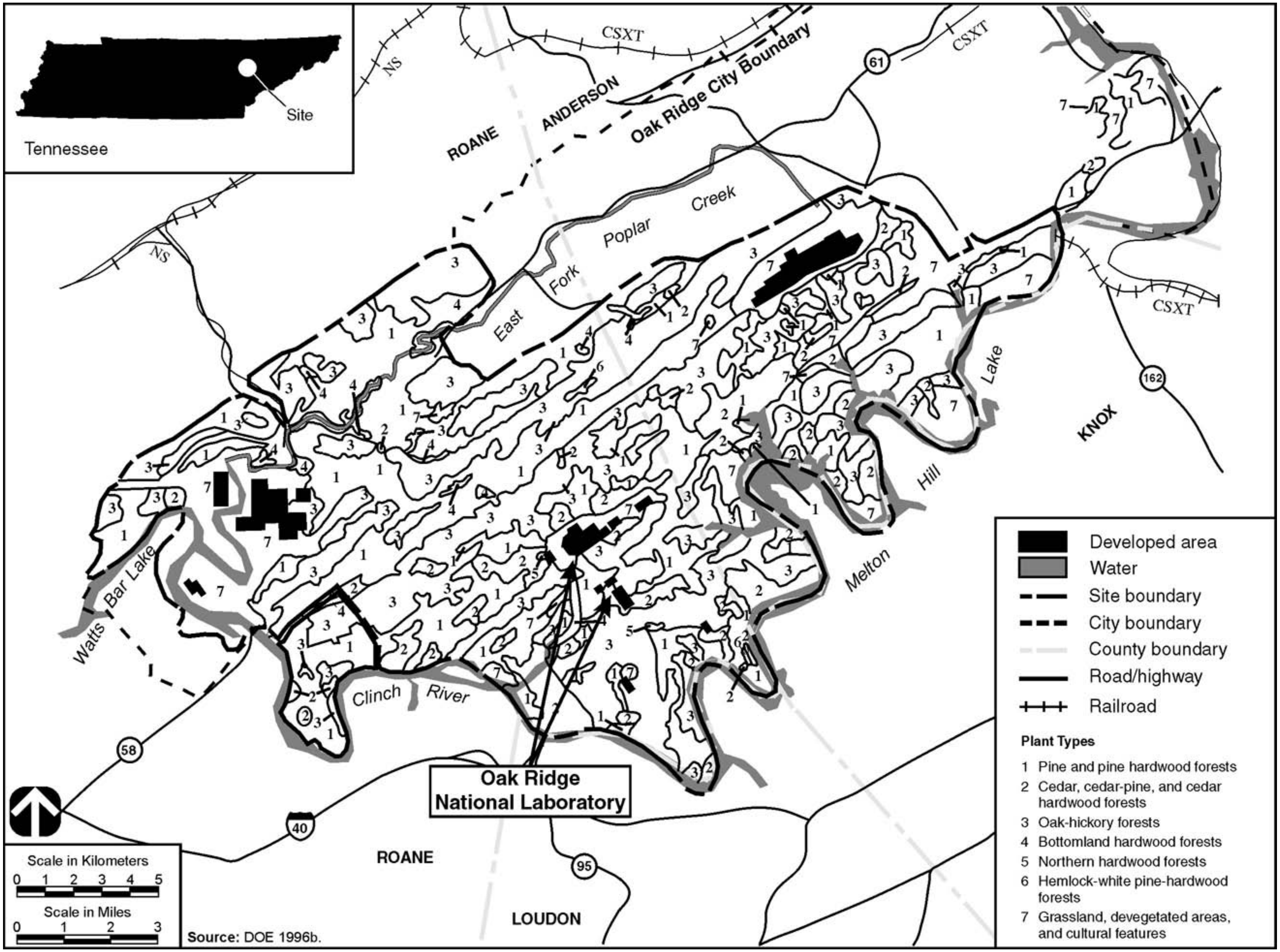
Sources: DOE 1996b; ORNL 1999.

Figure 3–20 Generalized Land Use at Oak Ridge Reservation and Vicinity



Source: Modified from DOE 1996c.

Figure 3–23 Surface Water Features in the Vicinity of Oak Ridge National Laboratory



Source: DOE 1996b.

Figure 3–24 Distribution of Plant Communities at the Oak Ridge Reservation

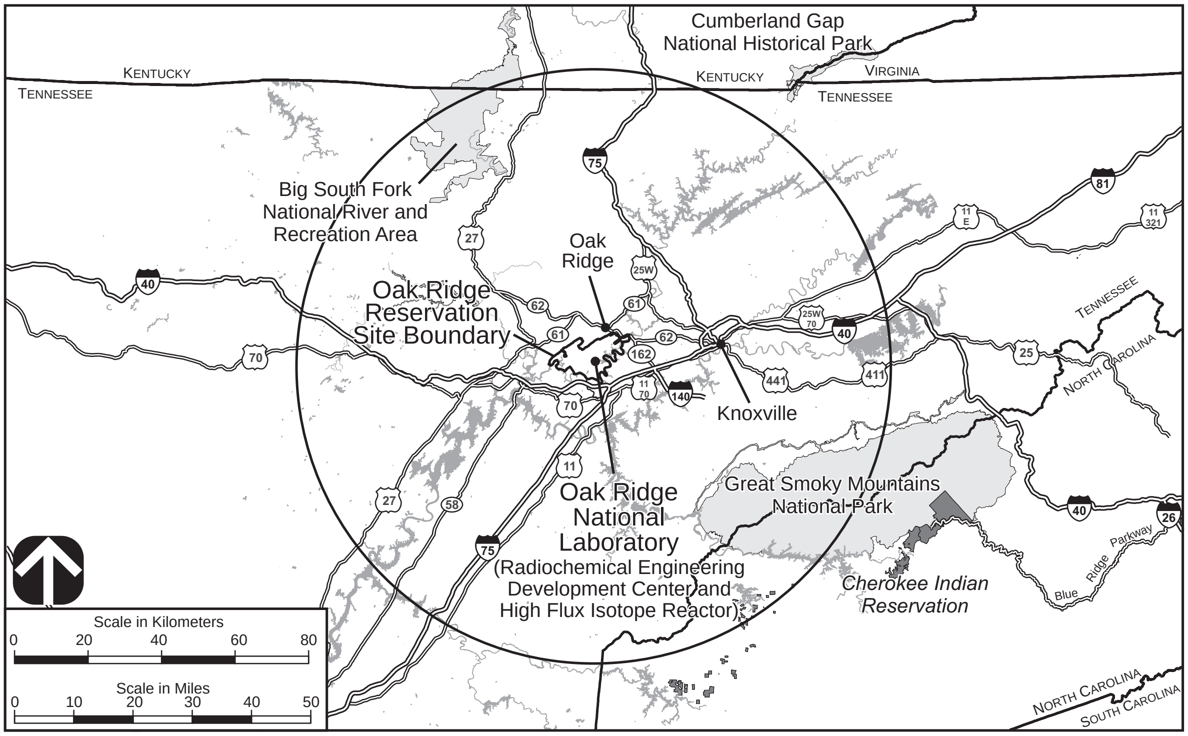


Figure 3–25 Location of Oak Ridge National Laboratory and Indian Reservation Surrounding Oak Ridge Reservation

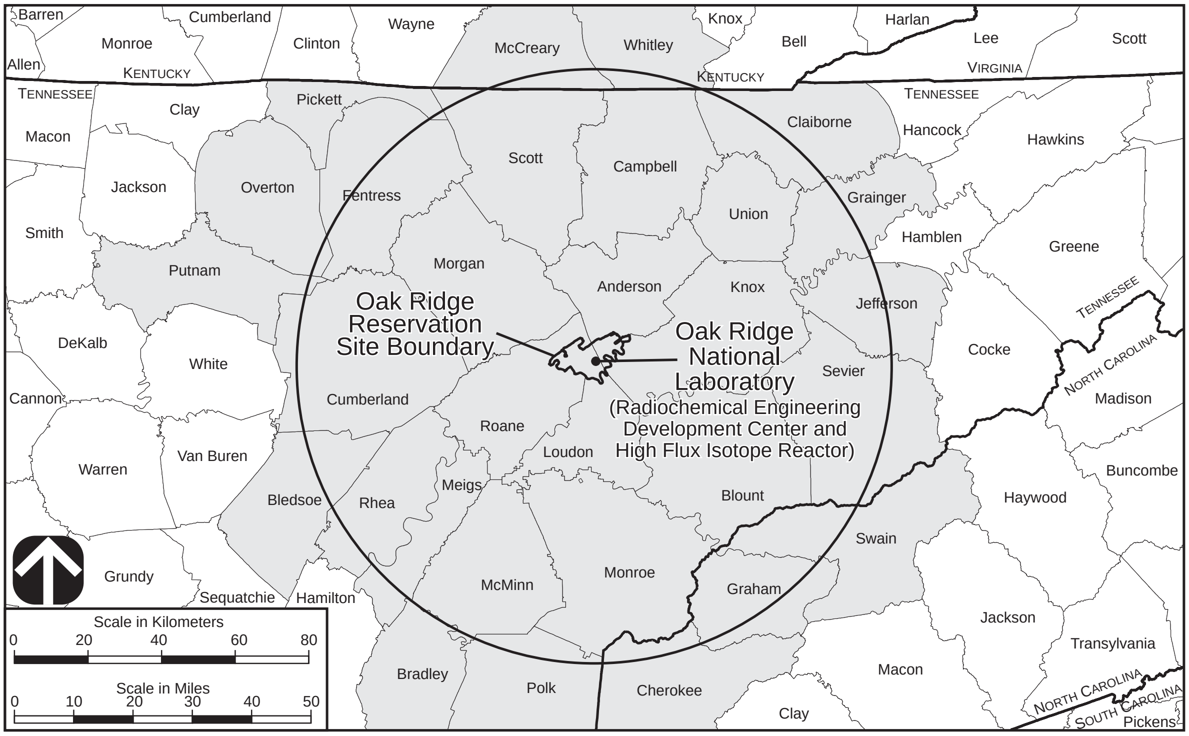
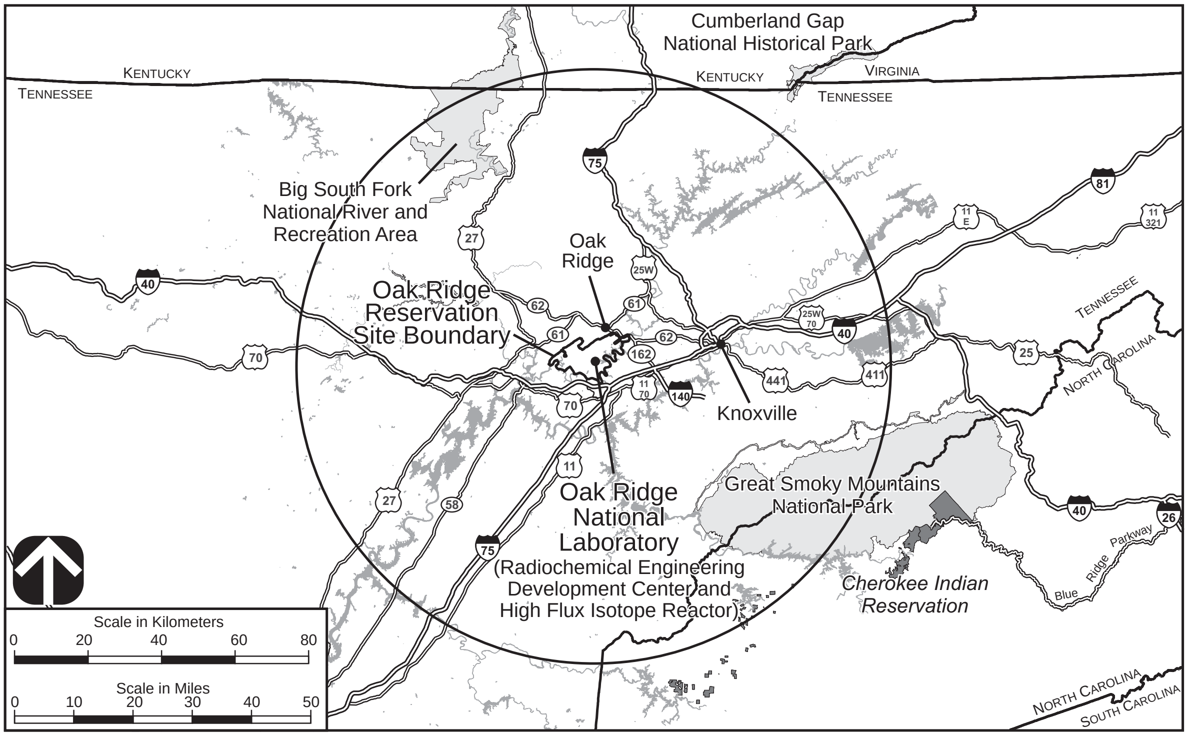


Figure 3–26 Potentially Affected Counties Near Oak Ridge National Laboratory



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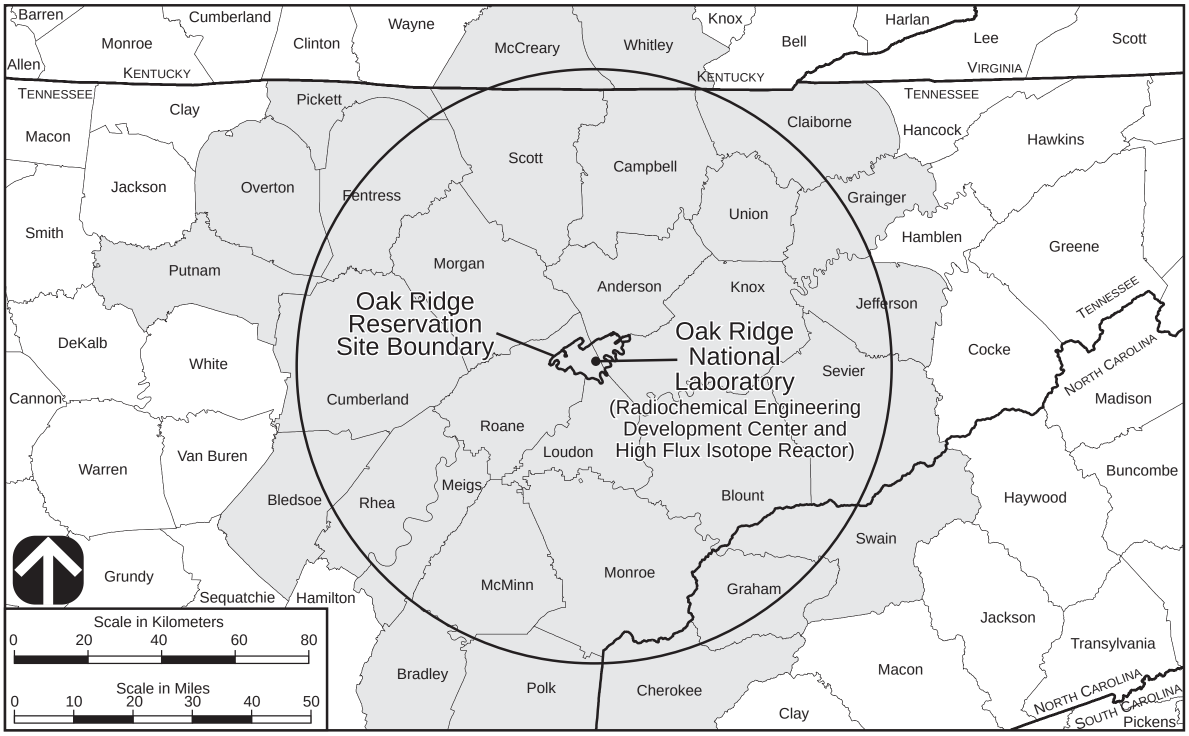

Figure 3–26 Potentially Affected Counties Near Oak Ridge National Laboratory

APPENDIX A
OVERVIEW OF THE PUBLIC PARTICIPATION PROCESS

APPENDIX A
OVERVIEW OF THE PUBLIC PARTICIPATION PROCESS

A.1 Public Scoping Comments

The Notice of Intent for this *Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)* was issued on November 10, 2004, and announced seven scoping meetings and a comment period (November 10, 2004, through January 31, 2005). **Figure A–1** illustrates the National Environmental Policy Act (NEPA) process for the *Consolidation EIS* and how the Notice of Intent and public scoping period are part of the overall process.

The U.S. Department of Energy (DOE) conducted scoping meetings to support the *Consolidation EIS* at the locations shown in **Table A–1**; dates of the meetings and public attendance are also provided. These scoping meeting sites were chosen based on the proposed alternatives identified by DOE for consolidation of radioisotope power systems (RPS) nuclear production operations.

All public scoping comments were reviewed, and comments on similar or related topics were grouped under comment issue categories, as shown in **Table A–2**. Each comment issue category was evaluated, and a response has been prepared and included in the table.

Table A–1 Public Scoping Meeting Locations, Dates, and Attendance

Location	*Date*	*Attendance*
Idaho Falls, Idaho	December 6, 2004	42
Jackson, Wyoming	December 7, 2004	9
Fort Hall, Idaho	December 8, 2004	20
Twin Falls, Idaho	December 9, 2004	12
Los Alamos, New Mexico	December 13, 2004	12
Oak Ridge, Tennessee	December 15, 2004	12
Washington, DC	December 17, 2004	13
	Total	120

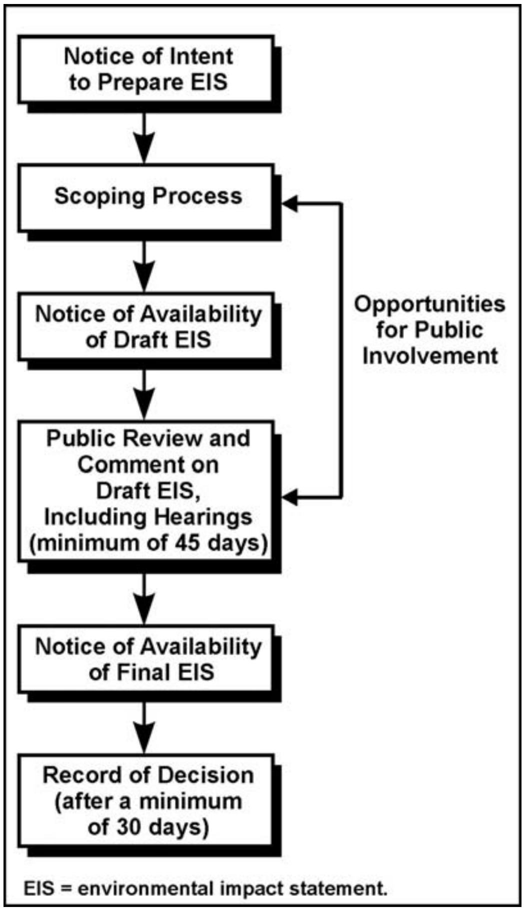

Figure A–1 National Environmental Policy Act Process for the *Consolidation EIS*

Table A–2 Public Scoping Issues and Responses

Public Scoping Issue	*DOE Response*
Impacts	
Increased usage of the Advanced Test Reactor (ATR) by DOE's Office of Nuclear Energy, Science and Technology could potentially displace existing tertiary operations such as medical isotope production (cobalt-60).	Evaluation of ATR's capabilities confirms that the plutonium-238 production mission would not displace existing tertiary operations such as medical isotope production (cobalt-60).
Would there be an increase in jobs at the Idaho National Laboratory (INL) (formerly Idaho National Engineering and Environmental Laboratory) with this new mission?	This new mission, under the Consolidation Alternative, would create temporary jobs for construction and less than 100 jobs for operation of the new facilities at the Materials and Fuels Complex (MFC) (formerly Argonne National Laboratory-West).
American Indians should benefit from the new mission.	This subject is not part of the scope of this environmental impact statement (EIS).
DOE is proposing to consolidate all activities related to RPS to INL because the population density there is less than at other sites, so if there were a radiological release, then fewer people would be exposed (i.e., fewer fatalities).	INL offers appropriate security for the storage and handling of neptunium-237 and plutonium-238; an existing operating nuclear reactor (ATR) for target irradiation capable of producing DOE's goal of 5 kilograms per year of plutonium-238; and the already completed and operational Space and Security Power Systems Facility at MFC.
Waste Management	
The EIS should provide a detailed accounting of the wastes that would be generated under each alternative evaluated in the EIS over the entire life cycle; the processes for managing these wastes; and the location of their ultimate disposition.	This information is included in Chapter 4 of this EIS.
All alternatives should analyze the impacts of additional waste generation from Office of Nuclear Energy, Science and Technology consolidation activities on INL's overall cleanup program.	These impacts are analyzed in Chapter 4 of this EIS.
All newly generated waste from Office of Nuclear Energy, Science and Technology activities should be treated and transported off site, thereby, preventing it from becoming "legacy waste."	As discussed in Chapter 4 of this EIS, all generated radioactive waste would be treated and transported to an appropriate offsite waste disposal location.
All alternatives evaluated in the EIS should be in full compliance with the State of Idaho Settlement Agreement and Consent Order.	All alternatives in this EIS are in full compliance with the State of Idaho Settlement Agreement and Consent Order.
The transuranic waste produced from this consolidation project is non-defense related; therefore, it does not meet the Waste Isolation Pilot Plant (WIPP) acceptance criteria. Formal documentation of the transuranic waste acceptability at WIPP should be finalized before consolidation occurs.	WIPP has issued formal documentation identifying this transuranic waste at LANL as acceptable for disposal at WIPP. Formal documentation identifying the transuranic waste as acceptable for disposal at WIPP will be finalized before consolidation occurs.
Emergency Response	
Each alternative evaluated in the EIS should identify who would respond to a transportation accident involving a radiological release (plutonium-238 and neptunium-237) and what emergency response measures would be implemented if there is a radiological release.	Transportation accident emergency response measures are discussed in Chapter 4 of this EIS.
Emergency response teams should be trained to address potential transportation accidents involving a radiological release such as plutonium-238. If the Shoshone-Bannock Tribes are the first responders to an accident on the reservation, then radiological training would be required.	Emergency response teams are or would be trained to address potential transportation accidents involving a radiological release of plutonium-238.

Public Scoping Issue	***DOE Response***
Transportation/Shipping Containers	
How many shipments of plutonium-238 and neptunium-237 are being planned for on- and offsite shipping? What route would be utilized for these shipments?	The number and route of shipments are discussed in Appendix D and analyzed in Chapter 4 of this EIS.
The tribal emergency response team should be notified in advance of the plutonium-238 shipments, especially when traveling through the reservation.	It is DOE policy not to notify any emergency response organization of the date of a safe secure transport such as that of plutonium-238.
A transportation agreement between DOE and the Shoshone-Bannock Tribes should be in place before continuing any more shipments across the reservation.	This subject is outside the scope of this EIS.
How would the plutonium-238 be transported, and what security measures would be in place to prevent accidents, a terrorist attack, and/or radiological releases?	All intersite transportation of plutonium-238 would use licensed shipping containers in DOE safe secure transports with appropriate DOE security, as discussed in Appendix D of this EIS.
What shipping container would be used to ship the plutonium-238? How are these containers tested and evaluated so as to ensure their efficacy?	The certified Type B 5320 package (approved in Title 10 of the *Code of Federal Regulations*, Part 71 [10 CFR 71]), would be used to ship plutonium-238. The container is tested to meet all the accident conditions specified in 10 CFR 71, which include drops, puncture, fire, and flooding or water immersion. This is discussed further in Appendix D of this EIS.
What road would be used to transport the plutonium-238 between ATR and the RPS facility? Would this road be secure?	A new 24-kilometer (15-mile)-long road, described in greater detail in Chapter 2 of this EIS, would be constructed that connects ATR and the RPS facility at MFC. This road would exist solely inside the INL boundaries and be isolated and controlled by INL. The road would be secure during all plutonium-238 shipments.
Security	
What security measures are in place at INL that makes the site appealing for the proposed consolidation site?	MFC at INL has a Perimeter Intrusion Detection and Assessment System (PIDAS) in place that surrounds all structures involved with the production of RPS and plutonium-238.
Does DOE intend to increase security measures with the new consolidation mission?	Current DOE security measures provide the highest level of protection for the Consolidation Alternative at the INL MFC.
Defense/Terrorist Concerns	
INL would become a prime terrorist target with this new consolidation mission and with the increased stockpile of radiological materials.	The increase in the inventory of radiological materials at INL due to the Consolidation Alternative or Consolidation with Bridge Alternative would be extremely small as compared to the existing radiological material inventory at INL, and the radiological material at MFC would be in a secure PIDAS area.
Could plutonium-238 be used in a “dirty bomb”?	Plutonium-238 could be used in a “dirty bomb,” but its high decay heat would render it much less attractive, due to handling problems, than other radioisotopes. Its storage and management in the PIDAS secure area of MFC make it extremely difficult to access. Furthermore, its sintered oxide form inside the manufactured RPS, which would be transported from INL under all alternatives, is not suitable for dispersion in a dirty bomb.

Public Scoping Issue	***DOE Response***
Could plutonium-238 be used in nuclear weapons, and, if so, does DOE have any intentions of supporting a defense mission while at INL?	In theory, plutonium-238 could be used in a nuclear weapon; however, its very high decay heat causes it to be too unstable for use in such a weapon. All current and planned U.S. nuclear weapons use either plutonium-239 or highly enriched uranium-235. The DOE nuclear weapons complex does not include INL, and DOE has no intentions of supporting nuclear weapons work at INL. See Appendix E of this EIS for further details on this subject.
American Indian Cultural Resources	
All alternatives evaluated in the EIS should include an analysis of the impacts on the American Indian culture (i.e., hunting, fishing, etc.), with special emphasize on the Shoshone-Bannock Tribes' treaty rights.	Impacts on the American Indian culture are evaluated in the cultural resource and environmental justice sections in Chapter 4 of the EIS.
Would the security at INL be upgraded to the point where the Shoshone-Bannock Tribes would not have access to aboriginal lands that INL presently occupies?	INL security would not affect current Shoshone-Bannock Tribes' access to aboriginal lands. DOE is committed to meet the American Indian Religious Freedom Act of 1978 (42 United States Code [U.S.C.] 1996) and Executive Order 13007 (May 24, 1996).
National Environmental Policy Act	
What is the connection between the *Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS)* and the *Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)*? Isn't this segmentation?	The *NI PEIS* established the environmental impacts of a wide spectrum of alternatives for domestic production of radioisotopes, including plutonium-238. Its Record of Decision (ROD) selected domestic production with existing facilities, and its amended ROD, reflecting security concerns from the terrorist attacks of September 11, 2001, redirected storage of neptunium-237 to INL instead of the Oak Ridge National Laboratory (ORNL). This *Consolidation EIS*, partly in response to September 11, 2001, which occurred after the *NI PEIS* was issued, focuses on increased security by using protected areas at INL, minimizing transport of neptunium-237 and plutonium-238, and achieving increased efficiencies associated with the mission being accomplished at one location. These two EISs do not constitute segmentation, but rather a logical extension of one to the other and an accounting for changing security concerns.
INL should prepare a sitewide EIS to incorporate the change in mission to include the proposed consolidation and Office of Nuclear Energy, Science and Technology activities.	This *Consolidation EIS* presents INL sitewide impacts of this mission. Cumulative impacts at INL are discussed in Chapter 4.
Why is DOE converting the neptunium-237, currently stored at the Savannah River Site, into neptunium-237 oxide for shipment to INL, when the NEPA process is not finished?	This action is covered by the amended ROD to the *NI PEIS*. (*Federal Register* Volume 69, No. 156, August 13, 2004).
The *NI PEIS* ROD made a determination to use the High Flux Isotope Reactor (HFIR) for plutonium-238 production; why has DOE changed its mind?	The *NI PEIS* ROD made a determination to use both ATR and HFIR for plutonium-238 production. However, HFIR has always been limited to a maximum annual plutonium-238 production rate of 2 kilograms per year due to other competing missions, whereas ATR was found to be capable of meeting DOE's goal of 5 kilograms per year of plutonium-238. For the purpose of consolidation at one DOE site, the higher capacity of ATR at INL makes this site the logical choice, along with its higher security capability for consolidation. A new Consolidation with Bridge Alternative has been added to the EIS that exclusively uses HFIR, also considered available to supplement ATR under the No Action Alternative in this EIS.

Public Scoping Issue	***DOE Response***
Production/Costs	
How much plutonium-238 would be produced per year? How much over the entire life cycle of the program?	The goal for this program is to produce 5 kilograms per year of plutonium-238 for a 35-year time period, which is a total of 175 kilograms of plutonium-238.
How much plutonium-238 is used in one radioisotope thermoelectric generator (RTG)? How much plutonium-238 do the national security users require for their applications?	Current-design RTGs like that used on the National Aeronautics and Space Administration (NASA) Cassini mission use approximately 9.6 kilograms of plutonium-238 each. Cassini required three such RTGs, or a total of about 28.8 kilograms of plutonium-238. The classified nature of national security requirements for plutonium-238 precludes identification of any specific plutonium-238 mass needs. However, national security end users have identified that they will have a continuous and probably increasing need for future plutonium-238 in RTGs and radioisotope heater units (RHUs).
How many RTGs have been built? How much does each RTG cost?	DOE has provided 44 RTGs and more than 240 RHUs for NASA space missions since 1961. DOE has produced more than 500 RTGs and RHUs for all applications since 1961. The cost of an RTG is outside the scope of this EIS.
Russia	
How much plutonium-238 does the United States purchase from Russia?	To date, the United States has purchased 16.5 kilograms of plutonium-238 and has an existing contract to allow the purchase of an additional 5 kilograms of plutonium-238.
Will the United States continue to purchase plutonium-238 from Russia after we establish our own domestic capability?	Currently, the United States is planning to continue purchasing plutonium-238 from Russia.
Why does DOE need to reestablish a domestic capability to produce plutonium-238 when the Russians are willing to sell plutonium-238 to the United States?	The agreement with Russia does not allow the United States to use this plutonium-238 for national security needs. Therefore, the Russian plutonium-238 can be used only for NASA missions. There is no guarantee that Russia can provide a long-term stable supply of plutonium-238 to meet U.S. non-national-security needs.
RPS Facility	
What "purification" or chemical process does DOE intend to use at INL? Does DOE plan to use an incinerator?	The chemical process that would be used at INL is identical to that currently used at Los Alamos National Laboratory (LANL) and intended for the Radiochemical Engineering Development Center at ORNL under the No Action Alternative and as described in the *NI PEIS* and in Chapter 2 of this EIS. No incinerator would be used.
Where would the new facility be located, and how large would it be?	The new facility would be located at MFC at INL within the PIDAS. Its dimensions are discussed in detail in Chapter 2 of this EIS.
How much would this new modern facility cost?	The cost for this facility is presented in Chapter 2 of this EIS.
What safeguards would be installed for safeguarding workers, the public, and the environment? How would this be different from LANL, which is currently performing the assembly and encapsulating portion of the RPS and has a history of accidents and worker exposure?	The new facility at the MFC INL would be a state-of-the-art facility with modern equipment and a high seismic-design capacity and would incorporate all the design and operational lessons learned from previous DOE facilities, including those at LANL. It would also be located inside a PIDAS secure area at INL.
How many stages of high-efficiency particulate air (HEPA) filters would be installed in the new facility?	The new facility is planned to have four physically separated safety-grade HEPA filter stages.

Public Scoping Issue	*DOE Response*
How efficient are HEPA filters during an accident (e.g., fire)? Does DOE perform any type of quality assurance on the HEPA filters, and, if so, what type of tests do they perform? How often are the HEPA filters checked and replaced?	During an accident, HEPA filters remove greater than 99 percent of all respirable particulates. DOE certifies and tests all safety-grade HEPA filters in accordance with its *Nuclear Air Cleaning Handbook,* DOE-HDBK-1169-2003. These tests ensure minimum filter performance of 99.97 percent retention for 0.3-micron particles. HEPA filters are checked for differential pressures by daily surveillance and replaced every 10 years for dry conditions and 5 years for wet conditions. In the event of an accident, the HEPA filters are immediately replaced. Appendix C of this EIS shows that a fire accident will not affect filter efficiency. Periodic monitoring and testing of in-place, safety-significant or safety-class HEPA filters are required by the safety bases of a nuclear facility. In general, these requirements may vary depending on the individual requirements of the facility and the type of operations. For a typical plutonium facility, there is a technical safety requirement that the differential pressure across each HEPA filter stage in each exhaust system be regularly monitored and that the HEPA filter be replaced when the pressure exceeds a predetermined value. In addition, all sites perform a periodic, in-place test to ensure that the removal efficiency is maintained. For most sites, this is done annually and is generally also a surveillance requirement of the safety analysis. Table 8–2 of the *Nuclear Air Cleaning Handbook,* recommends in-place system-leak tests of HEPA filters "every 12 months for DOE sites as a basis or more/less frequency, as determined by a technical evaluation."
Additional Alternatives to Be Analyzed	
Restarting and operating the Fast Flux Test Facility (FFTF) located at Hanford should be considered a viable option for plutonium-238 and medical radioisotope production.	DOE decided in the *NI PEIS* ROD that "the FFTF would be permanently deactivated." DOE has also initiated an EIS for the decommissioning of FFTF (Notice of Intent for DOE/EIS-0364, dated August 13, 2004). On May 19, 2005, as part of deactivation activities, a hole was drilled in the FFTF reactor vessel core support structure to allow access for the removal of the liquid sodium coolant. This effectively rendered FFTF inoperable and foreclosed the option of restart.
The funds being used to finance this consolidation effort should be used to restart FFTF.	DOE decided in the *NI PEIS* ROD that "the FFTF would be permanently deactivated." DOE has also initiated an EIS for the decommissioning of FFTF (Notice of Intent for DOE/EIS-0364, dated August 13, 2004). On May 19, 2005, as part of deactivation activities, a hole was drilled in the FFTF reactor vessel core support structure to allow access for the removal of the liquid sodium coolant. This effectively rendered FFTF inoperable and foreclosed the option of restart.
Constructing a new reactor or restarting an existing DOE reactor should be evaluated, especially when considering the cost of this consolidation project.	In the *NI PEIS* ROD, DOE decided to use existing, operating reactors only for production of plutonium-238. DOE is not revisiting this decision at this time.
HFIR should be maintained as a primary and/or secondary alternative for producing plutonium-238. With the existence of HFIR, the consolidation effort is unwarranted.	In this EIS, HFIR is being considered as both a primary (Consolidation with Bridge Alternative) and secondary (No Action Alternative) producer of plutonium-238. However, HFIR does not, by itself, have the capacity to produce the DOE requirement of 5 kilograms per year of plutonium-238.
Plutonium-238 currently being used in defense applications should be recovered and reallocated to the national security applications and NASA missions that DOE supports.	DOE currently recovers and reallocates available plutonium-238 for national security and NASA missions and will continue this activity.

Public Scoping Issue	***DOE Response***
National Security Initiatives	
How are the RTGs being used for national security? Is it being used for nuclear weapons, space-based nuclear weapons (e.g., Star Wars), or military satellites?	The specific use of RTGs for national security is classified. However, national security use of RTGs does not include nuclear weapons, space-based nuclear weapons, or military satellites.
Who are the national security users – the U.S. Department of Defense?	National security users are classified.
How much plutonium-238 is being used in national security applications? How much for NASA missions?	As presented in Chapter 2, Table 2–1 of this EIS, plutonium-238 requirements through 2010 for national security and NASA are 25 and 8 kilograms, respectively.
Out of Scope	
DOE and NASA should consider nonradioactive technologies such as solar panels for space exploration.	The *NI PEIS* discussed the use of solar panels for space exploration and concluded that their use is impractical for deep space missions.
Plutonium-238 production is like reprocessing.	Plutonium-238 production is not like reprocessing, as it does not involve removal of fissionable material from spent nuclear fuel.
NASA and DOE should be good stewards of the environment and stop using radiological materials in their missions, including the RTG.	NASA and DOE operate under safety programs that ensure the highest level of safety and protection to the environment.
Money being used to finance this consolidation could be used for other, more worthwhile initiatives: the environment, education, health care, and social programs.	This subject is outside the scope of this EIS.

Note: To convert from kilograms to pounds, multiply by 2.2046; to convert from kilometers to miles, by 0.6214.

APPENDIX B
ENVIRONMENTAL IMPACT METHODOLOGIES

APPENDIX B
ENVIRONMENTAL IMPACT METHODOLOGIES

This appendix briefly describes the methods used to assess the potential direct, indirect, and cumulative effects of the alternatives in the *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)*. Included are impact assessment methodologies for land resources, air quality, noise, geology and soils, water resources, ecological resources, cultural resources, socioeconomics, environmental justice, waste management, cumulative impacts, infrastructure, public and occupational health and safety, and transportation. Each section includes a description of the affected resources, region of influence (ROI), and the impact assessment method. Detailed descriptions of the methods for the evaluation of human health effects of normal operations, facility accidents, and transportation are presented in Appendix C of this environmental impact statement (EIS).

Methods for assessing environmental impacts vary for each resource area. For air quality, for example, pollutant emissions from operations related to production of radioisotope power systems (RPS) were evaluated for their effect on ambient concentrations and their compliance with ambient standards. Comparison with regulatory standards is a commonly used method for benchmarking environmental impacts, and appropriate comparisons have been made in a number of resource analyses to provide perspective on the magnitude of identified impacts. For waste management, waste generation rates were compared with site waste generation rates and with the capacities of waste management facilities. Impacts in all resource areas were analyzed consistently; that is, the impact values were estimated using a consistent set of input variables and computations. Moreover, efforts were made to ensure that calculations in all areas used accepted protocols and up-to-date models.

B.1 Land Resources

B.1.1 Land Use

B.1.1.1 Description of Affected Resources

Land use includes the land on and adjacent to the site, the physical features that influence current or proposed uses, pertinent land use plans and regulations, and land ownership and availability. The ROI for the *Consolidation EIS* includes the site and areas immediately surrounding the site.

B.1.1.2 Description of Impact Assessment

The amount of land disturbed and conformity with existing land use were considered to evaluate potential impacts (see **Table B–1**). The *Consolidation EIS* evaluates the impacts of alternatives on land use within each facility site location. The analysis focuses on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and use designations, proximity to special use areas, and other factors pertaining to land use. Total additional land area requirements considered include those areas to be occupied by the footprint of new facilities that would be required in conjunction with any additional parking areas, graveled areas, or construction laydown areas. These requirements were compared to the total land area of the site.

B.1.2 Visual Resources

B.1.2.1 Description of Affected Resources

Visual resources are the 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 stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The ROI for visual resources includes the geographic area from which the RPS production facilities and the transfer roadway may be seen. This would generally involve nearby higher elevations and public roadways.

Table B–1 Impact Assessment Protocol for Land Use and Visual Resources

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Land area used	Acreage of site	Facility acreage requirements	Area converted to project use
Compatibility with existing or future land use	Existing land use configurations	Location of facilities on the site; expected modifications of site activities and uses to accommodate the alternatives	Incompatibility with existing or future land use
Visual resources	Current Visual Resource Management classification	Location of facilities on the site; facility dimensions and appearance	Change in Visual Resource Management classification

B.1.2.2 Description of Impact Assessment

Visual resource assessments are based on the Bureau of Land Management's visual resource management method. A qualitative visual resource analysis, adapted from the Bureau of Land Management's visual contrast rating system (DOI 1986), is conducted to determine whether the candidate sites would change as a result of proposed RPS consolidation activities. Classifications of visual contrast settings are provided in **Table B–2**. Classifications were derived from an inventory of scenic qualities, sensitivity levels, and distance zones for particular areas.

Table B–2 Bureau of Land Management Classification of the Visual Resources

Classification	*Visual Settings*
Class I	Very limited management activity; natural ecological change
Class II	Management activities may be seen, but should not attract the attention of the casual observer, such as solitary small buildings or dirt roads
Class III	Management activities may attract attention, but should not dominate the view of the casual observer; natural landscape still dominates buildings, utility lines, and secondary roads
Class IV	Management activities may dominate the view and major focus of viewer attention, such as cluster of two-story buildings, large industrial/office complexes, primary roads, and limited clear cutting for utility lines or ground disturbances

The visual resources analysis focuses on the degree of contrast between the Proposed Action and the surrounding landscape, the location and sensitivity levels of public vantage points, and the visibility of the Proposed Action from the vantage points. The distance from a vantage point to the affected area and atmospheric conditions were also considered, as distance and haze can diminish the degree of contrast and visibility. A qualitative assessment of the degree of contrast between proposed facility construction and operations and the existing visual landscape is presented, as applicable.

Thus, to determine the range of potential visual effects of new facilities, the analysis considered potential impacts of construction and operations in light of the aesthetic quality of surrounding areas, as well as the visibility of proposed activities and facilities from public vantage points.

B.2 Infrastructure

B.2.1 Description of Affected Resources

Site infrastructure includes physical resources encompassing the transportation and utility systems required to support the construction and/or modification and operation of facilities associated with production of RPS. It includes the capacities of onsite road networks, electric power and electrical load capacities, natural gas and liquid fuel (i.e., fuel oil, diesel fuel, and gasoline) capacities, and water supply system capacity.

The ROI is generally limited to the boundaries of each proposed site. However, should infrastructure requirements exceed site capacities, the ROI would be expanded (for analysis) to include the sources of additional supply. For example, if electrical demand (with added facilities) exceeded site availability, then the ROI would be expanded to include the likely source of additional power (i.e., the power pool currently supplying the site).

B.2.2 Description of Impact Assessment

In general, infrastructure impacts were assessed by evaluating the requirements of each alternative, including associated activities and facility demands against site capacities. An impact assessment was made for each resource (road networks, electricity, fuel, and water) for the various alternatives (see **Table B–3**). Local transportation system impacts were addressed qualitatively, as additional transportation infrastructure requirements under the Proposed Action and alternatives. Tables reflecting site availability and infrastructure requirements were developed for each alternative. Data for these tables were obtained from documentation[1] describing the existing infrastructure at the facility site locations and from data reports prepared to support the EIS with regard to production of RPS.

Table B–3 Impact Assessment Protocol for Infrastructure

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Transportation			
Roads (kilometers)	Site/facility area capacity and current usage	Activity and facility requirements	Additional requirement (with added facilities) exceeding facility area/site capacity
Electricity			
Energy consumption (megawatt-hours)	Site/facility area and current usage	Activity and facility requirements	Additional requirement (with added facilities) exceeding facility area/site capacity
Fuel			
Natural gas (cubic meters) Gasoline (million liters) Diesel fuel (million liters)	Site/facility area and current usage	Activity and facility requirements	Additional requirement (with added facilities) exceeding facility area/site capacity
Water (million liters)	Site/facility area and current usage	Activity and facility requirements	Additional requirement (with added facilities) exceeding facility area/site capacity

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[1] *For applicable source data, see the documentation referenced in Sections 3.1.2, 3.2.2, and 3.3.2 of the Consolidation EIS.*

Any projected demand for infrastructure resources exceeding site availability can be regarded as an indicator of impact. Whenever projected demand approaches or exceeds capacity, further analysis for that resource is warranted. Often, design changes can mitigate the impact of additional demand for a given resource. For example, substituting fuel oil for natural gas (or vice versa) for heating or industrial processes can be accomplished at little cost during the design of a facility, provided the potential for impact is identified early. Similarly, a dramatic "spike" in peak demand for electricity can sometimes be mitigated by changes to operational procedures or parameters.

B.3 Noise

B.3.1 Description of Affected Resources

Noise, or sound, results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. Propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is undesirable sound that interferes or interacts negatively with the human or natural environment. Noise can disrupt normal activities (e.g., hearing, sleep), damage hearing, or diminish the quality of the environment.

Noise-level measurements used to evaluate the effects of nonimpulsive sound on humans are compensated by an A-weighting scale that accounts for the hearing response characteristics (i.e., frequency) of the human ear. Noise levels are expressed in decibels, or in the case of A-weighted measurements, decibels A-weighted. The U.S. Environmental Protection Agency (EPA) has developed noise-level guidelines for different land use classifications (EPA 1974). The EPA guidelines identify a 24-hour exposure level of 70 decibels as the level of environmental noise that will prevent any measurable hearing loss over a lifetime. Likewise, levels below 55 decibels outdoors and 45 decibels indoors are identified as preventing activity interference and annoyance.

Noise from facility construction or operations and associated traffic could affect human and animal populations. The ROI for each facility includes the site and surrounding areas, including transportation corridors, where proposed activities might increase noise levels. Transportation corridors most likely to experience increased noise levels are those roads within a few kilometers of the site boundary that carry most of the site's employee and shipping traffic.

Noise-level data representative of site environs were obtained from existing reports. The acoustic environment was further described in terms of existing noise sources for the proposed locations and traffic noise levels along access routes.

B.3.2 Description of Impact Assessment

Noise impacts associated with the alternatives could result from construction and operations activities, including increased traffic (see **Table B–4**). Impacts of proposed activities under each alternative were assessed according to the types of noise sources and facility site locations relative to the site boundary and noise-sensitive receptors. Potential noise impacts of traffic were assessed based on the likely increase in traffic volume. Possible impacts on wildlife were evaluated based on the possibility of sudden loud noises occurring during site activities under each alternative.

Table B–4 Impact Assessment Protocol for Noise

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Noise	Identification of sensitive offsite receptors (e.g., nearby residences, nearby threatened and endangered wildlife habitat); description of noise-levels and noise sources in the vicinity of the site	Description of noise sources; shipment and workforce traffic estimates	Increase in day/night average sound level at sensitive receptors

B.4 Air Quality

B.4.1 Description of Affected Resources

Air pollution refers to the introduction, directly or indirectly, of any substance into the air that could:

- endanger human health,
- harm living resources and ecosystems,
- damage material property, or
- impair or interfere with the comfortable enjoyment of life and other legitimate uses of the environment.

For the purpose of the *Consolidation EIS*, only outdoor air pollutants were addressed. They could be in the form of solid particles, liquid droplets, gases, or a combination of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants or by reaction with normal atmospheric constituents that may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere with the appropriate standards. Ambient air quality standards have been established by Federal and state agencies, allowing an adequate margin of safety for the protection of public health and welfare from the adverse effects of pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; those below such standards are considered acceptable.

The pollutants of concern are primarily those for which Federal and state ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air compounds. Criteria air pollutants are those listed in Title 40 of the *Code of Federal Regulations* (CFR) Part 50 (40 CFR 50), "National Primary and Secondary Ambient Air Quality Standards." Hazardous air pollutants and other toxic compounds are those listed in Title I of the Clean Air Act, as amended (Title 40 of the *United States Code*, Section 7401 *et seq.* [40 U.S.C. 7401 *et seq.*]), those regulated by the National Emissions Standards for Hazardous Air Pollutants (40 CFR 61), and those that have been proposed or adopted for regulation by the applicable state or are listed in state guidelines. States may set ambient standards that are more stringent than the National Ambient Air Quality Standards (NAAQS). The more stringent of the state or Federal standards for each site is shown in this *Consolidation EIS*.

Areas with air quality that meets the NAAQS for criteria air pollutants are designated as being in "attainment," while areas with air quality that does not meet the NAAQS for such pollutants are designated as "nonattainment." Areas may be designated as "unclassified" when sufficient data for attainment-status designation are lacking. Attainment-status designations are assigned by county, metropolitan statistical area, consolidated metropolitan statistical area, or portions thereof, or air quality control regions. Air quality control regions designated by EPA and attainment-status designations are listed in 40 CFR 81, "Designation of Areas for Air Quality Planning Purposes."

Prevention of Significant Deterioration (PSD) regulations limit pollutant emissions from new or modified sources and establish allowable increments of pollutant concentrations for attainment areas. Three PSD classifications are specified, with the criteria established, in the Clean Air Act. Class I areas include national wilderness areas, memorial parks larger than 2,020 hectares (5,000 acres), national parks larger than 2,430 hectares (6,000 acres), and areas that have been redesignated as Class I. Class II areas are all areas not designated as Class I. No Class III areas have been designated (42 U.S.C. 7472 *et seq.*).

The ROI for air quality encompasses an area surrounding a candidate site that is potentially affected by air pollutant emissions caused by implementation of the alternatives. The air quality impact area normally evaluated is the area in which concentrations of criteria pollutants would increase more than a significant amount in a Class II area (on the basis of averaging period and pollutant: 1 microgram per cubic meter for the annual average for sulfur dioxide, nitrogen dioxide, and PM_{10};[1] 5 micrograms per cubic meter for the 24-hour average for sulfur dioxide and PM_{10}; 500 micrograms per cubic meter for the 8-hour average for carbon monoxide; 25 micrograms per cubic meter for the 3-hour average for sulfur dioxide; and 2,000 micrograms for the 1-hour average for carbon monoxide [40 CFR 51.165]). Generally, this covers a few kilometers downwind from the source. Further, for sources within 100 kilometers (60 miles) of a Class I area, the air quality impact area evaluated would include the Class I area if the increase in concentration of any air pollutants for which there are PSD increments is greater than 1 microgram per cubic meter (24-hour average). The area of the ROI depends on emission source characteristics, pollutant types, emission rates, and meteorological and topographical conditions. For the purpose of this analysis, impacts were evaluated at the site boundary and along roads within the sites to which the public has access, plus any additional areas in which contributions to pollutant concentrations are expected to exceed significant levels.

Baseline air quality is typically described in terms of pollutant concentrations modeled for existing sources at each candidate site and background air pollutant concentrations measured near the sites. For this analysis, emission data from existing sources were obtained from existing EISs and recent site environmental reports. Concentrations from these data were modeled using the Industrial Source Complex Short Term model (EPA 1995, 2000), or were obtained from existing documents.

B.4.2 Description of Impact Assessment

Potential air quality impacts of pollutant emissions from construction, normal operations, and deactivation were evaluated for each alternative. This assessment included a comparison of pollutant concentrations under each alternative with applicable Federal and state ambient air quality standards (see **Table B–5**). If both Federal and state standards exist for a given pollutant and averaging period, compliance was evaluated using the more stringent standard. Operational air pollutant emissions data for each alternative were based on conservative engineering analyses.

For each alternative, contributions to offsite air pollutant concentrations were modeled on the basis of guidance presented in EPA's "Guideline on Air Quality Models" (40 CFR 51, Appendix W). The EPA screening model, SCREEN 3, was selected as an appropriate model. The modeling analysis incorporated conservative assumptions, which tend to overestimate pollutant concentrations. The maximum modeled

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[1] *Particulate matter with an aerodynamic diameter less than or equal to 10 microns (10 microns = .00001 meters or .0004 inches).*

concentration was estimated for each pollutant and averaging time and compared with the applicable standard. The concentrations evaluated were the maximum occurring at or beyond the site boundary and at a public access road or other publicly accessible area within the site.

Table B–5 Impact Assessment Protocol for Air Quality

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Criteria air pollutants and other regulated pollutants [a]	Measured and modeled ambient concentrations (micrograms per cubic meter) from existing sources at site	Emission rate (kilograms per year) of air pollutants from facility; source characteristics (stack height and diameter, exit temperature and velocity)	Concentration of alternative and total site concentration of each pollutant at or beyond site boundary or within boundary on public road compared to applicable standard
Toxic and hazardous air pollutants [b]	Measured and modeled ambient concentrations (micrograms per cubic meter) from existing sources at site	Emission rate (kilograms per year) of air pollutants from facility; source characteristics (stack height and diameter, exit temperature and velocity)	Concentration of alternative of each pollutant at or beyond site boundary or within boundary on public road and compared to acceptable source impact level

[a] Carbon monoxide, hydrogen fluoride, lead, nitrogen oxides, ozone, PM_{10}, sulfur dioxide, total suspended particulates.

[b] Clean Air Act, Section 112, hazardous air pollutants: pollutants regulated under the National Emissions Standards for Hazardous Air Pollutants and other state-regulated pollutants.

B.5 Geology and Soils

B.5.1 Description of Affected Resources

Geologic resources include consolidated and unconsolidated earth materials, including rock and mineral assets such as ore and aggregate materials (e.g., sand, gravel) and fossil fuels such as coal, oil, and natural gas. Geologic conditions include hazards such as earthquakes, faults, volcanoes, landslides, sinkholes, and other conditions leading to land subsidence and unstable soils. Soil resources include the loose surface materials of the Earth in which plants grow, usually consisting of mineral particles from disintegrating rock, organic matter, and soluble salts. Certain soils are important farmlands, which are designated by the U.S. Department of Agriculture Natural Resources Conservation Service. Important farmlands include prime farmland, unique farmland, and other farmland of statewide or local importance as defined in 7 CFR 657.5 and could be subject to the Farmland Protection Policy Act (7 U.S.C. 4201 *et seq*.).

Geology and soils were considered with respect to those attributes and geologic and soil resources that could be affected by the alternatives, as well as those geologic conditions that could affect each alternative, including associated facilities. The ROI for geology and soils includes the site and nearby offsite areas subject to disturbance by construction, and/or modification, and operation of facilities for production of RPS and those areas beneath existing or new facilities that would remain inaccessible for the life of the facilities. Conditions that could affect the integrity and safety of existing, modified, or new facilities over the timeframe associated with each alternative include large-scale geologic hazards (e.g., earthquakes, volcanic activity, landslides, and land subsidence) and local hazards associated with the site-specific attributes of the soil and bedrock beneath site facilities. Thus, the area within which these geologic conditions exist is also used to define the ROI for this resource area.

B.5.2 Description of Impact Assessment

Construction, modification, and operation activities under each of the alternatives were considered from the perspective of direct impacts on specific geologic resources and soil attributes to encompass the consumption of geologic resources. Construction activities were the focus of the impact assessment for geologic and soil resources; hence, the land area to be disturbed and geologic resources consumed to support the alternatives considered, the depth and extent of required excavation work, land areas occupied during operations, and the identification of unstable geologic strata (such as soils or sediments prone to subsidence, liquefaction, shrink-swell, or erosion) were key factors in the analysis (see **Table B–6**).

Table B–6 Impact Assessment Protocol for Geology and Soils

Resource	***Required Data***		***Measure of Impact***
	Affected Environment	***Alternative***	
Geologic hazards	Presence of geologic hazards within the region of influence	Location of facilities	Potential for damage to facilities
Mineral and energy resources	Presence of any rare and/or valuable mineral or energy resources on the site and availability of geologic resources within the region of influence	Location of facilities and project activity demands	Potential to consume, destroy, or render resources inaccessible
Important farmland soils	Presence of prime farmland soils near the facility site locations	Location of facilities	Conversion of important farmland soils to nonagricultural use

The geology and soils impact analysis also considered risks to the facilities (existing, new, or modified) from large-scale geologic hazards such as faulting and earthquakes, lava extrusions and other volcanic activity, landslides, and sinkholes (i.e., conditions that tend to affect broad expanses of land). In general, the facility hazard assessment was based on the presence of any identified hazard and the distance of the facilities from it. This element of the assessment included collection of site-specific information on the potential for impacts on site facilities from local and large-scale geologic conditions. Historical seismicity within a given radius of the site was reviewed, and potential earthquake source areas were identified as a means of assessing the potential for future earthquake activity. Earthquakes are described in the *Consolidation EIS* in terms of several parameters, as presented in **Table B–7**. Probabilistic earthquake ground motion data, to include peak ground acceleration and response spectral acceleration, were evaluated for each site to provide a comparative assessment of seismic hazard. Peak ground acceleration is indicative of what an object on the ground would experience during an earthquake and approximates what a short structure would be subjected to in terms of horizontal force. It does not account for the range of energies experienced by a building during an earthquake, particularly taller buildings. Measures of spectral acceleration account for the natural period of vibration of structures (i.e., short buildings have short natural periods [up to 0.6 seconds], and taller buildings have longer periods [0.7 seconds or longer]) (USGS 2004a). Both parameters are used by the U.S. Geological Survey National Seismic Mapping Project. The U.S. Geological Survey's latest National Earthquake Hazards Reduction Program (NEHRP) maps are based on spectral acceleration and depict maximum considered earthquake ground motion of 0.2- and 1.0-second spectral acceleration, respectively, based on a 2 percent probability of exceedance in 50 years (i.e., corresponding to an annual probability of occurrence of about 1 in 2,500). The NEHRP maps have been adapted for use in the seismic design portions of the *International Building Code* (ICC 2003, USGS 2004b).

The NEHRP maps were developed based on the recommendations of the Building Seismic Safety Council's Seismic Design Procedures Group (BSSC 2004a, 2004b). The Seismic Design Procedures Group-recommended maps, the maximum considered earthquake ground motion maps, are derived from the U.S. Geological Survey's probabilistic hazard maps with additional modifications that incorporate deterministic ground motions in selected areas and the application of engineering judgment (USGS 2004b). Note that the maximum considered earthquake maps are based on a reference site condition (firm rock) and are suitable for determining estimates of maximum considered earthquake ground shaking for design purposes at most sites. For sites with nonreference conditions and for design of buildings requiring a higher degree of seismic safety, site-specific design procedures must be used (BSSC 2004b).

Table B–7 The Modified Mercalli Intensity Scale of 1931, with Generalized Correlations to Magnitude, Earthquake Classification, and Peak Ground Acceleration

Modified Mercalli Intensity [a]	*Observed Effects of Earthquake*	*Approximate Magnitude* [b]	*Class*	*Peak Ground Acceleration (g)* [c]
I	Usually not felt except by a very few under very favorable conditions.	Less than 3	Micro	Less than 0.0017
II	Felt only by a few persons at rest, especially on the upper floors of buildings.	3 to 3.9	Minor	0.0017 to 0.014
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck.			
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy object striking building. Standing motorcars rock noticeably.	4 to 4.9	Light	0.014 to 0.039
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.	4 to 4.9	Light	0.039 to 0.092
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	5 to 5.9	Moderate	0.092 to 0.18
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	6 to 6.9	Strong	0.18 to 0.34
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned.	7 to 7.9	Major	0.34 to 0.65
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.	7 to 7.9	Major	0.65 to 1.24
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.	7 to 7.9	Major	1.24 and higher
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.	8 and higher	Great	1.24 and higher
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.	8 and higher	Great	1.24 and higher

[a] Intensity is a unitless expression of observed effects of earthquake-produced ground shaking. Effects may vary greatly between locations based on earthquake magnitude, distance from the earthquake, and local subsurface geology. The descriptions given are abbreviated from the Modified Mercalli Intensity Scale of 1931.

[b] Magnitude is a logarithmic measure of the strength (size) of an earthquake related to the strain energy released by it. There are several magnitude “scales” (mathematical formulas) in common use, including local “Richter” magnitude, body wave magnitude, and surface wave magnitude. Each has applicability for measuring particular aspects of seismic signals and may be considered equivalent within each scale’s respective range of validity. For very large earthquakes, the moment magnitude scale provides the best overall measurement of earthquake size.

[c] Acceleration is expressed as a percent relative to the Earth’s gravitational acceleration (g) (i.e., [g] is equal to 980 centimeters per second squared). Given values are correlated to Modified Mercalli Intensity based on measurements of California earthquakes only (Wald et al. 1999).

Sources: Compiled from USGS 2004c, 2004d; Wald et al. 1999.

An evaluation was also performed to determine if estimated requirements for rock, aggregate, soil, and products derived from rock and mineral resources to support construction and operations activities under each of the alternatives could exceed available resource reserves or stockpiles in the affected regions of influence. Specifically included in this analysis was the provision of borrow materials from onsite quarries and borrow pits to support construction activities. This was accomplished by comparing projections of resource demands for construction and operations with analyses of resource availability at each site and in the affected region. In addition, the analysis of impacts on geologic resources included a determination of whether the construction and operations activities at a specific site could destroy, or preclude the use of, valuable rock, mineral, or energy resources at affected sites.

Pursuant to the Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 *et seq.*) and its implementing regulations, the presence of important farmland soils, including prime farmland, was also evaluated. This act requires agencies to make Farmland Protection Policy Act evaluations part of the National Environmental Policy Act (NEPA) process, the main purpose being to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. However, otherwise qualifying farmlands in or already committed to urban development, land acquired for a project on or prior to August 4, 1984, and lands acquired or used by a Federal agency for national defense purposes are exempt from the Act's provisions (7 CFR 658.2 and 658.3).

B.6 Water Resources

B.6.1 Description of Affected Resources

Water resources are the surface and subsurface waters that are suitable for human consumption, aquatic or wildlife use, agricultural purposes, irrigation, recreation, or industrial/commercial purposes. The ROI used for water resources encompasses those surface water and groundwater systems that could be impacted by water withdrawals, effluent discharges, and spills or stormwater runoff associated with facility construction, and/or modification, and operations activities under the alternatives. As such, the assessment methodologies described in the following subsections relate to the analysis of those project activities that would generally result in short-term impacts (i.e., limited to the timeframe during which the activity is being performed).

B.6.2 Description of Impact Assessment

Determination of the impacts of the alternatives on water resources consisted of a comparison of project activity data and professional estimates regarding water use and effluent discharges with applicable regulatory standards, design parameters and standards commonly used in the water and wastewater engineering fields, and recognized measures of environmental impact. Certain assumptions were made to facilitate the impact assessment: (1) all water supply production and treatment and effluent treatment facilities would be available and upgraded as necessary in accordance with the timeframe considered under each alternative; (2) the effluent treatment facilities would meet the effluent limitations imposed by the respective National Pollutant Discharge Elimination System permits and/or state-issued discharge permits; and (3) any stormwater runoff from construction and operations activities would be handled in accordance with the regulations of the appropriate permitting authority. It was also assumed that, during construction and other land-disturbing activities, sediment fencing or other erosion control devices would be used to mitigate short-term adverse impacts of sedimentation and that, as appropriate, stormwater holding ponds would be constructed to lessen the impacts of runoff on surface water quality.

B.6.2.1 Water Use and Availability

Impacts on water use and availability were generally assessed by determining changes in the volume of current water usage and effluent discharges as a result of the proposed activities (see **Table B–8**).

Table B–8 Impact Assessment Protocol for Water Use and Availability

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Surface water availability	Surface waters near the facilities, including average flow, low flow, and current usage	Volume of withdrawals from, and discharges to, surface waters	Changes in availability to local/downstream users of water for human consumption, irrigation, or animal feeding
Groundwater availability	Groundwater near the facilities, including existing water rights for major water users and current usage	Volume of withdrawals from, and discharges to, groundwater	Changes in availability of groundwater for human consumption, irrigation, or animal feeding

B.6.2.2 Water Quality

The water quality impact assessment for the *Consolidation EIS* analyzed how routine effluent discharges and nonroutine releases (e.g., spills, containment failure) to surface water, as well as discharges reaching groundwater, from facilities that would be required under each alternative could potentially affect current water quality over the short term. The impacts of the alternatives were assessed as summarized in **Table B–9** and included a comparison of the projected effluent quality with relevant regulatory standards and implementing regulations such as the Clean Water Act (33 U.S.C. 1251 *et seq.*), Safe Drinking Water Act (42 U.S.C. 300(f) *et seq.*), state laws, and existing site permit conditions. The impact analyses evaluated the potential for contaminants to affect receiving water quality as a result of spills and other releases under the alternatives. Separate analyses were conducted for surface water and groundwater impacts.

Table B–9 Impact Assessment Protocol for Water Quality

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Surface water quality	Surface waters near the facility locations in terms of stream classifications and changes in water quality	Expected contaminants and contaminant concentrations in discharges to surface waters	Exceedance of relevant surface water quality criteria or standards under the Clean Water Act or state regulations and existing permits
Groundwater quality	Groundwater near the facility locations in terms of classification, presence of designated sole-source aquifers, and changes in quality of groundwater	Expected contaminants and contaminant concentrations in discharges that could reach groundwater	Contaminant concentrations in groundwater exceeding relevant standards or criteria established in accordance with the Safe Drinking Water Act or state regulations and/or existing permits

B.6.2.2.1 Surface Water Quality

The evaluation of surface water quality impacts focused on the quality and quantity of any effluents (including stormwater) to be discharged as a result of facility construction, and/or modification, and operations, and the quality of the receiving stream upstream and downstream from the discharges. The evaluation of effluent quality featured review of the expected parameters, such as the expected average and maximum flows, as well as the nature and parameter concentrations in expected effluents. Parameters of concern include total suspended solids, heavy metals, radionuclides, organic and inorganic chemicals, and any other constituents that could affect the local environment. Factors that currently degrade water quality were also identified.

Surface waters could be affected by site runoff and silting during facility construction or related activities that result in ground disturbance. Such impacts relate to the amount of land disturbed, the type of soil at the site, the topography, and weather conditions. Applications of standard management practices for stormwater and erosion control (e.g., sediment fences, covering disturbed areas) could minimize the impact.

During operations, surface waters could be affected by increased runoff from impervious surfaces (e.g., buildings) or cleared areas. Stormwater from these areas could be contaminated with materials deposited by airborne pollutants, automobile exhaust and residues, materials-handling releases (such as spills), and process effluents. Impacts of stormwater discharges could be highly variable and site specific, and mitigation would depend on management practices, the design of holding facilities (if any), the topography, and adjacent land use. Information from existing water quality data sources were compared with expected discharges from the facilities to determine the potential for and the relative impacts on surface waters.

B.6.2.2.2 Groundwater Quality

Potential short-term groundwater quality impacts associated with effluent discharges and other contaminant releases associated with new facility construction, and/or modification, and operations were examined. Available engineering estimates of contaminant concentrations were weighed against applicable Federal and state groundwater quality standards, effluent limitations, and drinking water standards to determine the impacts of each alternative. The consequences of groundwater use, including dewatering, and effluent discharges on other site groundwater conditions were also evaluated.

B.6.2.3 Waterways and Floodplains

The locations of waterways (e.g., ponds, lakes, streams) and delineated floodplains or zones were identified from maps and other existing documents to assess the potential for impacts of proposed new facility construction and operations, including direct effects on hydrologic characteristics. No construction activities within the Materials and Fuels Complex (MFC) at the Idaho National Laboratory (INL) would take place within a floodplain. Construction of a new road for the transfer of unirradiated and irradiated targets could occur within the floodplain of the Big Lost River under one route being considered. Therefore, a preliminary floodplain/wetland assessment has been prepared pursuant to 10 CFR 1022 and Executive Order 11988, “Floodplain Management” (see Appendix F of this EIS).

B.7 Ecological Resources

B.7.1 Description of Affected Resources

Ecological resources include terrestrial and aquatic resources, wetlands, and threatened and endangered species. The ROI evaluated for ecological impacts encompassed those areas within the site potentially disturbed by facility construction and operations. To determine whether important ecological resources were present, previous surveys of the site were reviewed.

Terrestrial resources are defined as those plant and animal species and communities that are most closely associated with the land; for aquatic resources, a water environment. Wetlands are defined by the U.S. Army Corps of Engineers and EPA as “… those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

Endangered species are defined under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*) as those in danger of extinction throughout all or a large portion of their range. Threatened species are defined as those species likely to become endangered within the foreseeable future. The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service propose species to be added to the lists of threatened and endangered species. They also maintain a list of "candidate" species for which they have evidence that listing may be warranted, but for which listing is currently precluded by the need to list species more in need of Endangered Species Act protection. Candidate species do not receive legal protection under the Endangered Species Act, but should be considered in project planning in case they are listed in the future. Critical habitat for threatened and endangered species is designated by the USFWS or the National Marine Fisheries Service. Critical habitat is defined as specific areas that contain physical and biological features essential to the conservation of species and that may require special management consideration or protection. Most states also maintain lists of rare and endangered species as well as other special status species.

B.7.2 Description of Impact Assessment

Impacts on ecological resources could occur as a result of land disturbance, water use, human activity, and noise from the construction and operation of facilities associated with RPS production, including the proposed new road (see **Table B–10**). Night lighting could also impact site ecology. Each of these factors was considered when evaluating potential impacts of the proposed activities. Terrestrial resources could be directly affected through the loss of habitat, which could lead to the direct loss of nests and young animals. Habitat loss, as well as human intrusion and noise, could also result in the movement of more mobile wildlife to adjacent areas with similar habitat. If these areas were below the carrying capacity for the species involved, the animals would be expected to survive. However, displaced animals could be lost if the areas to which they moved were already heavily populated. Thus, the analysis of impacts on terrestrial wildlife was based largely on the extent of plant community loss or modification. Indirect impacts of factors such as human disturbance, noise, and night lighting were evaluated qualitatively.

Impacts on threatened and endangered species, state-protected species, and their habitats during construction of facilities were determined in a manner similar to that for other terrestrial and aquatic resources. A list of sensitive species that could be present at the site was compiled. Informal consultations were initiated with the appropriate USFWS offices and the state as part of the impact assessment for sensitive species.

B.8 Cultural Resources

B.8.1 Description of Affected Resources

Cultural resources are the indications of human occupation and use of property as defined and protected by a series of Federal laws, regulations, and guidelines. For the *Consolidation EIS*, potential impacts were assessed separately for each of the cultural resource categories: prehistoric, historic, and American Indian. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geologic age and could be sources of information on ancient environments and the evolutionary development of plants and animals. Although not governed by the same historic preservation laws as cultural resources, they could be affected by the Proposed Action in much the same manner.

Table B–10 Impact Assessment Protocol for Ecological Resources

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Terrestrial resources	Vegetation and wildlife within the vicinity of facilities	Area disturbed by facility site activities, air and water emissions, and noise	Loss or disturbance to terrestrial habitat; emissions and noise values above levels shown to cause impacts on terrestrial resources
Aquatic resources	Aquatic resources within the vicinity of facilities	Facility area air and water emissions, water source and quantity, and wastewater discharge location and quantity	Discharges above levels shown to cause impacts on aquatic resources
Wetlands	Wetlands within the vicinity of facilities	Area disturbed by facility site activities, air and water emissions, and wastewater discharge location and quantity	Loss or disturbance to wetlands
Threatened and endangered species	Threatened and endangered species within the vicinity of facilities	Area disturbed by facility site activities, air and water emissions, noise, water source and quantity, and wastewater discharge location and quantity	Determination that site activities could disturb threatened and endangered species and their habitats

Prehistoric resources are the physical remains of human activities that predate written records. They generally consist of artifacts that alone or collectively can yield information about the past. Historic resources consist of physical remains that postdate the emergence of written records. In the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492 and later. Ordinarily, sites less than 50 years old are not considered historic, but exceptions can be made for such properties if they are of particular importance, such as structures associated with World War II or Cold War themes. American Indian resources are sites, areas, and materials important to American Indians for religious or heritage reasons. Such resources may include geographic features, plants, animals, cemeteries, battlefields, trails, and environmental features. The ROI for cultural resource analysis encompasses those areas within the site that would potentially be disturbed by facility construction and occupied during operations.

B.8.2 Description of Impact Assessment

The analysis of impacts on cultural resources addressed potential direct and indirect impacts at each site (see **Table B–11**). To determine whether cultural resources were present, previous surveys of facility locations were examined.

Potential indirect impacts include those associated with reduced access to a resource site, as well as impacts associated with increased traffic and visitation to sensitive areas. Direct impacts include those resulting from ground-disturbing activities associated with construction and operations. Consultations to comply with Section 106 of the National Historic Preservation Act are being conducted with the State Historic Preservation Officer. Correspondence offering consultation was sent to American Indian tribes.

Table B–11 Impact Assessment Protocol for Cultural Resources

Resource	***Required Data***		***Measure of Impact***
	Affected Environment	***Alternative***	
Prehistoric and historic resources	Prehistoric and historic resources within the vicinity of facilities	Location of facilities on the site and facility acreage requirements	Potential for loss, isolation, or alteration of the character of prehistoric and historic resources; introduction of visual, audible, or atmospheric elements out of character; neglect of resources listed or eligible for listing on the National Register of Historic Places
American Indian resources	American Indian resources within the vicinity of facilities	Location of facilities on the site and facility acreage requirements	Potential for loss, isolation, or alteration of the character of American Indian resources; introduction of visual, audible, or atmospheric elements out of character
Paleontological resources	Paleontological resources within the vicinity of facilities	Location of facilities on the site and facility acreage requirements	Potential for loss, isolation, or alteration of paleontological resources

B.9 Public and Occupational Health and Safety

B.9.1 Description of Affected Resources

The assessment of public and occupational safety and health includes determining the potential adverse effects on human health of exposure to ionizing radiation and hazardous chemicals. Health effects are determined by identifying the type and quantities of additional material (radioactive and chemical) to which one might be exposed, estimating chemical concentrations and radiological doses, and then calculating the resultant health effects (latent cancer fatalities [LCFs]). The impacts of various releases during normal activities and postulated accidents on human health of workers and the public residing within 80 kilometers (50 miles) of each site were assessed. This assessment used site-specific factors such as meteorology, population distribution, and nearest public resident. More detailed information on analysis approach, modeling, the types and quantities of materials released during normal operation and accident conditions is provided in Appendix C of this EIS.

B.9.2 Description of Impact Assessment

Health effects, in terms of incremental doses and related risks (LCFs), were assessed based on the types and quantities of material released. Models were used to project the impacts on the health of workers and the public of releases during normal, or incident-free, operations. The models included:

- GENII (PNL 1988) for all radioactive material released during normal operations,
- MACCS2 (SNL 1997) for all radioactive material released during accident conditions, and
- ALOHA (EPA 1999b) for hazardous chemicals released during accident conditions

Detailed discussions of application of these models are provided in Appendix C of this EIS.

B.10 Transportation

B.10.1 Description of Affected Resources

Transportation of any commodity involves a risk to both transportation crewmembers and members of the public. This risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of certain materials, such as hazardous or radioactive waste, can pose an additional risk due to the unique nature of the material itself. To permit a complete appraisal of the environmental impacts of the Proposed Action and alternatives, the human health risks associated with the transportation of radioactive materials on public highways and railroads were assessed.

Transportation impacts consist of two parts: the impacts of incident-free, or routine, transportation and the impacts of transportation accidents. Incident-free transportation impacts include radiological impacts on the public and the workers from the radiation field surrounding the transportation package. Nonradiological impacts of potential transportation accidents include traffic accident fatalities.

Transportation-related risks are calculated and presented separately for workers (truck drivers or railroad engineers) and members of the general public (residing or in vehicles along the routes and those at rest and refueling stops). For the incident-free operation, 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 residing within 80 kilometers (50 miles) of the accident, and the maximally exposed individual, who would be an individual located 100 meters (330 feet) directly downwind from the accident. The risk to the affected population is a measure of the radiological risk posed to society as a whole by the alternatives being considered. As such, the impact on the affected population is used as the primary means of comparing various alternatives. In addition, the nonradiological risk associated with traffic accident fatalities is another comparison parameter among the alternatives.

B.10.2 Description of Impact Assessment

The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing the individual risks from all reasonably conceivable accidents. Only as a result of a severe fire and/or a powerful collision, which are of extremely low probability, could a transportation package of the type used to transport radioactive material be damaged to the extent that there could be a release of radioactivity to the environment with significant consequences. In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive material, the consequences of maximum reasonably foreseeable accidents, events with a probability greater than 1×10^{-7} (1 chance in 10 million) per year, were also assessed. The latter consequences are determined for atmospheric conditions likely to prevail during accidents. The analysis used the RISKIND computer code to estimate doses to individuals and populations (Yuan et al. 1995).

The risks of incident-free effects are expressed in additional LCFs. The risks of radiological accidents are expressed as additional LCFs and, for nonradiological accidents, as additional immediate (traffic) fatalities.

In determining the transportation risks, per shipment risk factors are calculated for the incident-free and accident conditions using the RADTRAN 5 computer program (SNL 2003) in conjunction with the Transportation Routing Analysis Geographic Information System (TRAGIS) computer program (Johnson and Michelhaugh 2003) to choose representative routes in accordance with U.S. Department of Transportation regulations. The TRAGIS program provides population estimates along the representative routes for determining the population radiological risk factors. Details on analysis approach, modeling, and parameter selections are provided in Appendix D of this EIS.

B.11 Socioeconomics

B.11.1 Description of Affected Resources

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by the Proposed Action could affect regional employment, income, and expenditures. Job creation is generally characterized by two types: (1) construction-related jobs, that are transient in nature and short in duration, and thus less likely to have a longer term socioeconomic impact; and (2) operations-related jobs in support of facility operations, required for a longer period of time, that have the greater potential for permanent socioeconomic impacts in the ROI.

The socioeconomic environment is generally made up of regional economic indicators and demographic characteristics of the area. Economic indicators include employment, the civilian labor force, and unemployment rates. Demographic characteristics include population, housing, education, health and local transportation information.

B.11.2 Description of Impact Assessment

For each county in the ROI, data were compiled on current socioeconomic conditions, including employment, the civilian labor force, and unemployment. Census data were compiled for population, housing, and community services. U.S. Bureau of the Census population estimates for the regions of influence were combined with overall projected workforce requirements for each alternative to determine the extent of impacts on regional economic and demographic (population) characteristics, including levels of demand for housing and community services, and local transportation impacts (see **Table B–12**).

B.12 Waste Management

B.12.1 Description of Affected Resources

Depending on the alternative, construction and operation of facilities associated with production of RPS would generate several types of waste. Such wastes could include the following:

- Mixed transuranic waste: Radioactive waste not classified as high-level radioactive waste and containing more than 100 nanocuries per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years that also contains hazardous components regulated under the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 *et seq.*).

- Low-level radioactive waste: Waste that contains radioactivity and is not classified as high-level radioactive waste, transuranic waste, or spent nuclear fuel, or the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the transuranic concentration is less than 100 nanocuries per gram of waste.

Table B–12 Impact Assessment Protocol for Socioeconomics

Resource	***Required Data***		***Measure of Impact***
	Affected Environment	***Alternative***	
Regional Economic Characteristics			
Workforce requirements	Site workforce projections	Estimated construction and operations staffing requirements and timeframes	Workforce requirements added to sites' workforce projections
Region of influence – civilian labor force	Labor force estimates from the Census Bureau	Estimated construction and operations staffing requirements and timeframes	Workforce requirements as a percentage of the civilian labor force
Employment rate	Latest available employment data in counties surrounding the site from the Census Bureau	Estimated construction and operations staffing requirements and timeframes	Potential change in unemployment
Demographic Characteristics			
Population and demographics of race, ethnicity, and income	Latest available estimates by county from the Census Bureau	Estimated effect on population	Potential effects on population
Housing and Community Services			
Housing – percent of occupied housing units (houses and apartments)	Latest available ratios from the Census Bureau	Estimated housing unit requirements	Potential change in housing unit availability
Education - Total enrollment - Teacher-to-student ratio	Latest available information for local school districts or state and county estimates	Estimated effect on enrollment and teacher-to-student ratio	Projected change in teacher-to-student ratio
Health care – number of hospital beds and physicians per 1,000 residents	Latest available rates from the Census Bureau	Estimated effect on health care services	Potential change in the availability of hospital beds/ physicians
Local Transportation			
Traffic – number of vehicles	Latest available information on traffic conditions affecting site access roads, intrasite road, and local regional transportation networks	Estimated number of commuter and truck vehicle trips to and from the site	Projected change in traffic conditions

- Mixed low-level radioactive waste: low-level radioactive waste that also contains hazardous components regulated under RCRA (42 U.S.C. 6901 *et seq.*).

- Hazardous waste: Under RCRA, a solid waste that, because of its characteristics, may: (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes appear on special EPA lists or possess at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (42 U.S.C. 2011 *et seq.*).

- Nonhazardous solid waste: Discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (42 U.S.C. 2011 *et seq.*).

The alternatives could have an impact on existing U.S. Department of Energy (DOE) facilities devoted to the treatment, storage, and disposal of these categories of waste.

B.12.2 Description of Impact Assessment

As shown in **Table B–13**, impacts were assessed by comparing the projected wastestream volumes generated from the proposed activities under each alternative with the site's waste management capacities and generation rates. Only the impacts relative to the capacities of waste management facilities were considered; other environmental impacts of waste management facility operations (human health effects) are evaluated in other facility-specific or sitewide NEPA documents.

Table B–13 Impact Assessment Protocol for Waste Management

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Waste management capacity - Mixed transuranic waste - Low-level radioactive waste - Mixed low-level radioactive waste - Hazardous waste - Nonhazardous waste	Site generation rates (cubic meters per year) for each waste type Site management capacities (cubic meters) or rates (cubic meters per year) for potentially affected treatment, storage, and disposal facilities for each waste type	Generation rates (cubic meters per year) for each waste type	Combination of facility waste generation volumes and other site generation volumes in comparison to the capacities of applicable waste management facilities

B.13 Cumulative Impacts

This section describes the methodology used to estimate cumulative impacts. The methodology includes subsections describing: (1) regulations and guidance, (2) approach to cumulative impacts, (3) uncertainties, (4) selection of resource areas for analysis, (5) spatial and temporal considerations, and (6) description of impact assessment.

B.13.1 Regulations and Guidance

Cumulative impacts analysis in DOE NEPA documents is governed by the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (CEQ regulations) (40 CFR 1500-1508) and the DOE NEPA Implementing Procedures (10 CFR 1021). Because specific requirements are not incorporated in the CEQ and DOE regulations, one must look to *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997), and *Consideration of Cumulative Impacts in EPA Review of National Environmental Policy Act Documents* (EPA 1999a) for guidance on how to conduct cumulative impact analyses.

The CEQ regulations (40 CFR 1500-1508) define cumulative effects as impacts on the environment that result from the Proposed Action 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, no matter what entity (Federal, non-Federal, or private) is taking the action (EPA 1999a).

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. Said another way, the effects of human activities will accumulate when a second perturbation occurs at a site before the system can fully rebound from the effect of the first perturbation.

While there is no universally accepted framework for cumulative effects analysis, eight general principles identified in *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997) have gained acceptance. These eight principles are based on the premise that resources, ecosystems, and the human community each can experience effects. For each of these there are thresholds, or levels, of stress beyond which their desired condition degrades.

Following is a summary of the CEQ's eight principles of cumulative effects analysis:

1. Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions. This includes any other actions that affect the same resources.

2. Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, or human community of all actions taken, no matter who (Federal, non-Federal, or private) has taken the actions. Effects of individual activities may interact to cause additional effects not apparent when looking at individual effects one at a time.

3. Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, or human community being affected, as opposed to from the perspective of the Proposed Action. Analyzing cumulative effects involves developing an understanding of how the resources are susceptible to effects.

4. It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those effects that are truly meaningful. The boundaries for evaluating cumulative effects should be expanded to the point at which the resource is no longer affected significantly or the effects are no longer of interest to affected parties.

5. Cumulative effects on a given resource, ecosystem, or human community are rarely aligned with political or administration boundaries. Cumulative effects analysis on natural systems must use natural ecological boundaries; analysis of human communities must use actual sociocultural boundaries to ensure including all effects.

6. Cumulative effects may result from accumulation of similar effects, or from the synergistic interaction of different effects. In some cases, the net adverse cumulative effect is less than the sum of the individual effects; in other cases, the net adverse cumulative effect is greater.

7. Cumulative effects may last for many years beyond the life of the action that caused the effects. An example is radioactive contamination. Cumulative effects analysis needs to apply the best science and forecasting techniques.

8. Each affected resource, ecosystem, or human community must be analyzed in terms of its capacity to accommodate additional effects, based on its own time and space parameters. The most effective cumulative effects analysis focuses on what is needed to ensure long-term productivity or sustainability of the resource.

The methodology used in the *Consolidation EIS* incorporates these eight principles.

B.13.2 Approach to Cumulative Impacts

Region of Influence (ROI):

A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

In general, the following approach was used:

- The ROI for impacts associated with projects analyzed in this EIS was defined.
- The affected environment and baseline conditions were identified.
- 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.

B.13.3 Uncertainties

As described above, cumulative impacts were assessed by combining the smallest and largest potential effects of *Consolidation 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, the set of actions that impact air quality occurs at different times and locations across the ROI, and, therefore, it is unlikely that the impacts are completely additive. The effects were combined irrespective of the time and location of the impact, even though they do not necessarily occur in the same timeframe, to envelope any uncertainties in the projected activities and their effects. This approach produces a maximum estimation of cumulative impacts for the activities considered.

B.13.4 Selection of Resource Areas for Analysis

As shown in **Table B–14**, the following resource areas were selected for cumulative impact analysis: land resources; site infrastructure (i.e., employment, electricity, and water use); geology and soils; air quality; ecological resources; cultural resources; public health and safety; occupational health and safety; transportation; and waste management.

Table B–14 Selection of Resource Areas for Cumulative Impact Analysis

Resource Area	*Evaluated in Recent EIS* [a]	*Historically Important* [b]	*Appreciable Impact in this Consolidation EIS* [c]
Land resources	X	X	X
Site infrastructure	X		
Geology and soils	X		X
Air quality	X		
Ecological resources	X	X	X
Cultural resources	X	X	X
Public health and safety	X	X	
Occupational health and safety	X	X	X
Transportation	X	X	X
Waste Management	X	X	X

EIS = environmental impact statement.

[a] From Table B–14.

[b] From Chapter 3, *Consolidation EIS*.

[c] From Chapter 4, *Consolidation EIS*.

These resource areas were selected based on examination of previous INL NEPA documents, an examination of resource areas in the region with historically appreciable effects, and the potential for appreciable environmental effects of implementing the *Consolidation EIS* alternatives. This is consistent with CEQ cumulative effects analysis principles No. 3: *"Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, or human community being affected…"* and No. 4: *"…the list of environmental effects must focus on those effects that are truly meaningful"* (CEQ 1997). The resource areas selected are those most likely to have potential for meaningful cumulative impacts.

B.13.5 Spatial and Temporal Considerations

The environmental impacts of an action have limits in both space (geographically) and time (temporally). Cumulative impacts of past, present, and reasonably foreseeable future actions have similar limits.

Spatial considerations determine the geographic area to be evaluated. The geographic area (ROI) to be evaluated is specific to each resource area and includes the area that may be affected by cumulative impacts. The ROIs used in the cumulative impact analysis are summarized in **Table B–15**. Many of these are the same as those described in the introduction to Chapter 3 of this EIS.

Table B–15 Regions of Influence for Resource Areas Evaluated in the Cumulative Impact Analysis

Resource Area	*Region of Influence*
Land resources	Includes the site, and nearby offsite land areas within local planning jurisdictions
Site infrastructure	Includes the site, and areas immediately adjacent to the site that supply the majority of resources (i.e., land, workers, electricity, and water)
Geology and soils	Includes the site, and nearby offsite areas
Air quality	Includes the site, and nearby offsite areas within local air quality control regions
Ecological resources	Includes the site, and nearby offsite plants, animals, and habitat that could be affected
Cultural resources	Includes the site, and nearby offsite cultural resources that could be affected
Public health and safety	Includes the site, offsite areas within 80 kilometers (50 miles) of the site, and transportation corridors
Occupational health and safety	Includes the site, and transportation corridors; limited to workers
Transportation	Includes the site, and local offsite transportation corridors
Waste management	Includes site waste management facilities and other offsite areas in the region where wastes are managed

This *Consolidation EIS* evaluates impacts for a 35-year timeframe for the No Action Alternative. The Consolidation Alternative evaluates impacts for a 2-year construction period, a 1-year startup/testing period, and a 35-year operating period. The Consolidation with Bridge Alternative spans the period from 2007 to 2047 and includes a 5-year bridge period, and a 35-year operating period. The impacts of other present and future actions within this timeframe were considered. In addition, actions that have impacts that remain even after the activity is completed (residual impacts) were also considered.

B.13.6 Description of Impact Assessment

Based on examination of the potential environmental effects of implementing *Consolidation EIS* alternatives, DOE and other agency actions in the region, and private actions, DOE selected a suite of resource areas that were likely to have potential for cumulative impacts and need to be analyzed. The selected indicators of cumulative impacts are shown in **Table B–16**.

Table B–16 Indicators of Cumulative Impacts

Category	*Indicator*
Land resources	- Land disturbed compared with local land availability
Site infrastructure	- Electricity use compared with local capacity - Water use compared with local capacity - Peak site employment
Geology and soils	- Geologic materials needed compared to amounts available
Air quality	- Criteria pollutant concentrations compared with standards or guidelines
Ecological resources	- Exposure of plants and animals to contaminant emissions
Cultural resources	- Disturbance of cultural resources
Public health and safety	- Offsite population dose and latent cancer fatalities - Maximally exposed individual dose - Comparison with dose limits and background dose
Occupational health and safety	- Total dose and latent cancer fatalities - Comparison with dose limits and background dose
Transportation	- Public Total dose and latent cancer fatalities Maximally exposed individual dose - Transportation workers Total dose and latent cancer fatalities Maximally exposed individual dose - Traffic fatalities
Waste management	- Transuranic waste generation rate compared with existing management capacities and generation rate - Low-level radioactive waste generation rate compared with existing management capacities and generation rate - Mixed low-level radioactive waste generation rate compared with existing management capacities and generation rate - Hazardous waste generation rate compared with existing management capacities and generation rate - Nonhazardous waste generation rate compared with existing management capacities and generation rate

B.14 Environmental Justice

B.14.1 Description of Affected Resources

Environmental justice assesses the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations that could result from implementation of the alternatives in the *Consolidation EIS*. In assessing the impacts, the following definitions of minority individuals and populations and low-income population were used:

- Minority individuals: Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races.

- Minority populations: Minority populations are identified 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 the minority population percentage in the general population or other appropriate unit of geographic analysis.

- Low-income population: Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's *Current Population Reports*, Series PB60, on Income and Poverty.

Consistent with the impact analysis for the public and occupational health and safety, the affected populations are defined as those minority and low-income populations that reside within an 80-kilometer (50-mile) radius centered on the candidate facilities at the site for production of RPS.

B.14.2 Description of Impact Assessment

Adverse health effects are measured in risks and rates that could result in LCFs as well as other fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. The minority and low-income populations are subsets of the general public residing around the site, and all are exposed to the same hazards generated from various operations at the site. Therefore, estimates for environmental justice impacts are determined using either the human health risks results or similar methods provided in Appendix C of this EIS.

B.15 References

BSSC (Building Seismic Safety Council), 2004a, 2003 Edition *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, Part 1: Provisions* (FEMA 450), Washington, DC, Available at http://www.bssconline.org/.

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APPENDIX C

EVALUATION OF RADIOLOGICAL AND HAZARDOUS CHEMICAL HUMAN HEALTH IMPACTS FROM ROUTINE NORMAL OPERATIONS AND ACCIDENT CONDITIONS

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EVALUATION OF RADIOLOGICAL AND HAZARDOUS CHEMICAL HUMAN HEALTH IMPACTS FROM ROUTINE NORMAL OPERATIONS AND ACCIDENT CONDITIONS

C.1 Introduction

This appendix provides a brief general discussion of radiation and its health effects. It also describes the methods and assumptions used for estimating the potential impacts and risks to individuals and the general public from exposure to releases of radioactivity during normal operations and postulated accidents involving releases of radioactivity or hazardous chemicals at facilities used for the production of radioisotope power systems (RPS).

This appendix presents numerical information using engineering and/or scientific notation. For example, the number 100,000 also can be expressed as 1×10^5. The fraction 0.001 can be expressed as 1×10^{-3}. The following chart defines the equivalent numerical notations that may be used in this appendix.

Fractions and Multiples of Units

Multiple	*Decimal Equivalent*	*Prefix*	*Symbol*
1×10^6	1,000,000	mega-	M
1×10^3	1,000	kilo-	k
1×10^2	100	hecto-	h
1×10	10	deka-	da
1×10^{-1}	0.1	deci-	d
1×10^{-2}	0.01	centi-	c
1×10^{-3}	0.001	milli-	m
1×10^{-6}	0.000001	micro-	µ

C.1.1 Radiological Impacts on Human Health

Radiation exposure and its consequences are topics of interest to the general public. For this reason, this environmental impact statement (EIS) places emphasis on the consequences of exposure to radiation, provides the reader with information on the nature of radiation, and explains the basic concepts used in the evaluation of radiation health effects.

C.1.1.1 Nature of Radiation and Its Effects on Humans

What Is Radiation?

Radiation is energy transferred in the form of particles or waves. Globally, human beings are exposed constantly to radiation from the solar system and the Earth's rocks and soil. This radiation contributes to the natural background radiation that always surrounds us. Manmade sources of radiation also exist, including medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants.

All matter in the universe is composed of atoms. Radiation comes from the activity of tiny particles within an atom. An atom consists of a positively charged nucleus (central part of an atom) with a number of negatively charged electron particles in various orbits around the nucleus. There are two types of particles in the nucleus: neutrons that are electrically neutral and protons that are positively charged. Atoms of different types are known as elements. There are more than 100 natural and manmade elements. An element has equal numbers of electrons and protons. When atoms of an element differ in their number of neutrons, they are called isotopes of that element. All elements have three or more isotopes, some or all of which could be unstable (i.e., decay with time).

Unstable isotopes undergo spontaneous change, known as radioactive disintegration or radioactive decay. The process of continuously undergoing spontaneous disintegration is called radioactivity. The radioactivity of a material decreases with time. The time it takes a material to lose half of its original radioactivity is its half-life. An isotope's half-life is a measure of its decay rate. For example, an isotope with a half-life of 8 days will lose one-half of its radioactivity in that amount of time. In 8 more days, one-half of the remaining radioactivity will be lost, and so on. Each radioactive element has a characteristic half-life. The half-lives of various radioactive elements may vary from millionths of a second to millions of years.

As unstable isotopes change into more stable forms, they emit electrically charged particles. These particles may be either alpha particles (a helium nucleus) or beta particles (an electron), with various levels of kinetic energy. Sometimes these particles are emitted in conjunction with gamma rays. The alpha and beta particles are frequently referred to as ionizing radiation. Ionizing radiation refers to the fact that the charged particle energy force can ionize, or electrically charge, an atom by stripping off one of its electrons. Gamma rays, even though they do not carry an electric charge as they pass through an element, can ionize atoms by ejecting electrons. Thus, they cause ionization indirectly. Ionizing radiation can cause a change in the chemical composition of many things, including living tissue (organs), which can affect the way they function.

When a radioactive isotope of an element emits a particle, it changes to an entirely different element, one that may or may not be radioactive. Eventually, a stable element is formed. This transformation, which may take several steps, is known as a decay chain. For example, radium, which is a member of the radioactive decay chain of uranium, has a half-life of 1,622 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays first to polonium, then through a series of further decay steps to bismuth, and ultimately to a stable isotope of lead. Meanwhile, the decay products will build up and eventually die away as time progresses.

The characteristics of various forms of ionizing radiation are briefly described below and in the box to the right.

Radiation Type	***Typical Travel Distance in Air***	***Barrier***
α	Few centimeters	Sheet of paper or skin's surface
β	Few meters	Thin sheet of aluminum foil or glass
γ	Very large	Thick wall of concrete, lead, or steel
η	Very large	Water, paraffin, graphite

Alpha (α)—Alpha particles are the heaviest type of ionizing radiation. They can travel only a few centimeters in air. Alpha particles lose their energy almost as soon as they collide with anything. They can be stopped easily by a sheet of paper or by the skin's surface.

Beta (β)—Beta particles are much (7,330 times) lighter than alpha particles. They can travel a longer distance than alpha particles in the air. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but can be stopped by a thin sheet of aluminum foil or glass.

Gamma (γ)—Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma rays travel at the speed of light. Gamma radiation is very penetrating and requires a thick wall of concrete, lead, or steel to stop it.

Neutrons (n)—Neutrons are particles that contribute to radiation exposure both directly and indirectly. The most prolific source of neutrons is a nuclear reactor. Indirect radiation exposure occurs when gamma rays and alpha particles are emitted following neutron capture in matter. A neutron has about one-quarter the weight of an alpha particle. It will travel in the air until it is absorbed in another element.

Units for Measuring Radiation

During the early days of radiological experience, there was no precise unit for radiation measure. Therefore, a variety of units were used to measure radiation. These units were used to determine the amount, type, and intensity of radiation. Just as heat can be measured in terms of its intensity or effects using units of calories or degrees, amounts of radiation or its effects can be measured in units of curies, radiation absorbed dose (rad), or dose equivalent (roentgen equivalent man, or rem). The following summarizes those units.

Curie—The curie, named after French scientists Marie and Pierre Curie, describes the "intensity" of a sample of radioactive material. The rate of decay of 1 gram of radium was the basis of this unit of measure. Because the measured decay rate kept changing slightly as measurement techniques became more accurate, the curie was subsequently defined as exactly 3.7×10^{10} disintegrations (decays) per second.

Rad—The rad is the unit of measurement for the physical absorption of radiation. The total energy absorbed per unit quantity of tissue is referred to as absorbed dose (or simply dose). As sunlight heats pavement by giving up an amount of energy to it, radiation similarly gives up energy to objects in its path. One rad is equal to the amount of radiation that leads to the deposition of 0.01 joule of energy per kilogram of absorbing material.

Radiation Units and Conversions to International System of Units

1 curie	= 3.7×10^{10} disintegrations per second
	= 3.7×10^{10} becquerels
1 becquerel	= 1 disintegration per second
1 rad	= 0.01 gray
1 rem	= 0.01 sievert
1 gray	= 1 joule per kilogram

Rem—A rem is a measurement of the dose equivalent from radiation based on its biological effects. The rem is used in measuring the effects of radiation on the body as degrees Centigrade are used in measuring the effects of sunlight heating pavement. Thus, 1 rem of one type of radiation is presumed to have the same biological effects as 1 rem of any other kind of radiation. This allows comparison of the biological effects of radionuclides that emit different types of radiation.

The units of radiation measure in the International System of Units are: becquerel (a measure of source intensity [activity]), gray (a measure of absorbed dose), and sievert (a measure of dose equivalent).

An individual may be exposed to ionizing radiation externally (from a radioactive source outside the body) or internally (from ingesting or inhaling radioactive material). The external dose is different from the internal dose because an external dose is delivered only during the actual time of exposure to the external radiation source, while an internal dose continues to be delivered as long as the radioactive source is in the body. The dose from internal exposure is calculated over 50 years following the initial exposure. Both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time.

Sources of Radiation

The average American receives a total of approximately 360 millirem per year from all sources of radiation, both natural and manmade, of which approximately 300 millirem per year are from natural sources. The sources of radiation can be divided into six different categories: cosmic radiation, terrestrial radiation, internal radiation, consumer products, medical diagnosis and therapy, and other sources (NCRP 1987). These categories are discussed in the following paragraphs.

Cosmic Radiation—Cosmic radiation is ionizing radiation resulting from energetic charged particles from space continuously hitting the Earth's atmosphere. These particles and the secondary particles and photons they create comprise cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with the altitude above sea level. The average dose to people in the United States from this source is approximately 27 millirem per year.

External Terrestrial Radiation—External terrestrial radiation is the radiation emitted from the radioactive materials in the Earth's rocks and soils. The average dose from external terrestrial radiation is approximately 28 millirem per year.

Internal Radiation—Internal radiation results from the human body metabolizing natural radioactive material that has entered the body by inhalation or ingestion. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributors to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon, which contribute approximately 200 millirem per year. The average dose from other internal radionuclides is approximately 39 millirem per year.

Consumer Products—Consumer products also contain sources of ionizing radiation. In some products, such as smoke detectors and airport x-ray machines, the radiation source is essential to the product's operation. In other products, such as televisions and tobacco, the radiation occurs as the products function. The average dose from consumer products is approximately 10 millirem per year.

Medical Diagnosis and Therapy—Radiation is an important diagnostic medical tool and cancer treatment. Diagnostic x-rays result in an average exposure of 39 millirem per year. Nuclear medical procedures result in an average exposure of 14 millirem per year.

Other Sources—There are a few additional sources of radiation that contribute minor doses to individuals in the United States. The dose from nuclear fuel cycle facilities (e.g., uranium mines, mills, and fuel processing plants) and nuclear power plants has been estimated to be less than 1 millirem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions from certain mineral extraction facilities, and transportation of radioactive materials contribute less than 1 millirem per year to the average dose to an individual. Air travel contributes approximately 1 millirem per year to the average dose.

Exposure Pathways

As stated earlier, an individual may be exposed to ionizing radiation both externally and internally. The different ways that could result in radiation exposure to an individual are called exposure pathways. Each type of exposure is discussed separately in the following paragraphs.

External Exposure—External exposure can result from several different pathways, all resulting from radiation that is external to the body. Such pathways include exposure to a cloud of radiation passing over the receptor (an exposed individual), standing on ground that is contaminated with radioactivity, and swimming or boating in contaminated water. If the receptor leaves the source of radiation exposure, the dose rate will be reduced. It is assumed that external exposure occurs uniformly during the year. The appropriate dose measure is called the effective dose equivalent.

Internal Exposure—Internal exposure results from a radiation source entering the human body through either inhalation of contaminated air or ingestion of contaminated food or water. In contrast to external exposure, once a radiation source enters the body, it remains there for a period of time that varies depending on decay and biological half-life. The absorbed dose to each organ of the body is calculated for a period of 50 years following the intake. The calculated absorbed dose is called the committed dose equivalent. Various organs have different susceptibilities to damage from radiation. The quantity that takes these different susceptibilities into account is called the committed effective dose equivalent, and it provides a broad indicator of the risk to the health of an individual from radiation. The committed effective dose equivalent is a weighted sum of the committed dose equivalent in each major organ or tissue. The concept of committed effective dose equivalent applies only to internal pathways.

Radiation Protection Guides

Several organizations have issued radiation protection guides. The responsibilities of the main radiation safety organizations, particularly those that affect policies in the United States, are summarized below.

International Commission on Radiological Protection (ICRP)—This Commission has the responsibility for providing guidance in matters of radiation safety. The operating policy of this organization is to prepare recommendations to deal with basic principles of radiation protection and to leave to the various national protection committees the responsibility of introducing the detailed technical regulations, recommendations, or codes of practice best suited to the needs of their countries.

National Council on Radiation Protection and Measurements (NCRP)—In the United States, this Council is the national organization that has the responsibility for adapting and providing detailed technical guidelines for implementing the ICRP recommendations. The Council consists of technical experts who are specialists in radiation protection and scientists who are experts in disciplines that form the basis for radiation protection.

National Research Council/National Academy of Sciences—The National Research Council is an organization within the National Academy of Sciences that associates the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the Federal Government.

U.S. Environmental Protection Agency (EPA)—The EPA has published a series of documents, *Radiation Protection Guidance to Federal Agencies*. This guidance is used as a regulatory benchmark by a number of Federal agencies, including the U.S. Department of Energy (DOE), in the realm of limiting public and occupational work force exposures to the greatest extent possible.

The Interagency Steering Committee on Radiation Standards (ISCORS), issued a technical report entitled "*A Method for Estimating Radiation Risk from TEDE.*" ISCORS technical reports serve as guidance to Federal agencies to assist them in preparing and reporting the results of analyses and implementing radiation protection standards in a consistent and uniform manner. This report provides dose-to-risk conversion factors where doses are estimated using total effective dose equivalent (TEDE). It is recommended for use by DOE personnel and contractors when computing potential radiation risk from calculated radiation dose for comparison purposes. However, for situations in which a radiation risk assessment is required for making risk management decisions, the radionuclide-specific risk coefficients in the EPA's *Federal Radiation Guidance Report No. 13*, "*Cancer Risk Coefficients for Environmental Exposure to Radionuclides*," should be used.

Limits of Radiation Exposure

Limits of exposure to members of the public and radiation workers are derived from ICRP recommendations. The EPA uses the NCRP and Measurements and the ICRP recommendations and sets specific annual exposure limits (usually less than those specified by the Commission) in *Radiation Protection Guidance to Federal Agencies* documents. Each regulatory organization then establishes its own set of radiation standards. The various exposure limits set by DOE and the EPA for radiation workers and members of the public are given in **Table C–1**.

Table C–1 Exposure Limits for Members of the Public and Radiation Workers

Guidance Criteria (Organization)	*Public Exposure Limits at the Site Boundary*	*Worker Exposure Limits*
10 CFR 835 (DOE)	–	5 rem per year [a]
10 CFR 835.1002 (DOE)	–	1 rem per year [b]
DOE Order 5400.5 (DOE) [c]	0.01 rem per year (all air pathways) 0.004 rem per year (drinking water pathway) 0.1 rem per year (all pathways)	–
40 CFR 61 (EPA)	0.01 rem per year (all air pathways)	–
40 CFR 141 (EPA)	0.004 rem per year (drinking water pathways)	–

CFR = *Code of Federal Regulations.*

[a] Although this is a limit (or level) that is enforced by DOE, worker doses must be managed in accordance with as low as is reasonably achievable principles. Refer to footnote b.

[b] This is a control level. It was established by DOE to assist in achieving its goal to maintain radiological doses as low as is reasonably achievable. DOE recommends that facilities adopt a more limiting 0.5 rem per year Administrative Control Level (DOE 1999). Reasonable attempts have to be made by the site to maintain individual worker doses below these levels.

[c] Derived from 40 CFR 61, 40 CFR 141, and 10 CFR 20.

C.1.1.2 Health Effects

Radiation exposure and its consequences are topics of interest to the general public. To provide the background for discussions of impacts, this section explains the basic concepts used in the evaluation of radiation effects.

Radiation can cause a variety of damaging health effects in people. The most significant effects are induced cancer fatalities. These effects are referred to as "latent" cancer fatalities because the cancer may take many years to develop. In the discussions that follow, all fatal cancers are considered latent; therefore, the term "latent" is not used.

The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR) has prepared a series of reports to advise the U.S. Government on the health consequences of radiation exposures. *Health Effects of Exposure to Low Levels of Ionizing Radiation*, BEIR V (NRC 1990), provides current estimates for excess mortality from leukemia and other cancers that are expected to result from exposure to ionizing radiation. BEIR V provides estimates that are consistently higher than those in its predecessor, BEIR III. This increase is attributed to several factors, including the use of a linear dose response model for cancers other than leukemia, revised dosimetry for the Japanese atomic bomb survivors, and additional followup studies of the atomic bomb survivors and associated others. BEIR III employs constant, relative, and absolute risk models, with separate coefficients for each of several sex and age-at-exposure groups. BEIR V develops models in which the excess relative risk is expressed as a function of age at exposure, time after exposure, and sex for each of several cancer categories. The BEIR III models were based on the assumption that absolute risks are comparable between the atomic bomb survivors and the U.S. population. BEIR V models were based on the assumption that the relative risks are comparable. For a disease such as lung cancer, where baseline risks in the United States are much larger than those in Japan, the BEIR V approach leads to larger risk estimates than the BEIR III approach.

The models and risk coefficients in BEIR V were derived through analyses of relevant epidemiologic data that included the Japanese atomic bomb survivors, ankylosis spondylitis patients, Canadian and Massachusetts fluoroscopy (breast cancer) patients, New York postpartum mastitis (breast cancer) patients, Israeli tinea capitis (thyroid cancer) patients, and Rochester thymus (thyroid cancer) patients. Models for leukemia, respiratory cancer, digestive cancer, and other cancers used only the atomic bomb survivor data, although results of analyses of the ankylosis spondylitis patients were considered. Atomic bomb survivor analyses were based on revised dosimetry, with an assumed relative biological effectiveness of 20 for neutrons, and were restricted to doses less than 400 rads. Estimates of risks of fatal cancers, other than leukemia, were obtained by totaling the estimates for breast cancer, respiratory cancer, digestive cancer, and other cancers.

The NCRP (NCRP 1993), based on the radiation risk estimates provided in BEIR V, and the ICRP (ICRP 1991), estimates the total detriment resulting from low dose or low dose rate exposure to ionizing radiation to be 0.00056 per rem for the working population and 0.00073 per rem for the general population. The total detriment includes fatal and nonfatal cancers as well as severe hereditary (genetic) effects. The major contribution to the total detriment is from fatal cancer, estimated to be 0.0006 per rem for both radiation workers and the general population, respectively. The breakdowns of the risk estimators for both workers and the general population are given in **Table C–2**. Nonfatal cancers and genetic effects are less probable consequences of radiation exposure.

Table C–2 Nominal Health Risk Estimators Associated with Exposure to 1 Rem of Ionizing Radiation

Exposed Individual	*Fatal Cancer* [a, c]	*Nonfatal Cancer* [b]	*Genetic Disorders* [b]	*Total*
Worker	0.0004	0.00008	0.00008	0.00056
Public	0.0005	0.0001	0.00013	0.00073

[a] For fatal cancer, the health effect coefficient is the same as the probability coefficient. When applied to an individual, the units are the lifetime probability of a cancer fatality per rem of radiation dose. When applied to a population of individuals, the units are the excess number of fatal cancers per person-rem of radiation dose.

[b] In determining a means of assessing health effects from radiation exposure, the ICRP has developed a weighting method for nonfatal cancers and genetic effects.

[c] For high individual exposures (greater than or equal to 20 rem), the health factors are multiplied by a factor of 2.

Source: NCRP 1993.

The EPA, in coordination with other Federal agencies involved in radiation protection, has issued *Federal Radiation Guidance Report No. 13*, "Cancer Risk Coefficients for Environmental Exposure to Radionuclides," September 1999. This document is a compilation of risk factors for doses from external gamma radiation and internal intakes of radionuclides. *Federal Radiation Guidance Report No. 13* is the basis of the radionuclide risk coefficients used in the *EPA Health Effects Assessment Summary Tables* (EPA 2001) and in computer dose codes such as the DOE Argonne Residual Radiation (RESRAD) code.

However, the Department and other agencies regularly conduct dose assessments with models and codes that calculate radiation dose from exposure or intake using dose conversion factors and do not compute risk directly. In these cases, where it is necessary or desirable to estimate risk for comparative purposes (e.g., comparing the risk associated with alternative actions), it is common practice to simply multiply the calculated TEDE by a risk-to-dose factor. DOE previously recommended a TEDE-to-fatal cancer risk factor of 5×10^{-4} per rem for the public and 4×10^{-4} per rem for working-age populations. These values were based upon recommendations of the former Committee on Interagency Radiation Research and Policy Coordination (CIRRPC). The ISCORS guidance supersedes the 1992 CIRRPC guidance and recommends that agencies use a conversion factor of 6×10^{-4} fatal cancers per TEDE (rem) for mortality and 8×10^{-4} cancers per rem for morbidity when making qualitative or semi-quantitative estimates of risk from radiation exposure to members of the general public[1] (DOE 2002).

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[1] *Such estimates should not be stated with more than one significant digit.*

The TEDE-to-risk factor provided by ISCORS in *Technical Report 1* is based upon a static population with characteristics consistent with the U.S. population. There are no separate ISCORS recommendations for workers. For workers (adults), a risk of fatal cancer of 5×10^{-4} per rem and a morbidity risk of 7×10^{-4} per rem may be used. However, given the uncertainties in the risk estimates, for most estimates the value for the general population of 6×10^{-4} per rem could be used for workers (DOE 2002).

The DOE Office of Environmental Policy and Guidance recommends use of these values, but we also emphasize that they are principally suited for comparative analyses and where it would be impractical to calculate risk using the *Federal Radiation Guidance Report No. 13*. If risk estimates for specific radionuclides are needed, the cancer risk coefficients in the *Federal Radiation Guidance Report No. 13* should be used (DOE 2002).

The ISCORS report notes that the recommended risk coefficients used with TEDE dose estimates generally produce conservative radiation risk estimates (i.e., they overestimate risk)[2]. For the ingestion pathway of 11 radionuclides compared, risks would be overestimated compared to the *Federal Radiation Guidance Report No. 13* values for about 8 radionuclides and significantly overestimated (by up to a factor of 6) for 4 of these. The DOE Office of Environmental Policy and Guidance also compared the TEDE multiplying the conversion factor approach to *Federal Radiation Guidance Report No. 13* for the inhalation pathway and found a bias toward overestimation of risk, although it was not as severe as for ingestion. For 16 radionuclides/chemical states evaluated, 7 were significantly overestimated (by more than a factor of 2), 5 were significantly underestimated, and the remainder agreed within about a factor of 2. Generally, these differences are within the uncertainty of transport and uptake portions of dose or risk modeling and, therefore, the approach recommended is fully acceptable for comparative assessments. That notwithstanding, it is strongly recommended that, wherever possible, the more rigorous approach with *Federal Radiation Guidance Report No. 13* cancer risk coefficients be used (DOE 2002).

The values in Table C–2 are "nominal" cancer and genetic disorder probability coefficients. They are based on an idealized population receiving a uniform dose over whole body. Recent studies by the EPA, based on age-dependent dose coefficients for members of the public, indicate that the product of the effective dose and the probability coefficient could overestimate or underestimate radiological risks (EPA 1999b). The risk coefficient provided in *Federal Guidance Report No. 13* eliminates the need for separate probability coefficients for cancer incidence and mortalities (EPA 1999b). In support of the risk results provided in *Federal Guidance Report No. 13,* the EPA performed an uncertainty analysis on the effects of uniform whole body exposures. The analysis resulted in an increase in the estimated nominal risk coefficient from 0.051 fatal cancers per gray (0.00051 fatal cancers per rad) to 0.0575 fatal cancers per gray (0.000575 fatal cancers per rad) (EPA 1999a). This result indicates an increase in nominal risk coefficient of about 20 percent over that provided in NCRP 1993 for the public (given in Table C–2).

Based on review of the recent EPA reports, the ISCORS recommended that a risk factor of 0.06 fatal cancers per sievert (0.0006 fatal cancers per rem) be used for estimating risks when using calculated dose (ISCORS 2002). The DOE Office of NEPA Policy and Compliance recommended that the 0.0006 fatal cancers per rem be used for both the workers and members of the public (DOE 2003).

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[2] *This statement presumes that Federal Radiation Guidance Report No. 13 is a more accurate measure of potential risk than multiplying the TEDE by a single average risk factor. The numerical estimate of cancer deaths is based upon the linear extrapolation of risk estimates for total cancer mortality derived at radiation doses above 10 rad (0.1 gray). Other methods of extrapolation would yield higher or lower risk estimates at low doses. Epidemiological studies of human radiation exposure are not sufficiently sensitive to determine the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region and the possibility of zero risk cannot be excluded.*

The numerical estimates of fatal cancers presented in this EIS were obtained using a linear extrapolation from the nominal risk estimated for lifetime total cancer mortality that results from a dose of 0.1 gray (10 rad). Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of fatal cancers. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation, and the possibility of no risk cannot be excluded (CIRRPC 1992).

Health Effect Risk Estimators Used in this EIS

Health impacts from radiation exposure, whether from external or internal sources, generally are identified as "somatic" (i.e., affecting the exposed individual) or "genetic" (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects than genetic effects. The somatic risks of most importance are induced cancers. Except for leukemia, which can have an induction period (time between exposure to carcinogen and cancer diagnosis) of as little as 2 to 7 years, most cancers have an induction period of more than 20 years.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues; the thyroid and skin demonstrate a greater sensitivity than other organs. Such cancers, however, also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the most probable serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities rather than cancer incidence are presented in this EIS. The numbers of fatal cancers can be used to compare the risks among the various alternatives.

Based on the preceding discussion, the number of fatal cancers to workers and the general public during normal operations and for postulated accidents in which individual doses are less than 20 rem are calculated using a health risk estimator of 0.0006 per person-rem. (The risk estimators are lifetime probabilities that an individual would develop a fatal cancer per rem of radiation received.) The risk estimators associated with total cancer incidence among the public is 0.0008 per person-rem (ISCORS 2002).

Recent analysis by EPA (EPA 1999a and 1999b) address the effects of low dose and dose rate exposure to ionizing radiation. Consistent with the conclusion in NCRP 1993, the risk to individuals receiving doses of 20 rem or more are double those associated with doses of less than 20 rem.

The fatal cancer estimators are used to calculate the statistical expectation of the effects of exposing a population to radiation. For example, if 100,000 people were each exposed to a one-time radiation dose of 100 millirem (0.1 rem), the collective dose would be 10,000 person-rem. The exposed population would then be expected to experience 6 additional cancer fatalities from the radiation (10,000 person-rem × 0.0006 lifetime probability of cancer fatalities per person-rem = 6 cancer fatalities).

Calculations of the number of excess fatal cancers associated with radiation exposure do not always yield whole numbers. These calculations may yield numbers less than one, especially in environmental impact applications. For example, if a population of 100,000 were exposed to a total dose of only 0.001 rem per person, the collective dose would be 100 person-rem (100,000 persons × 0.001 rem = 100 person-rem). The corresponding estimated number of cancer fatalities would be 0.06 (100 person-rem × 0.0006 cancer fatalities per person-rem = 0.06 cancer fatalities). The 0.06 means that there is 1 chance in 16.6 that the exposed population would experience 1 fatal cancer. In other words, the 0.06 cancer fatalities is the *expected* number of deaths that would result if the same exposure situation were applied to many different groups of 100,000 people. In most groups, no person would incur a fatal cancer from the 0.001 rem dose each member received. In a small fraction of the groups, one cancer fatality would result; in exceptionally few groups, two or more cancer fatalities would occur. The *average* expected number of deaths over all the groups would be

0.06 cancer fatalities (just as the average of 0, 0, and 0, added to 1 is 1/4, or 0.25). The most likely outcome is no cancer fatalities.

The same concept is applied to estimate the effects of radiation exposure on an individual member of the public. Consider the effects of an individual's exposure to a 360-millirem (0.36 rem) annual dose from all radiation sources. The probability that the individual will develop a fatal cancer from continuous exposure to this radiation over an average life of 72 years (presumed) is 0.016 (1 person × 0.36 rem per year × 72 years × 0.0006 cancer fatalities per person-rem = 0.016). This corresponds to 1 chance in 64 that the individual would develop a fatal cancer in a lifetime.

C.2 Methodology for Estimating Normal Operation Radiological and Hazardous Chemical Impacts

C.2.1 GENII Computer Code, a Generic Description

The radiological impacts from releases during normal operation of the facilities used to perform RPS production operations were calculated using Version 1.485 of the GENII computer code (PNL 1988). Site-specific input data were used, including location, meteorology, population, and source terms. This section briefly describes GENII and outlines the approach used for normal operations.

C.2.1.1 Description of the Code

The GENII computer model, developed by Pacific Northwest National Laboratory, is an integrated system of various computer modules that analyze environmental contamination resulting from acute or chronic releases to, or initial contamination in, air, water, or soil. The model calculates radiation doses to individuals and populations. The GENII computer model is well documented for assumptions, technical approach, method, and quality assurance issues. The GENII computer model has gone through extensive quality assurance and quality control steps, including comparing results from model computations with those from hand calculations and performing internal and external peer reviews (PNL 1988).

The GENII code consists of several modules for various applications as described in the code manual (PNL 1988). For this EIS, only the ENVIN, ENV, and DOSE computer modules were used. The output of one module is stored in a file that can be used by the next module in the system. The functions of the three GENII computer modules used in this EIS are discussed below.

ENVIN

The ENVIN module of the GENII code controls the reading of input files and organizes the input for optimal use in the environmental transport and exposure module, ENV. The ENVIN code interprets the basic input, reads the basic GENII data libraries and other optional input files, and organizes the input into sequential segments based on radionuclide decay chains.

A standardized file that contains scenario, control, and inventory parameters is used as input to ENVIN. Radionuclide inventories can be entered as functions of releases to air or water, concentrations in basic environmental media (air, soil, or water), or concentrations in foods. If certain atmospheric dispersion options have been selected, this module would generate tables of atmospheric dispersion parameters that are used in later calculations. If the finite plume air submersion option is selected in addition to the atmospheric dispersion calculations, preliminary energy-dependent finite plume dose factors can be prepared as well. The ENVIN module prepares the data transfer files that are used as input by the ENV module; ENVIN generates the first portion of the calculation documentation—the run input parameters report.

ENV

The ENV module calculates the environmental transfer, uptake, and human exposure to radionuclides that result from the chosen scenario for the user-specified source term. The code reads the input files from ENVIN and then, for each radionuclide chain, sequentially performs the precalculations to establish the conditions at the start of the exposure scenario. Environmental concentrations of radionuclides are established at the beginning of the scenario by assuming decay of pre-existing sources, considering biotic transport of existing subsurface contamination, and defining soil contamination from continuing atmospheric or irrigation depositions. For each year of postulated exposure, the code then estimates the air, surface soil, deep soil, groundwater, and surface water concentrations of each radionuclide in the chain. Human exposures and intakes of each radionuclide are calculated for pathways of external exposure from finite or infinite atmospheric plumes; inhalation; external exposure from contaminated soil, sediments, and water; external exposure from special geometries; and internal exposures from consumption of terrestrial foods, aquatic foods, drinking water, animal products, and inadvertent intake of soil. The intermediate information on annual media concentrations and intake rates is written to data transfer files. Although these may be accessed directly, they are usually used as input to the DOSE module of GENII.

DOSE

The DOSE module reads the intake and exposure rates defined by the ENV module and converts the data to radiation dose.

C.2.1.2 Data and General Assumptions

To perform the dose assessments for this EIS, different types of data were collected and generated. This section discusses the various data, along with the assumptions made for performing the dose assessments.

Dose assessments were performed for members of the general public at Oak Ridge National Laboratory (ORNL), Idaho National Laboratory (INL), and Los Alamos National Laboratory (LANL) to determine the incremental doses that would be associated with the alternatives addressed in this EIS. Incremental doses for members of the public were calculated (via GENII) for two different types of receptors:

- *Maximally Exposed Individual (MEI)*—The MEI was assumed to be an individual member of the public located at a position on the site boundary, including public roads inside the site, that would yield the highest impacts during normal operations. For this EIS, the MEI is located 4,550 meters (2.8 miles) east-northeast from the High Flux Isotope Reactor (HFIR) and the Radiochemical Engineering Development Center (REDC) at ORNL; 5,200 meters (3.2 miles) south-southeast from the Materials and Fuels Complex (MFC); and 900 meters (0.6 miles) from the Plutonium Facility at LANL.

- *Population*—The general population living within 80 kilometers (50 miles) of the facility. An average dose to a member of this population was also calculated.

Meteorological Data

The meteorological data used for all normal operational scenarios discussed in this EIS were in the form of joint frequency data files. A joint frequency data file is a table listing the fractions of time the wind blows in a certain direction, at a certain speed, and within a certain atmospheric stability class. The joint frequency data files were based on measurements taken over a period of several years at ORNL, INL, and LANL.

Population Data

Population distributions were based on U.S. Department of Commerce state population Census numbers (DOC 2001). Estimates were determined for the years 2010 and 2050 for areas within 80 kilometers (50 miles) of the release locations. The 2010 projection was used for the bridge period under the Consolidation with Bridge Alternative. The 2050 projection was used for all other alternatives. The estimated site-specific population was used in the impact assessments. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances up to 80 kilometers (50 miles). The grid was centered at the location from which the radionuclides were assumed to be released. The following total populations were projected. For 2010: 245,000 at MFC at INL; 1,129,000 at ORNL; and 357,400 at LANL. For 2050: 355,000 at MFC at INL, 1,438,000 at ORNL; and 608,800 at LANL.

Source Term Data

The source terms used to calculate the impacts of normal operations are provided in Section C.2.1.4.

Food Production and Consumption Data

Generic food consumption rates are available as default values in GENII. The default values are comparable to those established in the U.S. Nuclear Regulatory Commission (NRC) *Regulatory Guide 1.109* (NRC 1977). This regulatory guide provides guidance for evaluating ingestion doses from consuming contaminated terrestrial and animal food products using a standard set of assumptions for crop and livestock growth and harvesting characteristics.

Basic Assumptions

To estimate annual radiological impacts to the public from normal operations, the following additional assumptions and factors were considered in using GENII:

- Radiological airborne emissions were assumed to be released to the atmosphere at a height of 76.2 meters (250 feet) at REDC, 15.9 meters (52 feet) at the Plutonium Facility at Technical Area 55 (TA-55), and 12.8 meters (42 feet) at MFC at INL.

- Emission of the plume was assumed to continue throughout the year. Plume and ground deposition exposure parameters used in the GENII model for the exposed offsite individual and the general population are provided in **Table C–3**.

- The exposed individual or population was assumed to have the characteristics and habits of an adult human.

- A semi-infinite plume model was used for the air immersion doses.

Worker doses associated with RPS production operations were determined from historical data.

Table C–3 GENII Parameters for Exposure to Plumes (Normal Operations)

Maximally Exposed Offsite Individual				***General Population***			
External Exposure		***Inhalation of Plume***		***External Exposure***		***Inhalation of Plume***	
Plume (hours)	***Ground Contamination (hours)***	***Exposure Time (hours)***	***Breathing Rate (cubic centimeters per second)***	***Plume (hours)***	***Ground Contamination (hours)***	***Exposure Time (hours)***	***Breathing Rate (cubic centimeters per second)***
6,136	6,136	8,766	270	4,383	4,383	8,766	270

Sources: PNL 1988, NRC 1977.

C.2.1.3 Uncertainties

The sequence of analyses performed to generate the radiological impact estimates from normal operations include selection of normal operational modes, estimation of source terms, estimation of environmental transport and uptake of radionuclides, calculation of radiation doses to exposed individuals, and estimation of health effects. There are uncertainties associated with each of these steps. Uncertainties exist in the way the physical systems being analyzed are represented by the computational models and in the data required to exercise the models (due to measurement, sampling, or natural variability).

In principle, one can estimate the uncertainty associated with each source and predict the remaining uncertainty in the results of each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final results. However, conducting such a full-scale quantitative uncertainty analysis is neither practical nor a standard practice for a study of this type. Instead, the analysis is designed to ensure—through judicious selection of release scenarios, models, and parameters—that the results represent the potential risks. This is accomplished by making conservative assumptions in the calculations at each step. The models, parameters, and release scenarios used in the calculations are selected in such a way that most intermediate results and, consequently, the final estimates of impacts are greater than would be expected. As a result, even though the range of uncertainty in a quantity might be large, the value calculated for the quantity would be close to one of the extremes in the range of possible values, so the chance of the actual quantity being greater than the calculated value would be low. Conservative assumptions in this analysis bound all uncertainties.

The human health impacts from routine normal activities may have different impacts on specific populations such as American Indians or Hispanics whose cultural heritage can result in special pathways of exposure that are different than those modeled to evaluate the doses to the general population and MEI. Although the analyses performed to evaluate the public impacts of the alternatives did include normally significant pathways and were designed to be conservative, no pathways were included to specifically address local population use of local resources. Therefore, there is potentially more uncertainty in the effects of activities on these specific population groups. A qualitative evaluation of the potential impacts on these specific groups was performed based on the nuclides emitted and an understanding of the most significant pathways.

Parameter selection and practices of the population and MEI were chosen to be conservative. For example, it was assumed that the population breathed contaminated air all the time (spent no time away from the local area) and that all food was produced in the potentially affected area (no food from outside the local area). The dose to a member of the public was dominated by internal exposures from inhalation and ingestion. Typically, about one-third of the dose was from inhalation and two thirds was from ingestion. Inhalation of ambient air and the resulting dose would be about the same for all members of population surrounding the locations of interest.

C.2.1.4 Radiological Releases During Routine Normal Operations

The estimated radiological releases to the environment associated with routine normal operations are discussed below and are based on the methodology provided in Section C.2.1.2. The resulting impacts to the public and to workers associated with each alternative are presented and discussed in Chapter 4 of this EIS.

Routine radiological releases during normal operations are presented in **Table C–4** for each of the alternatives. These are incremental releases (i.e., releases due to the Proposed Action only). They do not include releases from other activities that might occur at the same facility or complex.

Table C–4 Normal Operation Incremental Radiological Releases

	No Action Alternative (curies per year plutonium-238)	***Consolidation Alternative (curies per year plutonium-238)***	***Consolidation with Bridge Alternative (curies per year plutonium-238)***	
Storage of Target Material				
Location	FMF at MFC at INL	FMF at MFC at INL	FMF at MFC at INL	
Emissions	1.7×10^{-8} (a)	1.7×10^{-8} (a)	1.7×10^{-8} (a)	
Target Fabrication and Post-Irradiation Processing				
Location	REDC at ORNL	Plutonium-238 Facility at MFC at INL	REDC at ORNL (2007-2011)	Plutonium-238 Facility at MFC at INL (2012-2047)
Emissions	1.7×10^{-7}	1.7×10^{-7}	6.8×10^{-8}	1.7×10^{-7}
Target Irradiation [b]				
Location	ATR at INL and HFIR at ORNL	ATR at INL	HFIR at ORNL (2007-2011)	ATR at INL (2012-2047)
Emissions	No Change	No Change	No Change	No Change
Purification, Pelletization, and Encapsulation				
Location	Plutonium Facility at LANL	Plutonium Facility at LANL (2007-2011) MFC at INL (2012-2047)	Plutonium Facility at LANL (2007-2011)	MFC at INL (2012-2047)
Emissions	1.0×10^{-8}	1.0×10^{-8}	1.0×10^{-8}	1.0×10^{-8}
RPS Assembly and Testing				
Location	Assembly and Testing Facility at MFC at INL	Assembly and Testing Facility at MFC at INL	Assembly and Testing Facility at MFC at INL	
Emissions	None	None	None	

FMF = Fuel Manufacturing Facility, MFC = Materials and Fuels Complex, INL = Idaho National Laboratory, REDC = Radiochemical Engineering Development Center, ORNL = Oak Ridge National Laboratory, ATR = Advanced Test Reactor, HFIR = High Flux Isotope Reactor, LANL = Los Alamos National Laboratory, RPS = radioisotope power systems.

[a] Releases associated with storage of neptunium-237 would be expected to be essentially zero because it is stored in licensed and shielded containers. However, it has been assumed that the doses due to storage would be 10 percent of the doses due to processing activities.

[b] The incremental emissions from ATR and HFIR are zero because it is assumed that they are in operation regardless of the Proposed Action, and the Proposed Action does not increase their emissions.

Target Material Storage—Release associated with the storage of neptunium-237 would be expected to be essentially zero. However, the *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS),* DOE/EIS-0310, has conservatively assumed that the doses due to storage would be 10 percent of the doses due to processing activities. That is why this EIS assumes a normal operation release due to storage of target material equivalent to 10 percent of the release due to target fabrication and post-irradiation activities.

Target Fabrication and Post-irradiation—Normal operational releases to the environment from target fabrication and post-irradiation processing activities were determined based on the conservative assumption made in the *NI PEIS* (DOE 2000) that a 5-kilogram (11-pound) inventory of plutonium-238 is processed on an annual basis. Employing a processing facility emission factor of 1.98×10^{-12}, and a specific activity of 17 curies per gram, a resulting annual release quantity of 1.7×10^{-7} curies is calculated as shown below:

(5,000 grams per year of plutonium-238) × (17 curies of plutonium-238 per gram of plutonium-238) × (1.98×10^{-12}) = 1.7×10^{-7} curies per year of plutonium-238

For a production of 2 kilograms per year of plutonium-238, the normal operation releases from target fabrication and post-irradiation activities would be (2/5) × (1.7×10^{-7}) = 6.8×10^{-8} curies per year of plutonium-238.

Target Irradiation—Normal operational release to the environment from Advanced Test Reactor (ATR) and/or HFIR for the purpose of calculating incremental dose would be zero because there would be no increase in activities in those reactors due to the additional target irradiation.

Purification, Pelletization, and Encapsulation—Normal operation releases from purification, pelletization, and encapsulation were based on stack monitoring data from the operations at LANL's Plutonium Facility at TA-55. Plutonium-238 emissions from the LANL Plutonium Facility between 1997 and 2003 ranged between 4.7×10^{-9} to 8.63×10^{-9} curies per year. These emissions from TA-55 of the facility containing the plutonium-238 operations are exhausted through Stack "ES-15," which is filtered by four stages of high-efficiency particulate air (HEPA) filters, with a control efficiency of 99.95 percent for each stage (LANL 2005a).

This EIS conservatively assumes an upper bound of 1.0×10^{-8} curies of plutonium-238 per year.

RPS Assembly and Testing—Normal operation releases are not expected from the RPS assembly and testing activities because the facility would only handle fully encapsulated radioactive material.

Storage of Available Inventory—Normal operation releases are not expected from the storage of the available and usable inventory of plutonium-238 because this inventory would be in the form of fully encapsulated radioactive material.

C.2.1.5 Occupational (Worker) Health Impacts

Health impacts from radiological exposure due to normal facility operation were determined for the facility worker directly involved in the fabrication, irradiation, processing, and storage of plutonium-238 targets. The *NI PEIS* (DOE 2000) provides number of workers, collective dose, and individual worker dose for processing activities at REDC. The *NI PEIS* also assumes that the worker dose due to storage of target materials is 10 percent of that due to processing activities. They were duplicated in this EIS.

Worker doses due to plutonium-238 purification, pelletization, and encapsulation activities at LANL's Plutonium Facility at TA-55 were obtained from 12 years (1993 to 2004) exposure data for workers involved in plutonium-238 operations (LANL 2005b). These doses are total measured internal and external radiation dose based on actual worker dosimetry data and by periodic worker biosafety monitoring. This data showed that an average of 79 workers have received 0.24[3] rem each annually for a collective dose of 19 person-rem per year.

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[3] *During peak plutonium-238 production years, a few workers at the LANL TA-55 Plutonium Facility received total annual doses of up to 2 rem each, which was the worker maximum dose administrative limit.*

C.2.1.6 Impacts of Exposures to Hazardous Chemicals on Human Health

The potential impacts of exposure to hazardous chemicals released to the atmosphere due to plutonium-238 production activities were evaluated for routine operations in the *NI PEIS* (DOE 2000). The results of the analysis are reproduced in Chapter 4 of this EIS. The methodology appears in Appendix H, Section H.3 of the *NI PEIS*.

C.3 Accident Analysis

Accident scenarios were divided into two categories: neptunium-237 target fabrication and processing and plutonium-238 purification, pelletization, and encapsulation. The identical accidents are evaluated for the No Action and Proposed Action alternatives, with the difference being the location of the accident. In the No Action case, target fabrication processing was analyzed in the *NI PEIS* for the REDC at ORNL. Also, the No Action Alternative analyzed the purification, pelletization, and encapsulation accidents at the Plutonium Facility at LANL. For the Proposed Action alternatives (i.e., Consolidation Alternative and Consolidation with Bridge Alternative), both sets of accidents were analyzed for the new facility at INL. The new facility at INL, currently in the conceptual design phase, will meet or exceed all safety design features of the REDC and LANL Plutonium Facility. This includes four separate dry HEPA filters for all air exhausted through the stack. Therefore, it is conservative to use the accident scenarios from these existing facilities for the new facility at INL in the Proposed Action alternatives.

Dose assessments were performed for members of the general public and noninvolved workers at ORNL, INL, and LANL to determine the doses that would be associated with the alternatives addressed in this EIS. Doses for members of the public and noninvolved workers were calculated (via MACCS2) for three different types of receptors:

- *Maximally Exposed Individual*—The MEI was assumed to be an individual member of the public located at a position on the site boundary, including public roads inside the site, that would yield the highest impacts from the postulated accident. For this EIS, the MEI is located 4,550 meters (2.8 miles) east-northeast from HFIR and REDC at ORNL; 5,200 meters (3.2 miles) south-southeast from MFC; and 900 meters (0.6 miles) from the Plutonium Facility at LANL.

- *Population*—The general population living within 80 kilometers (50 miles) of the facility.

- *Noninvolved worker*–A worker located 640 meters (2,100 feet) from the accident source term plume release location.

C.3.1 MACCS2 Code Description

The MACCS2 computer code is used to estimate the radiological doses and health effects that could result from postulated accidental releases of radioactive materials to the atmosphere. The specification of the release characteristics, designated a "source term," can consist of up to four Gaussian plumes that are often referred to simply as "plumes."

The radioactive materials released are modeled as being dispersed in the atmosphere while being transported by the prevailing wind. During transport, whether or not there is precipitation, particulate material can be modeled as being deposited on the ground. If contamination levels exceed a user-specified criterion, mitigating actions can be triggered to limit radiation exposures.

There are two aspects of the code's structure basic to understanding its calculations: (1) the calculations are divided into modules and phases, and (2) the region surrounding the facility is divided into a polar-coordinate grid. These concepts are described in the following sections.

MACCS2 is divided into three primary modules: ATMOS, EARLY, and CHRONC. Three phases are defined as the emergency, intermediate, and long-term phases. The relationship among the code's three modules and the three phases of exposure are summarized below.

The ATMOS module performs all of the calculations pertaining to atmospheric transport, dispersion, and deposition, as well as the radioactive decay that occurs before release and while the material is in the atmosphere. It uses a Gaussian plume model with Pasquill-Gifford dispersion parameters. The phenomena treated include building wake effects, buoyant plume rise, plume dispersion during transport, wet and dry deposition, and radioactive decay and in-growth. The results of the calculations are stored for use by EARLY and CHRONC. In addition to the air and ground concentrations, ATMOS stores information on wind direction, arrival and departure times, and plume dimensions.

The EARLY module models the period immediately following a radioactive release. This period is commonly referred to as the emergency phase. The emergency phase begins at each successive downwind distance point when the first plume of the release arrives. The duration of the emergency phase is specified by the user, and it can range between 1 and 7 days. The exposure pathways considered during this period are direct external exposure to radioactive material in the plume (cloud shine), exposure from inhalation of radionuclides in the cloud (cloud inhalation), exposure to radioactive material deposited on the ground (ground shine), inhalation of resuspended material (resuspension inhalation), and skin dose from material deposited on the skin. Mitigating actions that can be specified for the emergency phase include evacuation, sheltering, and dose-dependent relocation. All MACCS2 calculations for this EIS assumed no mitigating actions.

The CHRONC module performs all of the calculations pertaining to the intermediate and long-term phases. CHRONC calculates the individual health effects that result from both direct exposures to contaminated ground and from inhalation of resuspended materials, as well as indirect health effects caused by the consumption of contaminated food and water by individuals who reside both on and off the computational grid.

The intermediate phase begins at each successive downwind distance point upon conclusion of the emergency phase. The user can configure the calculations with an intermediate phase that has a duration as short as zero or as long as 1 year. In the zero-duration case, there is essentially no intermediate phase and a long-term phase, begins immediately upon conclusion of the emergency phase.

Intermediate models are implemented on the assumption that the radioactive plume has passed and the only exposure sources (ground shine and resuspension inhalation) are from ground-deposited material. It is for this reason that MACCS2 requires the total duration of a radioactive release be limited to no more than 4 days. Potential doses from food and water during this period are not considered.

The mitigating action model for the intermediate phase is very simple. If the intermediate phase dose criterion is satisfied, the resident population is assumed present and subject to radiation exposure from ground shine and resuspension for the entire intermediate phase. If the intermediate phase exposure exceeds the dose criterion, then the population is assumed relocated to uncontaminated areas for the entire intermediate phase. No mitigating actions were assumed for MACCS2 calculations in support of this EIS.

The long-term phase begins at each successive downwind distance point upon conclusion of the intermediate phase. The exposure pathways considered during this period are ground shine, resuspension inhalation, and food and water ingestion.

The exposure pathways considered are those resulting from ground-deposited material. A number of protective measures, such as decontamination, temporary interdiction, and condemnation, can be modeled in the long-term phase to reduce doses to user-specified levels. The decisions on mitigating action in the long-term phase are based on two sets of independent actions: (1) decisions relating to whether land at a specific location and time is suitable for human habitation (habitability), and (2) decisions relating to whether land at a specific location and time is suitable for agricultural production (ability to farm). MACCS2 calculations in support of this EIS assumed no protective measures.

All of the calculations of MACCS2 are stored based on a polar-coordinate spatial grid with a treatment that differs somewhat between calculations of the emergency phase and calculations of the intermediate and long-term phases. The region potentially affected by a release is represented with an (r, Θ) grid system centered on the location of the release. Downwind distance is represented by the radius "r". The angle, Θ, is the angular offset from the north, going clockwise.

The user specifies the number of radial divisions as well as their endpoint distances. The angular divisions used to define the spatial grid are fixed in the code. They correspond to the 16 points of the compass, each being 22.5 degrees wide. The 16 points of the compass are used in the United States to express wind direction. The compass sectors are referred to as the coarse grid.

Since emergency phase calculations use dose-response models for early fatalities and injuries that can be highly nonlinear, these calculations are performed on a finer grid basis than the calculations of the intermediate and long-term phases. For this reason, the calculations of the emergency phase are performed with the 16 compass sectors divided into 3, 5, or 7 equal, angular subdivisions. The subdivided compass sectors are referred to as the fine grid.

Two types of doses may be calculated by the code, "acute" and "lifetime."

Acute doses are calculated to estimate deterministic health effects that can result from high doses delivered at high dose rates. Such conditions may occur in the immediate vicinity of a nuclear facility following hypothetical severe accidents where confinement and/or containment failure has been assumed to occur. Examples of the health effects based on acute doses are early fatality, prodromal vomiting, and hypothyroidism.

Lifetime doses are the conventional measure of detriment used for radiological protection. These are 50-year dose commitments to either specific tissues (e.g., red marrow and lungs) or a weighted sum of tissue doses defined by ICRP and referred to as "effective dose." Lifetime doses may be used to calculate the stochastic health effect risk resulting from exposure to radiation. MACCS2 uses the calculated lifetime dose in cancer risk calculations.

C.3.2 ALOHA Code Description

Consequences of accidental chemical releases were determined using the Areal Locations of Hazardous Atmospheres (ALOHA) computer code (NOAA 1999). ALOHA is an EPA/National Oceanic and Atmospheric Administration-sponsored computer code that has been widely used in support of chemical accident responses and also in support of safety and National Environmental Policy Act (NEPA) documentation for DOE facilities. The ALOHA code is a deterministic representation of atmospheric releases of toxic and hazardous chemicals. The code can predict the rate at which chemical vapors escape (e.g., from puddles or leaking tanks) into the atmosphere; a specified direct release rate is also an option.

ALOHA performs calculations for chemical source terms and resulting downwind concentrations. Source term calculations determine the rate at which the chemical material is released to the atmosphere, release duration, and the physical form of the chemical upon release. The term "cloud" is used in this document to refer to the volume that encompasses the chemical emission. In general, the released chemical may be a gas, a vapor, or an aerosol. An aerosol release may consist of either solid (e.g., fume, dust) or liquid (e.g., fog, mist, spray) particles that are suspended in a gas or vapor medium. Liquid particles are also referred to as "droplets". The analyst specifies the chemical and then characterizes the initial boundary conditions of the chemical with respect to the environment through the source configuration input. The ALOHA code allows for the source to be defined in one of four ways (i.e., direct source, puddle source, tank source, or pipe source) in order to model various accident scenarios. The source configuration input is used to either specify the chemical source term or to provide ALOHA with the necessary information and data to calculate transient chemical release rates and physical state of the chemical upon release. ALOHA calculates time-dependent release rates for up to 150 time steps (NOAA 1999). ALOHA then averages the release rates from the individual time steps over one to five averaging periods, each lasting at least 1 minute (NOAA 1999). The five averaging periods are selected to most accurately portray the peak emissions. The five average release rates are inputs to the ALOHA algorithms for atmospheric transport and dispersion (NOAA 1999). ALOHA tracks the evolution of the mean concentration field of the five separate chemical clouds and calculates the concentration at a given time and location through superposition. ALOHA limits releases to 1 hour.

Evolution of the mean concentration field of the chemical cloud is calculated through algorithms that model turbulent flow phenomena of the atmosphere. The prevailing wind flows and associated atmospheric turbulence serve to transport, disperse, and dilute the chemical cloud that initially forms at the source. For an instantaneous release or release of short duration, the chemical cloud will travel downwind as a puff. In contrast, a plume will form for a sustained or continuous release.

The wind velocity is a vector term defined by a direction and magnitude (i.e., wind speed). The wind direction and wind speed determine where the puff or plume will go and how long it will take to reach a given downwind location. For sustained or continuous releases, the wind speed has the additional effect of stretching out the plume and establishing the initial dilution of the plume (i.e., determines the relative proportion of ambient air that initially mixes with the chemical source emission). Atmospheric turbulence causes the puff or plume to increasingly mix with ambient air and grow (disperse) in the lateral and vertical direction as it travels downwind. Longitudinal expansion also occurs for a puff. These dispersion effects further enhance the dilution of the puff or plume. The two sources of atmospheric turbulence are mechanical turbulence and buoyant turbulence. Mechanical turbulence is generated from shear forces that result when adjacent parcels of air move at different velocities (i.e., either at different speeds or directions). Fixed objects on the ground such as trees or buildings increase the ground roughness and enhance mechanical turbulence in proportion to their size. Buoyant turbulence arises from vertical convection and is greatly enhanced by the formation of thermal updrafts that are generated from solar heating of the ground.

The ALOHA code considers two classes of atmospheric transport and dispersion based upon the assumed interaction of the released cloud with the atmospheric wind flow.

- For airborne releases in which the initial chemical cloud density is less than or equal to that of the ambient air, ALOHA treats the released chemical as neutrally buoyant. A neutrally buoyant chemical cloud that is released to the atmosphere does not alter the atmospheric wind flow, and therefore, the term "passive" is used to describe the phenomenological characteristics associated with its atmospheric transport and dispersion. As a passive contaminant, the released chemical follows the bulk movements and behavior of the atmospheric wind flow.

- Conversely, if the density of the initial chemical cloud is greater than that of the ambient air, then the possibility exists for either neutrally buoyant or dense-gas type of atmospheric transport and dispersion. In dense-gas atmospheric transport and dispersion, the dense-gas cloud resists the influences of the hydraulic pressure field associated with the atmospheric wind, and the cloud alters

> the atmospheric wind field in its vicinity. Dense-gas releases can potentially occur with gases that have a density greater than air due to either a high molecular weight or from being sufficiently cooled. A chemical cloud with sufficient aerosol content can also result in the bulk cloud density being greater than that of the ambient air. Dense-gas releases undergo what has been described in the literature as "gravitational slumping."

Gravitational slumping is characterized by significantly greater lateral (crosswind) spreading and reduced vertical spreading as compared to the spreading that occurs with a neutrally buoyant release.

In addition to the source term and downwind concentration calculations, ALOHA allows for the specification of concentration limits for the purpose of consequence assessment (e.g., assessment of human health risks from contaminant plume exposure). ALOHA refers to these concentration limits as level-of-concern (LOC) concentrations. Safety analysis work uses the Emergency Response Planning Guidelines (ERPGs) and Temporary Emergency Exposure Limits (TEELs) for assessing human health effects for both facility workers and the general public. While ERPGs and TEELs are not explicitly a part of the ALOHA chemical database, ALOHA allows the user to input any value, including an ERPG or TEEL value, as the LOC concentration. The LOC value is superimposed on the ALOHA generated plot of downwind concentration as a function of time to facilitate comparison. In addition, ALOHA will generate a footprint that shows the area (in terms of longitudinal and lateral boundaries) where the ground-level concentration reached or exceeded the LOC during puff or plume passage (the footprint is most useful for emergency response applications).

The ALOHA code uses a constant set of meteorological conditions (e.g., wind speed, stability class) to determine the downwind atmospheric concentrations. The sequential meteorological data sets used for the radiological accident analyses were re-ordered from high to low dispersion by applying a Gaussian dispersion model (such as that used by ALOHA) at a representative downwind distance for each site. The median set of hourly conditions for each site (i.e., wind speed and stability corresponding to the median concentration) was used for the analysis; this is roughly equivalent to the conditions corresponding to the mean radiological dose estimates of MACCS2.

ALOHA contains physical and toxicological properties for the chemical spills included in this EIS and for approximately 1,000 additional chemicals. The physical properties were used to determine which of the dispersion models and accompanying parameters were applied. The toxicological properties were used to determine the levels of concern. Atmospheric concentrations at which health effects are of concern (e.g., ERPG-2) are used to define the footprint of concern. Because the meteorological conditions specified do not account for wind direction (i.e., it is not known *a priori* in which direction the wind would be blowing in the event of an accident), the areas of concern are defined by a circle of radius equivalent to the downwind distance at which the concentration decreases to levels less than the level of concern. In addition, the concentration at 640 meters (2,100 feet) (potential exposure to a noninvolved worker) and at the nearest site boundary distance (exposure to maximum exposed offsite individual) are calculated and presented.

C.3.3 Radiological Accident Scenarios

An evaluation of past accidents at INL, LANL, and ORNL documented in EIS Sections 3.2.9.4, 3.3.9.4, and 3.4.9.4, respectively, concluded that, although these accidents may have had a significant radiological impact on involved workers, they did not result in significant or, in some cases, measurable impacts on the public and noninvolved workers. The accidents analyzed in this EIS have greater impacts than the past accidents. For the processing facilities, a spectrum of accidents was developed that considered a full range of accidents that could affect noninvolved workers and the public associated with such facilities. The scenarios evaluated, however, represent cases that are considered to bound the risk profile for noninvolved workers and the public.

C.3.3.1 Neptunium-237 Target Processing Accident Scenario Selection and Description

The processing facility accidents presented in the *ORNL REDC Safety Analysis Report for Building 7920* (ORNL 1999) were reviewed for evaluation in this *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS)*. Process and facility details were based on the preconceptual design study to support plutonium-238 production (Wham et al. 1998). Since process details at the new building at INL are essentially the same as those at REDC, the same spectrum of accidents was evaluated for all the processing facilities. However, facility differences were accounted for in evaluating the consequences of these accidents.

Several evaluation-basis accidents were selected for inclusion in this *Consolidation EIS*. These include:

- A postulated explosion in a glovebox during neptunium-237 target fabrication, representing the glovebox-handling accident having the largest potential consequences;

- A postulated failure of the target dissolver tank containing both neptunium-237 and plutonium-238, representing the accidental spill having the greatest consequences; and

- A postulated explosion of an ion exchange column during plutonium-238 purification, which has the potential to release more plutonium-238 than any other processing facility design-basis accident.

A fire in a hot cell was judged to have lower consequences than an explosion, and was not included in this *Consolidation EIS*. This is based on an extensive experimental investigation (Hasegawa et al. 1992), which concluded that a fire in a hot cell would not represent a threat to the effectiveness of the facility roughing or HEPA filters and would be self-extinguishing within a short time from lack of oxygen.

Both neptunium-237 and plutonium-238 would be stored in shielded containers in quantities and configurations that preclude criticality. Target preparation and post-irradiation processing would be carried out in batches involving quantities well below those at which criticality could occur. As a result, a criticality accident could occur only as a result of a series of gross, deliberate violations of established controls.

The postulated beyond-evaluation-basis processing facility accident selected for use in this *Consolidation EIS* is a catastrophic earthquake resulting in a collapse of the nearby stack and failure of the HEPA filter system intended to mitigate the consequences of releases. Two cases involving this accident scenario were evaluated. Case 1 assumed that the facility was only being used to store neptunium-237. Case 2 assumed that the facility was an integrated storage, target fabrication, and irradiated-target-processing facility.

The waste stream from the irradiated targets would be processed in the same facilities as the irradiated targets. Accidents occurring during the processing of the waste stream were not evaluated in this *Consolidation EIS* because their consequences are bounded by the irradiated target accidents that have been evaluated.

Ion Exchange Explosion During Neptunium-237 Target Fabrication Accident

An accident could occur during fabrication of the neptunium-237 targets. As part of the target preparation, 1-kilogram (2.2-pound) quantities of neptunium-237 solution are processed (Wham et al. 1998) to yield neptunium in an oxide form for use as a target material. This operation takes place in a shielded glovebox and involves use of an ion exchange column. This accident scenario postulates an explosion of the ion exchange column in the glovebox. Judging from historical occurrences of this type of accident at radiochemical laboratories and processing facilities, the frequency of this event is "unlikely" (between 1×10^{-2} and 1×10^{-4} per year) (ORNL 1999). For the purpose of this *Consolidation EIS*, the accident frequency was assumed to be 1×10^{-2} per year.

The glovebox is maintained at a slight negative pressure with respect to that portion of the building outside the hot cells, and is continually exhausted to the atmosphere through roughing filters and then through two banks of HEPA filters arranged in series outside the building and then to the environs via a stack. Each bank of HEPA filters is assumed to remove 99.95 percent of all particulates at or above a size of 0.3 microns (Burchsted et al. 1976). (Note: This assumes two HEPA filters are in series and each is 99.95 percent efficient, yielding a 2.5×10^{-7} reduction factor.)

In the accident scenario, an explosion is estimated to release essentially all of the neptunium-237 into the glovebox. Additional data to calculate releases were taken from relevant facility data (ORNL 1999; Green 1998, 1999) and other accepted sources (DOE 1994). Since an explosion involves small quantities of materials, any increase in pressure is expected to be small and is not expected to result in transitory leakage of radioactive material from the glovebox into the operating area.

Airborne releases can be divided into respirable (smaller than about 10 microns) and nonrespirable fractions. Nonrespirable airborne particles can cause localized onsite contamination, but they do not contribute significantly to offsite doses for several reasons. For design-basis accidents, the filter efficiency for the larger, nonrespirable particles is greater than that for all particles of the respirable fractions, and significantly greater than the minimum value of 99.95 percent for 0.3-micron particles. For the beyond-design-basis earthquake, where filters are postulated to be ineffective, leakage from the hot cells is at a low rate, allowing for increased deposition and settling of the larger particles prior to release. Even where large, nonrespirable particles are released to the environment, their atmospheric transport is limited and they will “fall out” within a short distance from the release point.

Table C–5 shows the release fractions and source terms for this accident.

Table C–5 Neptunium-237 Target Preparation Accident Source Terms

Analysis Parameters	*Units*
Neptunium-237 inventory in glovebox	1,000 grams
Neptunium-237 released into glovebox from explosion	1,000 grams
Airborne release fraction times respirable particle fraction	7×10^{-2}
Leak path factor	0.50
Neptunium-237 reaching HEPA filters	35.0 grams
Neptunium-237 released from stack to environs	8.75×10^{-6} grams

HEPA = high-efficiency particulate air.
Source: Calculated results.

Target Dissolver Tank Failure During Plutonium-238 Separation Accident

A hypothetical accident scenario involving the failure of a tank in which irradiated neptunium-237 targets are to be dissolved was analyzed. Irradiated neptunium-237 target processing is planned to be carried out in approximately five batches per year. Each batch of irradiated targets is expected to contain approximately 1 kilogram (2.2 pounds) of plutonium-238 and 8 to 10 kilograms (17.6 to 22 pounds) of neptunium-237. A complete failure of the dissolver tank envelops a spectrum of accidental spills involving plutonium-238 in the hot cells. The complete failure of this tank is judged to be unlikely (between 1×10^{-2} and 1×10^{-4} per year) (ORNL 1999). For the purpose of this *Consolidation EIS*, the accident frequency is assumed to be 1×10^{-2} per year.

This scenario postulates the sudden, complete failure of the dissolver tank and the spilling of its contents onto the floor of the hot cell. The product of the airborne release fraction and the respirable fraction is the sum of that for a free-fall spill, plus evaporation of a shallow pool and are estimated (DOE 1994) to be 0.00013. A leak path factor of 0.75, applicable for a hot cell (Green 1998), was used.

The cell is exhausted first to roughing filters, then through two stages of HEPA filters in series, and then to the environs via a stack. (Note: This assumes two HEPA filters are in series, and each is 99.95 percent efficient, yielding a 2.5×10^{-7} reduction factor.)

Table C–6 shows the release fractions and source terms for this accident.

Table C–6 Target Dissolver Tank Failure Source Terms

Analysis Parameters	*Neptunium-237*	*Plutonium-238*
Inventory in dissolver tank	9,000 grams	1,000 grams
Spilled onto hot cell floor	9,000 grams	1,000 grams
Airborne release fraction times respirable fraction	0.00013	0.00013
Leak path factor	0.75	0.75
Amount entering HEPA filters	0.88 gram	0.098 gram
Amount released from stack to environs	2.19×10^{-7} gram	2.44×10^{-8} gram

HEPA = high-efficiency particulate air.
Source: Calculated results.

Ion Exchange Explosion During Plutonium-238 Separation Accident

A hypothetical accident scenario was considered based on the postulated explosion of an ion exchange column during plutonium-238 purification in a hot cell. Although plans for plutonium purification call for a solvent extraction process, an alternative method involves the use of an ion exchange process (Wham et al. 1998). In this alternative procedure, 495 grams (1.1 pounds) of plutonium-238 are loaded onto an ion exchange column. Judging from historical occurrences of this type of accident at radiochemical laboratories and processing facilities, the frequency of this event is unlikely (between 1×10^{-2} and 1×10^{-4} per year) (ORNL 1999). For the purpose of this *Consolidation EIS*, the accident frequency is assumed to be 1×10^{-2} per year.

Most of the plutonium would be deposited on the cell walls and floor, along with other explosion debris. The fraction of plutonium estimated to be released in airborne form and respirable size particles is 0.07 (DOE 1994).

The hot cell is maintained at a slight negative pressure with respect to the rest of the building. After effluents are exhausted from the hot cell, they pass first through roughing filters, then through two banks of HEPA filters outside the building. On exiting the HEPA filters, effluents are released to the environs through a stack. At the REDC, the explosion could also result in the generation of a weak shock wave and a momentary pressure increase of up to 10 to 50 kilopascals (several pounds per square inch gage) in the hot cell (ORNL 1999). This accident would not be expected to generate dynamic pressures sufficient to damage the hot cell confinement structure, but could result in some leakage of radioactive materials into the operating areas of the building due to the brief pressurization of the hot cell cubicle (ORNL 1999).

For REDC, the shock wave might impact the HEPA filters, possibly degrading their performance. Although the HEPA filters are tested to retain 99.97 percent efficiency, tornado conditions are estimated (DOE 1994) to reduce their efficiency to approximately 99 percent. This scenario assumes that the efficiency of the first-stage HEPA filters at REDC is partially degraded to 99.5 percent while the second-stage efficiency is 99.95 percent. This yields a reduction factor of 2.5×10^{-6} at REDC. The release to the environment was conservatively assumed to consist of a single "puff" associated with the immediate explosion.

Table C–7 shows the release fractions and source terms for this accident.

Table C–7 Plutonium-238 Ion Exchange Explosion Accident Source Terms

Analysis Parameters	*Units*
Plutonium-238 material at risk	495 grams
Plutonium-238 released into Hot Cell E from explosion	495 grams
Airborne release fraction times respirable particle fraction	7×10^{-2}
Leak path factor	0.75
Plutonium-238 reaching HEPA filters	26.0 grams
Plutonium-238 released to environs	6.50×10^{-5} gram

HEPA = high-efficiency particulate air.
Source: Calculated results.

Beyond-Evaluation-Basis Accident

The postulated beyond-evaluation-basis processing facility accident selected for use in this *Consolidation EIS* is a catastrophic earthquake. Such an event is less likely than the design-basis processing facility accidents, although its consequences could be severe. Its frequency is assumed to be 1×10^{-5} per year.

Case 1—Storage Facility

The earthquake is postulated to collapse the stack, severely damaging the HEPA filter system located nearby. Although the building is expected to collapse, the hot cells are expected to remain intact, but with cracked walls. In addition, one or more of the shielded viewing windows could be cracked or broken. The ventilation systems exhausting from the hot cells are expected to fail. Neptunium-237 is stored in double steel cans, with both the inner and outer cans sealed. The double cans are stacked in an array of robust, seismically supported steel storage tubes inside the hot cell. The analysis postulated the storage tube array would maintain geometry and not be damaged by equipment dislodged within the hot cell during the event. It was postulated that none of the storage cans in the storage tubes would be damaged. The storage cans would not be stressed to a level that would breach the double containment of the can design. No neptunium was postulated to be released from the storage cans during the event.

At INL, neptunium-237 is stored in a vault at the Fuel Manufacturing Facility, which is close to the new facility for the proposed alternative. The neptunium-237 storage cans are located in a rack inside the vault. While the postulated beyond-design-basis earthquake could cause portions of the facility to collapse, none of the storage cans in the vault would be breached. The storage cans would not be stressed to a level that would breach the double containment of the can design. Similarly, storage of available and usable plutonium-238 at the MFC in INL would also utilize sealed double steel cans in robust, seismically supported steel storage tubes. These plutonium-238 storage cans would not be stressed to a level that would breach the double containment of the can design.

Case 2—Processing Facility

The earthquake is postulated to collapse the stack, severely damaging the HEPA filter system located nearby. Although the building is expected to collapse, the hot cells are expected to remain intact, but with cracked walls. In addition, one or more of the shielded viewing windows could be cracked or broken. The ventilation systems exhausting from the hot cells are expected to fail. Radioactive materials in the hot cells will be released as a result of cracks in cell walls and shielded windows, but the rate of leakage is expected to be low, since the hot cells are not pressurized and there is no forced ventilation. The leak path factor (i.e., the mass fraction of airborne particulates in an enclosure that is released to the environment) under these conditions has been conservatively estimated to be 0.1 (Green 1997).

The plutonium-238 inventory in the facility would be in several different chemical and physical forms. Since processing is carried on in batches that overlap one another (Wham et al. 1998), the total quantity of plutonium-238 considered available for release from the facility is the sum of the amounts in the dissolver tank, the ion exchange column during purification, and in powder form that has not yet been placed into a sealed canister. Any plutonium-238 in irradiated targets awaiting processing is unlikely to be mechanically damaged by the earthquake because of their small size and thus resistance to mechanical breakage. Even if some targets were broken, the plutonium-238 is intimately mixed with the neptunium-237 oxide and an aluminum matrix, rendering it essentially immobile. The earthquake is postulated to result in a massive spill and/or failure of the dissolver tank, an explosion in an ion exchange column, and a spill of any plutonium-238 powder not in a sealed container.

Table C–8 shows the release fractions and the ground-level release source terms for this accident.

Table C–8 Beyond-Design-Basis Earthquake Accident Source Terms

	Plutonium-238 Form and Location			
Analysis Parameters	***Solution – Dissolver Tank***	***Solution – Ion Exchange Column***	***Powder – Hot Cell Cubicle***	***Total***
Material at risk	1,000 grams	495 grams	186 grams	1,681 grams
Released into hot cell	1,000 grams	495 grams	186 grams	1,681 grams
Airborne release fraction times respirable fraction	0.00013	0.07	0.0033	–
Leak path factor	0.1	0.1	0.1	-
Released to environs	0.013 gram	3.47 grams	0.061gram	3.54 grams

Source: Calculated results.

C.3.3.2 Purification, Pelletization, and Encapsulation Accident Scenario Selection and Description

For the processing facilities, a spectrum of accidents was developed that considered a full range of accidents associated with such facilities. The scenarios evaluated, however, represent bounding cases that are considered to envelop the risk profile.

The processing facility accidents presented in the LANL *TA-55 Hazard Analysis* (LANL 2002) were reviewed for evaluation in this *Consolidation EIS*. Process and facility details were based on the preconceptual design study to support plutonium-238 production (INL 2005). Since process details at the new INL facility are essentially the same as those at TA-55, the same spectrum of accidents was evaluated for all the processing facilities. However, facility differences were accounted for in evaluating the consequences of these accidents.

Several evaluation-basis accidents were selected for inclusion in this *Consolidation EIS*. These include:

- A postulated evaluation-basis fire adjacent to a glovebox during plutonium-238 powder-to-pellet fabrication, representing the glovebox-handling accident having the largest potential consequences. This accident was analyzed for two separate assumptions denoted as mitigated and unmitigated. Mitigated assumes normal functioning of all heating, ventilating, and air conditioning and fire suppression systems while unmitigated assumes failure of the heating, ventilating, and air conditioning and fire suppression systems.

- A postulated evaluation-basis earthquake (0.3-g acceleration) causing failure of the heating, ventilating, and air conditioning, fire safety equipment, nonsafety class ductwork, and internal nonsafety grade structures, but not the structure shell itself.

- A postulated beyond-evaluation-basis fire similar to the evaluation-basis fire but involving two gloveboxes and the assumption that exterior doors are open for the duration of the fire providing a direct unfiltered release to the environment.

- A postulated beyond-design-basis earthquake (0.5-g) with all the same assumed failures as the evaluation-basis earthquake, but in addition, a 50-percent degradation in HEPA filter removal efficiency.

Calculations of peak HEPA filter temperature for both fire accident scenarios showed that the maximum conservatively calculated air temperature at the HEPA filters would not cause any failure or degradation of the filters' efficiency in removing airborne respirable particles of plutonium-238.

Plutonium-238 would be stored in shielded containers in quantities and configurations that preclude criticality. Target preparation and post-irradiation processing would be carried out in batches involving quantities well below those at which criticality could occur. As a result, a criticality accident could occur only as a result of a series of gross, deliberate violations of established controls.

The waste stream from the irradiated targets would be processed in the same facilities as the irradiated targets. Accidents occurring during the processing of the waste stream were not evaluated in this *Consolidation EIS* because their consequences are bounded by the irradiated target accidents that have been evaluated.

Table C–9 lists the source term and frequency for each of the accident scenarios.

Table C–9 Accident Scenario Source Term and Frequency

Accident Scenario	*Material at Risk (grams of heat source plutonium)*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (grams of heat source plutonium)*	*Annual Frequency*
Design-basis fire - mitigated (not analyzed because bounded by unmitigated case)	20.4	1.0	0.01	1.0	0.011	0.0022	$>1 \times 10^{-5}$
Design-basis fire - unmitigated	20.4	1.0	0.01	1.0	1.0	0.2	1×10^{-5}
Design-basis earthquake	(a)	0.0 [b] or 1.0	(c)	(c)	0.06	0.0116	5×10^{-4}
Beyond-design-basis fire	40.8	1.0	0.01	1.0	0.18	0.074	1×10^{-6}
Beyond-design-basis earthquake	(a)	0.0 [b] or 1.0	(c)	(c)	0.06	0.0174	1×10^{-4}

[a] Composite of source terms from different locations containing heat source plutonium.
[b] Damage ratio depends on whether individual component or structure is designed to survive Earthquake.
[c] Depends on physical form of plutonium in the specific apparatus (e.g., powder, oxide, liquid).

Heat source plutonium, in Table C–9, consists of a mix of plutonium and other radioisotopes. A representative specification for heat source plutonium, in weight percent, is 80.2 percent plutonium-238, 15.9 percent plutonium-239, 3 percent plutonium-240, 0.6 percent plutonium-241, 0.1 percent plutonium-242, 0.1 percent neptunium-237, and 0.1 percent uranium-234 (decay product from plutonium-238). Since plutonium-238 has the highest curies per gram content of all these isotopes, accident analyses conservatively assumed that the heat source plutonium is 100 percent plutonium-238. Aged heat sources like those which would be transported from LANL and Pantex to INL under the Consolidation and Consolidation with Bridge Alternatives, have lower fractions of plutonium-238 in their plutonium because of the 87.8 year half-life of plutonium-238. The reduced plutonium-238 concentration would be replaced with uranium-234, the daughter or decay product of plutonium-238. For example, a heat source with 60 weight percent plutonium-238 would also contain 20.3 weight percent uranium-234 (80.2 − 60 = 20.2 + existing 0.1 = 20.3) along with the same percentages of the other radioisotopes. The much longer half-life of the other constituent radioisotopes results in no significant change in their relative concentrations.

C.3.3.3 Accident Scenario Summary

The accident scenarios described in this section apply to the No Action, Consolidation, and Consolidation with Bridge Alternatives. The principal difference is the location of the accident. This is better explained in **Table C–10**.

Table C–10 Accident Scenario Location for Each Alternative

Accident Scenario	*No Action Alternative and Bridge Period of Consolidation with Bridge Alternative Location*	*Consolidation Alternative and Consolidation Period of Consolidation with Bridge Alternative Location*
Target Fabrication and Processing Facility		
Design-basis neptunium-237 ion exchange explosion	ORNL REDC [a]	New Facility at INL-MFC [b]
Design-basis target dissolver tank failure	ORNL REDC [a]	New Facility at INL-MFC [b]
Design-basis plutonium-238 ion exchange explosion	ORNL REDC [a]	New Facility at INL-MFC [b]
Beyond design-basis earthquake	ORNL REDC [a]	New Facility at INL-MFC [b]
Plutonium-238 Purification, Pelletization, and Encapsulation Facility		
Unmitigated design-basis fire	LANL TA-55 [c]	New Facility at INL-MFC [b]
Design-basis earthquake	LANL TA-55 [c]	New Facility at INL-MFC [b]
Beyond-design-basis fire	LANL TA-55 [c]	New Facility at INL-MFC [b]
Beyond-design-basis earthquake	LANL TA-55 [c]	New Facility at INL-MFC [b]

ORNL = Oak Ridge National Laboratory, REDC = Radiochemical Engineering Development Center, INL = Idaho National Laboratory, MFC = Materials and Fuels Complex, LANL = Los Alamos National Laboratory, TA-55 = Technical Area 55.

[a] Accident analysis results from the *NI PEIS* (DOE 2000).

[b] Accident analysis calculations performed specifically for this EIS.

[c] Some accident analysis results from TA-55 Hazards Analysis (LANL 2002) and some from specific calculations performed for this EIS.

C.3.4 Radiological Accident Impacts

The following tables show the impacts for the Consolidation and Consolidation with Bridge Alternatives for accident scenarios that have been postulated for operations involving target processing and purification, pelletization, and encapsulation at INL. Other operations such as target irradiation in a reactor, RPS assembly and testing, and storage of target materials are also sources of potential accidents that have been considered. However, the expected impacts of these operations would be bounded by accidents that could occur during target processing and plutonium-238 purification, pelletization, and encapsulation.

Tables C–11 and C–12 show the consequences and risks, respectively, for target processing operations at INL under the Consolidation Alternative. **Tables C–13 and C–14** similarly show the Consolidation Alternative consequences and risks for plutonium-238 purification, pelletization, and encapsulation at INL.

Under the Consolidation with Bridge Alternative, target processing and plutonium-238 purification, pelletization, and encapsulation would be conducted sequentially in 5-year and 35-year periods. **Tables C–15 and C–16** show the consequences and risk for accidents postulated to occur during target processing at the REDC facility at ORNL for the first 5-year period and at INL for the next 35-year period. Similarly, for the purification, pelletization, and encapsulation operations, **Tables C–17 and C–18** show the consequences and risks at the Plutonium Facility at LANL for the first 5-years and at INL for the next 35 years. Consequences and risks in the Plutonium Facility at LANL are identical to the No Action Alternative.

Table C–11 Target Processing Accident Consequences Under the Consolidation Alternative at Idaho National Laboratory

Accident	*Maximally Exposed Individual*		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
	Dose (rem)	*Latent Cancer Fatality* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b]	*Dose (rem)*	*Latent Cancer Fatality* [a]
Neptunium-237 target preparation ion exchange explosion	5.2×10^{-9}	3.1×10^{-12}	7.9×10^{-7}	4.8×10^{-10}	7.2×10^{-8}	4.3×10^{-11}
Plutonium-238 separation tank failure	1.3×10^{-7}	7.5×10^{-11}	2.8×10^{-5}	1.7×10^{-8}	1.9×10^{-6}	1.1×10^{-9}
Plutonium-238 ion exchange explosion	4.9×10^{-4}	3.0×10^{-7}	7.43×10^{-2}	4.5×10^{-5}	6.9×10^{-3}	4.1×10^{-6}
Beyond-evaluation-basis earthquake	8.37	0.005	4,000	2.4	195	0.23

[a] Likelihood of a latent cancer fatality.
[b] Number of latent cancer fatalities.

Table C–12 Target Processing Annual Accident Risks Under the Consolidation Alternative at Idaho National Laboratory

Accident	*Maximally Exposed Individual* [a]	*Population to 80 Kilometers (50 miles)* [b]	*Noninvolved Worker* [a]
Neptunium-237 target preparation ion exchange explosion	3.1×10^{-14}	4.8×10^{-12}	4.3×10^{-13}
Plutonium-238 separation tank failure	7.5×10^{-13}	1.7×10^{-10}	1.1×10^{-11}
Plutonium-238 ion exchange explosion	3.0×10^{-9}	4.5×10^{-7}	4.1×10^{-8}
Beyond-evaluation-basis earthquake	5.0×10^{-8}	2.4×10^{-5}	2.3×10^{-6}

[a] Increased likelihood of a latent cancer fatality.
[b] Increased number of latent cancer fatalities.

Table C–13 Plutonium-238 Purification, Pelletization, and Encapsulation Accident Consequences Under the Consolidation Alternative at Idaho National Laboratory

Accident	*Maximally Exposed Individual*		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
	Dose (rem)	*Latent Cancer Fatality* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b]	*Dose (rem)*	*Latent Cancer Fatality* [a]
Unmitigated evaluation-basis fire	0.70	0.00042	228	0.14	15.6	0.0094
Unmitigated evaluation-basis earthquake	0.27	0.00016	169	0.10	6.38	0.0038
Beyond-evaluation-basis fire	0.42	0.00025	84.2	0.051	7.87	0.0047
Beyond-evaluation-basis earthquake	0.04	0.000025	20	0.012	0.97	0.00058

[a] Likelihood of a latent cancer fatality.

[b] Number of latent cancer fatalities.

Table C–14 Plutonium-238 Purification, Pelletization, and Encapsulation Annual Accident Risks Under the Consolidation Alternative at Idaho National Laboratory

Accident	*Maximally Exposed Individual* [a]	*Population to 80 Kilometers (50 miles)* [b]	*Noninvolved Worker* [a]
Unmitigated evaluation-basis fire	4.2×10^{-9}	1.4×10^{-6}	9.4×10^{-8}
Unmitigated evaluation-basis earthquake	8.2×10^{-8}	5.1×10^{-5}	1.9×10^{-6}
Beyond-evaluation-basis fire	2.5×10^{-10}	5.1×10^{-8}	4.7×10^{-9}
Beyond-evaluation-basis earthquake	2.5×10^{-9}	1.2×10^{-6}	5.8×10^{-8}

[a] Increased likelihood of a latent cancer fatality.

[b] Increased number of latent cancer fatalities.

Table C–15 Target Processing Accident Consequences Under the Consolidation with Bridge Alternative at Idaho National Laboratory and Oak Ridge National Laboratory

Accident	*Maximally Exposed Individual*		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
	Dose (rem)	*Latent Cancer Fatality* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b]	*Dose (rem)*	*Latent Cancer Fatality* [a]
Neptunium-237 target preparation ion exchange explosion at INL	5.2×10^{-9}	3.1×10^{-12}	7.9×10^{-7}	4.8×10^{-10}	7.2×10^{-8}	4.3×10^{-11}
Plutonium-238 separation tank failure at INL	1.3×10^{-7}	7.5×10^{-11}	2.8×10^{-5}	1.7×10^{-8}	1.9×10^{-6}	1.1×10^{-9}
Plutonium-238 ion exchange explosion at INL	4.9×10^{-4}	3.0×10^{-7}	7.43×10^{-2}	4.5×10^{-5}	6.9×10^{-3}	4.1×10^{-6}
Beyond-evaluation-basis earthquake at INL	8.37	0.005	4,000	2.4	195	0.23
Neptunium-237 target preparation ion exchange explosion at ORNL	9.4×10^{-9}	5.6×10^{-12}	1.0×10^{-5}	6.2×10^{-9}	5.5×10^{-9}	3.3×10^{-12}
Plutonium-238 separation tank failure at ORNL	2.2×10^{-7}	1.3×10^{-10}	3.6×10^{-4}	2.2×10^{-7}	1.2×10^{-7}	7.4×10^{-11}
Plutonium-238 ion exchange explosion at ORNL	0.00089	5.4×10^{-7}	0.98	5.9×10^{-4}	0.00052	3.1×10^{-7}
Beyond-evaluation-basis earthquake at ORNL	54	0.064	29,000	17.3	1,010	1.0

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory.

[a] Likelihood of a latent cancer fatality.

[b] Number of latent cancer fatalities.

Table C–16 Target Processing Annual Accident Risks Under the Consolidation with Bridge Alternative at Idaho National Laboratory and Oak Ridge National Laboratory

Accident	*Maximally Exposed Individual* [a]	*Population to 80 Kilometers (50 miles)* [b]	*Noninvolved Worker* [a]
Neptunium-237 target preparation ion exchange explosion at INL	3.1×10^{-14}	4.8×10^{-12}	4.3×10^{-13}
Plutonium-238 separation tank failure at INL	7.5×10^{-13}	1.7×10^{-10}	1.2×10^{-11}
Plutonium-238 ion exchange explosion at INL	3.0×10^{-9}	4.5×10^{-7}	4.1×10^{-8}
Beyond-evaluation-basis earthquake at INL	5.0×10^{-8}	2.4×10^{-5}	2.3×10^{-6}
Neptunium-237 target preparation ion exchange explosion at ORNL	5.6×10^{-14}	6.2×10^{-11}	3.3×10^{-14}
Plutonium-238 separation tank failure at ORNL	1.3×10^{-12}	2.2×10^{-9}	7.4×10^{-13}
Plutonium-238 ion exchange explosion at ORNL	5.4×10^{-9}	5.9×10^{-6}	3.1×10^{-9}
Beyond-evaluation-basis earthquake at ORNL	6.4×10^{-7}	1.7×10^{-4}	1.2×10^{-5}

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory.

[a] Increased likelihood of a latent cancer fatality.

[b] Increased number of latent cancer fatalities.

Table C–17 Plutonium-238 Purification, Pelletization, and Encapsulation Accident Consequences at Los Alamos National Laboratory and Idaho National Laboratory Under the Consolidation with Bridge Alternative

	Maximally Exposed Individual		*Population to 80 Kilometers (50 miles)*		*Noninvolved Worker*	
Accident	*Dose (rem)*	*Latent Cancer Fatality* [a]	*Dose (person-rem)*	*Latent Cancer Fatalities* [b]	*Dose (rem)*	*Latent Cancer Fatality* [a]
Unmitigated evaluation-basis fire at LANL	10.2	0.0061	1,850	1.11	15.9	0.0095
Unmitigated evaluation-basis earthquake at LANL	4.70	0.0028	834	0.50	7.6	0.0046
Beyond-evaluation-basis fire at LANL	5.37	0.0032	675	0.41	8.0	0.0048
Beyond-evaluation-basis earthquake at LANL	0.72	0.00043	165	0.10	1.2	0.00070
Unmitigated evaluation-basis fire at INL	0.70	0.00042	228	0.14	15.6	0.0094
Unmitigated evaluation-basis earthquake at INL	0.27	0.00016	169	0.10	6.38	0.0038
Beyond-evaluation-basis fire at INL	0.42	0.00025	84.2	0.051	7.87	0.0047
Beyond-evaluation-basis earthquake at INL	0.042	0.000025	20	0.012	0.97	0.00058

LANL = Los Alamos National Laboratory, INL = Idaho National Laboratory.

[a] Likelihood of a latent cancer fatality.

[b] Number of latent cancer fatalities.

Table C–18 Plutonium-238 Purification, Pelletization, and Encapsulation Annual Accident Risks at Los Alamos National Laboratory and Idaho National Laboratory Under the Consolidation with Bridge Alternative

Accident	*Maximally Exposed Individual* [a]	*Population to 80 Kilometers (50 miles)* [b]	*Noninvolved Worker* [a]
Unmitigated evaluation-basis fire at LANL	6.1×10^{-8}	1.1×10^{-5}	9.5×10^{-8}
Unmitigated evaluation-basis earthquake at LANL	1.4×10^{-6}	2.5×10^{-4}	2.3×10^{-6}
Beyond-evaluation-basis fire at LANL	3.2×10^{-9}	4.1×10^{-7}	4.8×10^{-9}
Beyond-evaluation-basis earthquake at LANL	4.3×10^{-8}	9.9×10^{-6}	7.0×10^{-8}
Unmitigated evaluation-basis fire at INL	4.2×10^{-9}	1.4×10^{-6}	9.4×10^{-8}
Unmitigated evaluation-basis earthquake at INL	8.2×10^{-8}	5.1×10^{-5}	1.9×10^{-6}
Beyond-evaluation-basis fire at INL	2.5×10^{-10}	5.1×10^{-8}	4.7×10^{-9}
Beyond-evaluation-basis earthquake at INL	2.5×10^{-9}	1.2×10^{-6}	5.8×10^{-8}

LANL = Los Alamos National Laboratory, INL = Idaho National Laboratory.

[a] Increased likelihood of a latent cancer fatality.

[b] Increased number of latent cancer fatalities.

C.3.5 Chemical Accidents

C.3.5.1 Chemical Accident Scenario

Anticipated annual inventories of chemicals stored onsite for plutonium-238 processing were identified and evaluated in the *NI PEIS* (DOE 2000). Two of the 40 chemicals identified, nitric acid and hydrochloric acid, were selected for evaluation for potential impacts to workers and the public. The stored annual inventories and ERPG levels of concern for these chemicals are shown in **Table C–19**.

Table C–19 Chemicals of Concern Used in Plutonium-238 Processing

Chemical	*Annual Inventory* [a] *(pounds)*	*ERPG-1* [b] *Concentration*	*ERPG-2* [c] *Concentration*	*ERPG-3* [d] *Concentration*
Nitric Acid	2,170	1 ppm	6 ppm	78 ppm
Hydrochloric Acid	321	3 ppm	20 ppm	150 ppm

ERPG = Emergency Response Planning Guideline, ppm = parts per million.

[a] On a daily basis, less than 10 gallons or 5 pounds of these chemicals would be used in plutonium-238 processing.

[b] ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor (NOAA 1999).

[c] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (NOAA 1999).

[d] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (NOAA 1999).

Note: To convert pounds to kilograms, multiply by 0.45359; to convert gallons to liters, multiply by 3.78533.

Source: DOE 2000.

The selection of these chemicals was based on their large quantities that are potentially available for release, chemical properties, and health effects. For these chemicals, an accident scenario is postulated in which a break in a tank or piping occurs, allowing the chemical to be released over a short time period. The cause of the break could be mechanical failure, corrosion, mechanical impact, or natural phenomena. The large quantity of these chemicals is used in target processing and would therefore only apply to ORNL for the No Action Alternative and Consolidation with Bridge Alternative and to INL for the Consolidation with Bridge

Alternative and Consolidation Alternative. The frequency of the accident is in the range of 1.0×10^{-5} to 1.0×10^{-4} per year.

Nitric Acid Release

In its concentrated form, nitric acid is an acute inhalation hazard. It is not combustible, but is a strong oxidizer, and its heat of reaction with reducing agents or combustibles may cause irritation. It can react with metals to release flammable hydrogen gas and nitrogen oxides (NO_x). It may react explosively with combustible organic or readily oxidizable materials.

Nitric acid in any concentration would react with any concentration of sodium hydroxide or sodium nitrate to produce heat. The reaction between the highest concentrations of nitric acid and highest concentrations of sodium hydroxide could result in extreme heat generation, resulting in fire. Nitric acid could also react with sodium nitrite to produce toxic gases. The mixture of these two chemicals results in a nitrous acid solution, which decomposes into the toxic gases nitrogen monoxide and nitrogen dioxide.

The accident scenario postulates an unmitigated catastrophic release of 984 kilograms (2,170 pounds) of nitric acid from an outdoor storage tank. The cause of the accident could be a vehicular crash, earthquake, or any similar high-energy event.

Hydrochloric Acid Release

Hydrochloric acid is a very strong acid and its solutions can be extremely corrosive. It is highly reactive with alkaline materials. It is not flammable, but reacts with most metals to form explosive/flammable hydrogen gas. Hydrochloric acid fumes have an acrid, penetrating odor. Aqueous solutions of hydrochloric acid attack and corrode nearly all metals, except mercury, silver, gold, platinum, tantalum, and certain alloys.

Exposure can cause severe burns and eye damage. It is harmful if inhaled and fatal if swallowed. Exposure to hydrochloric acid can cause circulatory collapse, which can cause death including asphyxial death due to glottic edema.

The accident scenario postulates an unmitigated catastrophic release of 147 kilograms (321 pounds) of hydrochloric acid from an outdoor storage tank. The cause of the accident could be a vehicular crash, earthquake, or any similar high-energy event.

C.3.5.2 Impacts

The released chemical forms a pool surrounding the tank and evaporates forming a plume that disperses into the environment. Existing berms surrounding the tanks are conservatively assumed to fail due to the postulated accident. The assumption results in the largest pool area causing the largest plume release. The chemical plume moves away from the point of release in the direction of prevailing wind and potentially impacts workers and the public.

Table C–20 shows the estimated atmospheric concentrations of the chemicals at specified distances for comparison with ERPG-2 and ERPG-3 levels of concern (NOAA 1999). The levels of concern for nitric acid are 6 parts per million for ERPG-2 and 78 parts per million for ERPG-3. The results indicate that, for a nitric acid release at INL or ORNL, ERPG-2 and ERPG-3 limits are not exceeded beyond the nearest site boundary. For the noninvolved worker located at a distance of 640 meters (2,100 feet) from the accident, both the ERPG-2 and ERPG-3 limits would not be exceeded at either INL or ORNL.

The levels of concern for hydrochloric acid are 20 parts per million for ERPG-2 and 150 parts per million for ERPG-3. The results indicate that for a hydrochloric acid release, ERPG-2 and ERPG-3 limits are not exceeded beyond the nearest site boundary at either INL or ORNL. For the noninvolved worker located at a distance of 640 meters (2,100 feet) from the accident, both the ERPG-2 and ERPG-3 limits would not be exceeded at either INL or ORNL.

Table C–20 Chemical Accident Impacts at Idaho National Laboratory and the Radiochemical Engineering Development Center at Oak Ridge National Laboratory

Chemical	*Quantity Released (pounds)*	*ERPG-2* [a]		*ERPG-3* [b]		*Concentration*	
		Limit	*Distance to Limit (meters)*	*Limit*	*Distance to Limit (meters)*	*Noninvolved Worker at 640 Meters*	*Nearest Site Boundary* [c]
Nitric acid at INL	2,170	6 ppm	128	78 ppm	21	0.33 ppm	0.013 ppm
Hydrochloric acid at INL	321	20 ppm	232	150 ppm	80	2.85 ppm	0.037 ppm
Nitric Acid at REDC (ORNL)	2,170	6 ppm	204	78 ppm	39	0.72 ppm	0.027 ppm
Hydrochloric Acid at REDC (ORNL)	321	20 ppm	444	150 ppm	142	9.97 ppm	0.13 ppm

ERPG = Emergency Response Planning Guideline, INL = Idaho National Laboratory, ppm = parts per million, REDC = Radiochemical Engineering Development Center, ORNL = Oak Ridge National Laboratory.

[a] ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action (NOAA 1999).

[b] ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (NOAA 1999).

[c] Nearest site boundary is 5,200 meters at INL and 4,600 meters at REDC.

Note: To convert pounds to kilograms, multiply by 0.45359; to convert meters to feet, multiply by 3.2808.

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APPENDIX D

EVALUATION OF HUMAN HEALTH EFFECTS OF OVERLAND TRANSPORTATION

APPENDIX D
EVALUATION OF HUMAN HEALTH EFFECTS OF OVERLAND TRANSPORTATION

D.1 Introduction

Transportation of any commodity involves a risk to both transportation crewmembers and members of the public. This risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of certain materials, such as hazardous or radioactive substances, can pose an additional risk because of the nature of the material itself. To permit a complete appraisal of the environmental impacts of the Proposed Action and alternatives, the human health risks associated with the transportation of radioactive materials are analyzed in this appendix.

This appendix provides an overview of the approach used to assess the human health risks that could result from transportation. The topics in this appendix include the scope of the assessment, packaging and determination of potential transportation routes, analytical methods used for the risk assessment (e.g., computer models), and important assessment assumptions. It also presents the results of the assessment. In addition, to aid in the understanding and interpretation of the results, specific areas of uncertainty are described with an emphasis on how the uncertainties could affect comparisons of the alternatives.

The risk assessment results are presented in this appendix in terms of “per shipment” risk factors, as well as the total risks under a given alternative. Per-shipment risk factors provide an estimate of the risk from a single shipment. The total risks under a given alternative are estimated by multiplying the expected number of shipments by the appropriate per-shipment risk factors.

D.2 Scope of Assessment

The scope of the transportation human health risk assessment, including the alternatives and options, transportation activities, potential radiological and nonradiological impacts, and transportation modes considered, is described in this section. There are specific shipping arrangements for various radioactive substances that cover the alternatives evaluated. This evaluation focuses on using on- and offsite public roads or private roads. Additional details of the assessment are provided in the remaining sections of this appendix.

D.2.1 Transportation-Related Activities

The transportation risk assessment is limited to estimating the human health risks related to transportation under each alternative. The risks to workers or the public during loading, unloading, and handling at U.S. Department of Energy (DOE) facilities, prior to or after shipment, are not included in the transportation assessment. The risks from these activities are considered as part of the facility operation impacts.

D.2.2 Radiological Impacts

For each alternative, radiological risks (i.e., those risks that result from the radioactive nature of the materials) are assessed for both incident-free (i.e., normal) and accident transportation conditions. The radiological risk associated with incident-free transportation conditions would result from the potential exposure of people to external radiation in the vicinity of a shipment. The radiological risk from transportation accidents would come from the potential release and dispersal of radioactive material into the environment during an accident and the subsequent exposure of people.

All radiological impacts are calculated in terms of committed dose and associated health effects in the exposed populations. The radiation dose calculated is the total effective dose equivalent (see Title 10 of the *Code of Federal Regulations*, Part 20 [10 CFR 20]), which is the sum of the effective dose equivalent from external radiation exposure and the 50-year committed effective dose equivalent from internal radiation exposure. Radiation doses are presented in units of roentgen equivalent man (rem) for individuals and person-rem for collective populations. The impacts are further expressed as health risks in terms of latent cancer fatalities (LCFs) in exposed populations using the dose-to-risk conversion factors recommended by DOE's Office of National Environmental Policy Act (NEPA) Policy and Compliance, based on Interagency Steering Committee on Radiation Safety guidance (DOE 2003).

D.2.3 Nonradiological Impacts

In addition to the radiological risks posed by transportation activities, vehicle-related risks are also assessed for nonradiological causes (i.e., causes related to the transport vehicles and not the radioactive cargo) for the same transportation routes. The nonradiological transportation risks, which would be incurred for similar shipments of any commodity, are assessed for both incident-free and accident conditions. The nonradiological risks during incident-free transportation conditions would be caused by potential exposure to increased vehicle exhaust emissions. The nonradiological accident risk refers to the potential occurrence of transportation accidents that directly result in fatalities unrelated to the shipment of cargo. Nonradiological risks are presented in terms of estimated fatalities.

D.2.4 Transportation Modes

All shipments are assumed to take place by dedicated truck transportation modes. Those requiring secure shipment would use DOE's Safe, Secure Trailer/Safeguards Transports (SST/SGTs).

D.2.5 Receptors

Transportation-related risks are calculated and presented separately for workers and members of the general public. The workers considered are truck and rail crewmembers involved in transportation and inspection of the packages. The general public includes all persons who could be exposed to a shipment while it is moving or stopped during transit. For the incident-free operation, the affected population includes individuals living within 800 meters (0.5 miles) of each side of the road or rail. Potential risks are estimated for the affected populations and for the hypothetical maximally exposed individual (MEI). For incident-free operation, the MEI would be a resident living near the highway or railroad and exposed to all shipments transported on the road or rail. For accident conditions, the affected population includes individuals residing within 80 kilometers (50 miles) of the accident, and the MEI would be an individual located 100 meters (330 feet) directly downwind from the accident. The risk to the affected population is a measure of the radiological risk posed to society as a whole by the alternative being considered. As such, the impact on the affected population is used as the primary means of comparing various alternatives.

D.3 Packaging and Transportation Regulations

D.3.1 Packaging Regulations

The primary regulatory approach to promote safety from radiological exposure is the specification of standards for the packaging of radioactive materials. Packaging represents the primary barrier between the radioactive material being transported and radiation exposure to the public, workers, and the environment. Transportation packaging for radioactive materials must be designed, constructed, and maintained to contain and shield its contents during normal transport conditions. For highly radioactive material, such as high-level radioactive waste or spent nuclear fuel, packagings must contain and shield their contents in the event of severe accident conditions. The type of packaging used is determined by the total radioactive hazard presented by the material within the packaging. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. "Strong and Tight" packaging is also used to transport certain low-specific-activity materials. Strong and Tight packaging is equivalent to Type A packaging.

Excepted packagings are limited to transporting materials with extremely low levels of radioactivity. Industrial packagings are used to transport materials that, because of their low concentration of radioactive materials, present a limited hazard to the public and the environment. Type A packagings are designed to protect and retain their contents under normal transport conditions and must maintain sufficient shielding to limit radiation exposure to handling personnel. Type A packaging, typically a 0.21-cubic-meter (55-gallon) drum or standard waste box, is commonly used to transport radioactive materials with higher concentrations or amounts of radioactivity than Excepted or Industrial packagings. Strong and Tight packagings are used in the United States for shipment of certain materials with low levels of radioactivity, such as natural uranium and rubble from the decommissioning of nuclear facilities. Type B packagings are used to transport material with the highest radioactivity levels, and are designed to protect and retain their contents under severe transportation accident conditions. They are described in more detail in the following sections. Packaging requirements are an important consideration for transportation risk assessment.

D.3.2 Transportation Regulations

The regulatory standards for packaging and transporting radioactive materials are designed to achieve four primary objectives:

- Protect persons and property from radiation emitted from packages during transportation by specific limitations on the allowable radiation levels,
- Contain radioactive material (achieved by packaging design requirements based on performance-oriented packaging integrity tests and environmental criteria),
- Prevent nuclear criticality (an unplanned nuclear chain reaction that can occur as a result of concentrating too much fissile material in one place), and
- Provide physical protection against theft and sabotage during transit.

The U.S. Department of Transportation (DOT) regulates the transportation of hazardous materials in interstate commerce by land, air, and water. DOT specifically regulates the carriers of radioactive materials and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements. DOT also regulates the labeling, classification, and marking of radioactive material packagings.

The U.S. Nuclear Regulatory Commission (NRC) regulates the packaging and transporting of radioactive material for its licensees, including commercial shippers of radioactive materials. In addition, under an agreement with DOT, NRC sets the standards for packages containing fissile materials and Type B packagings.

DOE, through its management directives, Orders, and contractual agreements, ensures the protection of public health and safety by imposing on its transportation activities standards equivalent to those of DOT and NRC. According to "U.S. Government Material" (49 CFR 173.7(d)), packagings built by or under the direction of DOE may be used for transporting Class 7 (radioactive) materials when they are evaluated, approved, and certified by DOE against packaging standards equivalent to those specified in "Packaging and Transportation of Radioactive Material" (10 CFR 71).

DOT also has requirements that help to reduce transportation impacts. Some requirements affect drivers, packaging, labeling, marking, and placarding. Others, specifying the maximum dose rate from radioactive material shipments, help to reduce incident-free transportation doses.

The Federal Emergency Management Agency (FEMA), an agency of the Department of Homeland Security, is responsible for establishing policies for, and coordinating civil emergency management, planning, and interaction with, Federal agencies that have emergency response functions in the event of a transportation incident. FEMA coordinates Federal and state participation in developing emergency response plans and is responsible for development of the interim Federal Radiological Emergency Response Plan. This plan is designed to coordinate Federal support to state and local governments, upon request, during the event of a transportation incident.

The Interstate Commerce Commission is responsible for regulation of the economic aspects of overland shipments of radioactive materials. The commission issues operating authorities to carriers and also monitors and approves freight rates.

D.4 Transportation Impact Analysis Methodology

The transportation risk assessment is based on the alternatives described in Chapter 2 of the EIS. **Figure D–1** summarizes the transportation risk assessment methodology. After the *Consolidation EIS* alternatives were identified and the requirements of the shipping campaign were understood, data were collected on the material characteristics and accident parameters.

Transportation impacts calculated in this *Consolidation EIS* are presented in two parts: impacts of incident-free or routine transportation and impacts of transportation accidents. Impacts of incident-free transportation and transportation accidents were further divided into nonradiological and radiological impacts. Nonradiological impacts of incident-free transportation could result from vehicular emissions and from transportation accidents in terms of traffic fatalities. Radiological impacts of incident-free transportation include impacts on members of the public and crew from radiation emanating from materials within the packages. Only under worst-case accident conditions, which are of low probability of occurrence, could a transportation package of the type used to transport the radioactive material be damaged to the point that radioactivity could be released to the environment.

The impacts of transportation accidents are expressed in terms of probabilistic risk, which is the probability of an accident multiplied by the consequences of that accident and summed over all reasonably conceivable accident conditions. Hypothetical transportation accident conditions ranging from low-speed "fender bender" collisions to high-speed collisions, with or without fires, were analyzed. The frequencies of accidents and consequences were evaluated using a method developed by NRC and originally published in the *Final Environmental Statement on the Transportation of Radioactive Materials by Air and Other Modes*, (*Radioactive Material Transportation Study*) (NRC 1977); *Shipping Container Response to Severe Highway and Railway Accident Conditions (Modal Study)* (NRC 1987); and *Reexamination of Spent Fuel Shipping Risk Estimates (Reexamination Study)* (NRC 2000). Radiological accident risk is expressed in terms of additional LCFs, and nonradiological accident risk is expressed in terms of additional immediate (traffic) fatalities. Incident-free risk is also expressed in terms of additional LCFs.

Transportation-related risks are calculated and presented separately for workers and members of the general public. The workers considered are truck/rail crewmembers involved in the actual transportation. The general public includes all persons who could be exposed to a shipment while it is moving or stopped during transit.

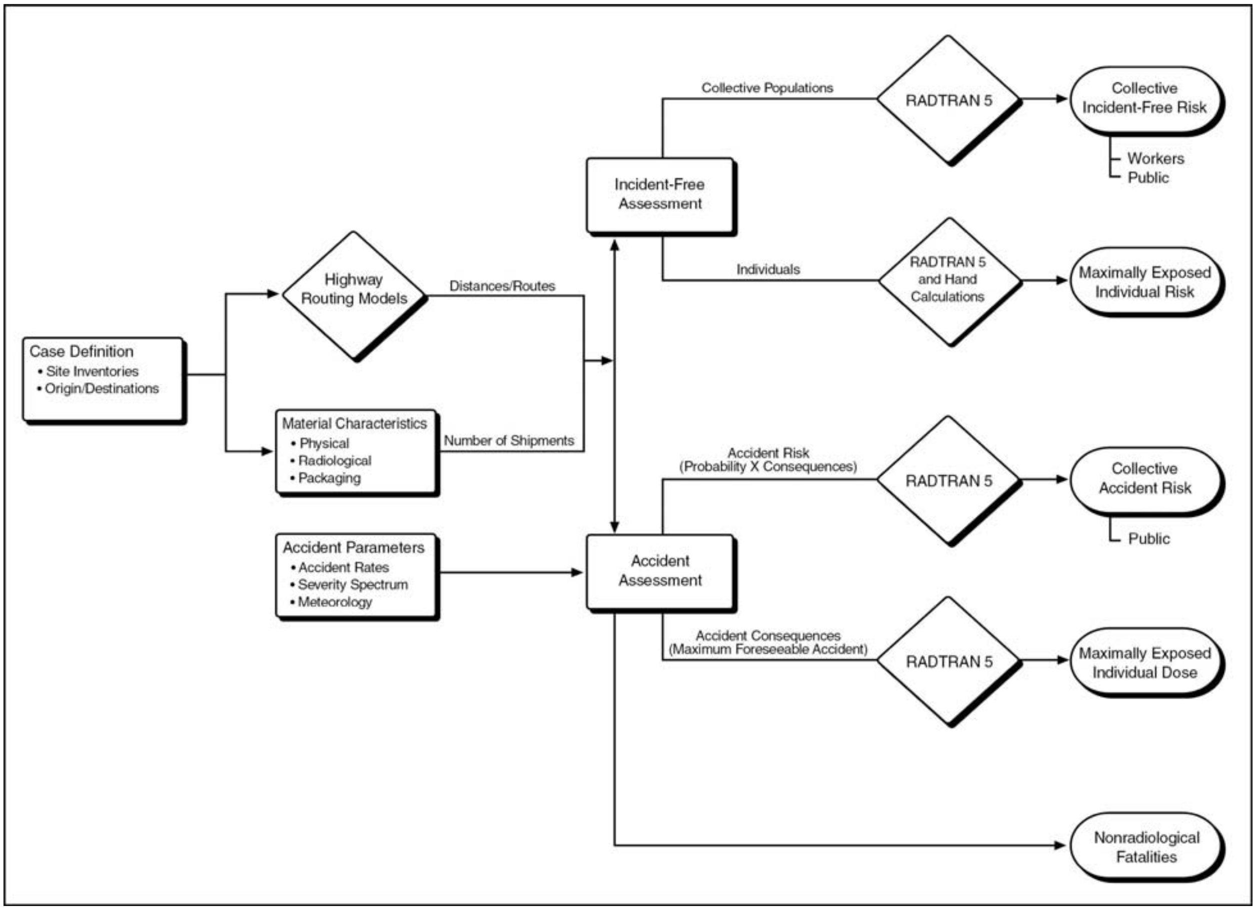

Figure D–1 Overland Transportation Risk Assessment

The first step in the ground transportation analysis is to determine the distances and populations along the routes. The Transportation Routing Analysis Geographic Information System (TRAGIS) computer program (Johnson and Michelhaugh 2003) was used to choose representative routes and the associated distances and populations. This information, along with the properties of the material being shipped and route-specific accident frequencies, was entered into the RADTRAN 5 computer code (SNL 2003), which calculates incident and accident risks on a per-shipment basis. The risks under each alternative are determined by summing the products of per-shipment risks for each radioactive substance by its number of shipments.

The RADTRAN 5 computer code (SNL 2003) is used for incident-free and accident risk assessments to estimate the impacts on populations. RADTRAN 5 was developed by Sandia National Laboratories to calculate population risks associated with the transportation of radioactive materials by a variety of modes, including truck, rail, air, ship, and barge. RADTRAN 5 was used to calculate the doses to the MEIs during incident-free operations.

The RADTRAN 5 population risk calculations include both the consequences and probabilities of potential exposure events. The RADTRAN 5 code consequence analyses include cloud shine, ground shine, inhalation, and resuspension exposures. The collective population risk is a measure of the total radiological risk posed to society as a whole by the alternative being considered. As such, the collective population risk is used as the primary means of comparing the various alternatives.

The RISKIND computer code (Yuan et al. 1995) is used to estimate the doses to MEIs and populations for the worst-case maximum reasonably foreseeable transportation accident. The RISKIND computer code was developed for DOE's Office of Civilian Radioactive Waste Management to analyze the exposure of individuals during incident-free transportation. In addition, the RISKIND code was designed to allow a detailed assessment of the consequences to individuals and population subgroups of severe transportation accidents under various environmental settings.

The RISKIND calculations were conducted to supplement the collective risk results calculated with RADTRAN 5. Whereas the collective risk results provide a measure of the overall risks under each alternative, the RISKIND calculations are meant to address areas of specific concern to individuals and population subgroups. Essentially, the RISKIND analyses are meant to address "What if" questions, such as "What if I live next to a site access road?" or "What if an accident happens near my town?"

D.4.1 Transportation Routes

To assess incident-free and transportation accident impacts, route characteristics were determined for offsite shipments between Idaho National Laboratory (INL), Oak Ridge National Laboratory (ORNL), and Los Alamos National Laboratory (LANL). For offsite transports, potential highway routes were determined using the routing computer program TRAGIS (Johnson and Michelhaugh 2003).

The TRAGIS computer program is a geographic-information-system-based transportation analysis computer program used to identify/select highway, rail, and waterway routes for transporting radioactive materials within the United States. Both the road and rail network are 1:100,000-scale databases, which were developed from the U.S. Geological Survey digital line graphs and the U.S. Bureau of the Census Topological Integrated Geographic Encoding and Referencing System. The population densities along each route are derived from 2000 Census data. The features in TRAGIS allow users to determine routes for shipment of radioactive materials that conform to DOT regulations as specified in "Transportation of Hazardous Materials; Driving and Parking Rules" (49 CFR 397).

Offsite Route Characteristics

Route characteristics important to the radiological risk assessment include the total shipment distance and the population distribution along the route. The specific route selected determines both the total potentially exposed population and the expected frequency of transportation-related accidents. Analyzed route characteristics are summarized in **Table D–1**. The population densities along each route are derived from 2000 Census data (Johnson and Michelhaugh 2003). Rural, suburban, and urban areas are characterized according to the following breakdown:

- Rural population densities range from 0 to 54 persons per square kilometer (0 to 139 persons per square mile),
- Suburban population densities range from 55 to 1,284 persons per square kilometer (140 to 3,326 persons per square mile), and
- Urban population densities include all population densities greater than 1,284 persons per square kilometer (3,326 persons per square mile).

The affected population, for route characterization and incident-free dose calculation, includes all persons living within 800 meters (0.5 miles) of each side of the road. Truck routes analyzed for shipments of radioactive materials are shown in **Figure D–2**.

Table D–1 Offsite Transport Truck Route Characteristics

From	*To*	*Nominal Distance (kilometers)*	*Distance Traveled in Zones (kilometers)*			*Population Density in Zone (number per square kilometer)*			*Number of Affected Persons*
			Rural	*Suburban*	*Urban*	*Rural*	*Suburban*	*Urban*	
Truck Routes									
INL	ORNL	3,369	2,684	631	54	11.5	300.5	2,200.6	543,647
ORNL	LANL	2,370	1,827	478	65	11.0	304.2	2,260.9	500,379
LANL	INL	1,878	1,551	282	45	8.0	354.1	2,325.7	347,910
Pantex	INL [a]	1,762	1,535	184	43	5.3	408.5	2,354.8	294,603

INL = Idaho National Laboratory, ORNL = Oak Ridge National Laboratory, LANL = Los Alamos National Laboratory.

[a] This route is used for transport of plutonium-238 heat sources within milliwatt generators removed from dismantled nuclear weapons.

Note: To convert from kilometers to miles, multiply by 0.6214; to convert from number per square kilometer to number per square mile, multiply by 2.59.

Onsite Route Characteristics

The onsite transport of various radioactive substances is either within a facility, or within a national laboratory site using private roads. Onsite transport occurs at ORNL between the Radiochemical Engineering Development Center (REDC) and the High Flux Isotope Reactor (HFIR), and at INL between the Materials and Fuels Complex (MFC) (formerly known as Argonne National Laboratory-West) and the Advanced Test Reactor (ATR). The REDC and HFIR facilities are about 100 meters (109 yards) apart, and transport occurs on closed roads entirely within the 7900 Area of the ORNL. DOE is proposing to construct a private service road with access restricted to INL contractor material transfers between MFC and ATR. This road would be located entirely within the INL site boundary and closed to the public. Therefore, public population density around these onsite transport roads would be zero.

D.4.2 Radioactive Material Shipments

DOE anticipates that any transportation of neptunium or plutonium dioxide would be required to use the Transportation Safeguards System and SST/SGT shipments. The SST/SGT is a fundamental component of the Transportation Safeguards System, which is operated by the Transportation Safeguards Division of the DOE Albuquerque Operations Office.

Neptunium is handled under safeguards applicable to special nuclear material in accordance with DOE Office of Safeguards and Security guidance. Pure neptunium-237 could potentially be used as nuclear weapons material; therefore, it is shipped under the Transportation Safeguards System. Under DOE Order 474.1, plutonium-238 would be in a safeguard category lower than Categories I and II, which require the use of a safe, secure trailer. However, DOE Order Supplemental Directive AL 5610.14 directs the use of the Transportation Safeguards System for shipments of plutonium-238. The nonirradiated and irradiated targets would carry much less neptunium per shipment, and the form of the neptunium would be less desirable for diversion, so safeguards requirements would be at a lower level.

Although DOE may choose to use the Transportation Safeguards System program for nonirradiated and irradiated target shipments, for the purposes of analysis and flexibility in package selection, this *Consolidation EIS* assumes that commercial vehicles would be used for target shipments.

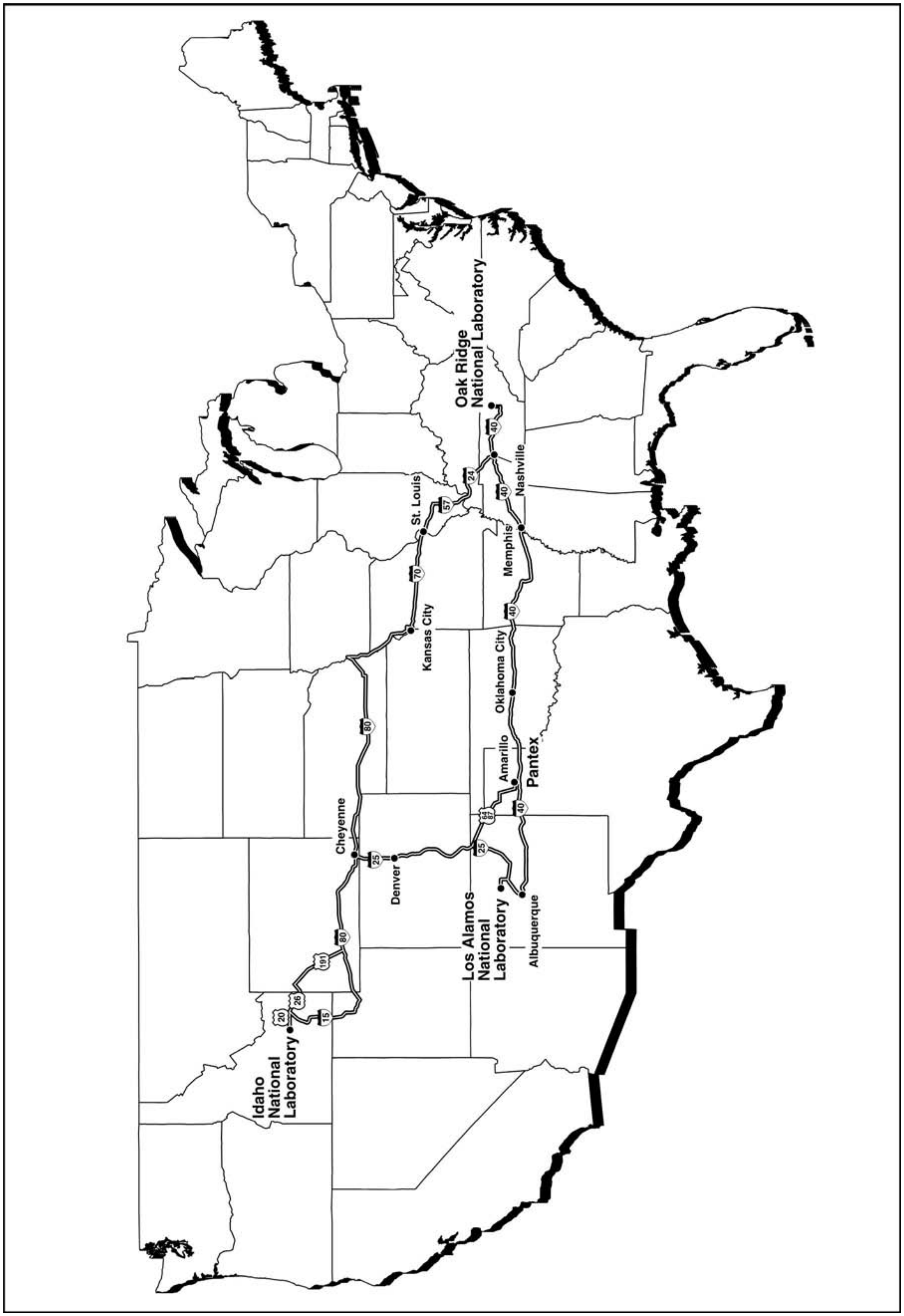

Figure D–2 Analyzed Truck Routes

The SST/SGT is a specially designed component of an 18-wheel tractor-trailer vehicle. While SST/SGT shipments are exempt from DOT regulations (49 CFR Section 173.7[b]), DOE operates and maintains these vehicles in a way that exceeds DOT requirements. Although details of vehicle enhancements and some operational aspects are classified, key characteristics of the SST/SGT system include the following:

- Enhanced structural characteristics and a highly reliable tie-down system to protect cargo from impact;
- Heightened thermal resistance to protect the cargo in case of fire (newer SST/SGT models);
- Established operational and emergency plans and procedures governing the shipment of nuclear materials;
- Various deterrents to prevent unauthorized removal of cargo;
- An armored tractor component that provides courier protection against attack and contains advanced communications equipment;
- Specially designed escort vehicles containing advanced communications equipment and additional couriers;
- 24-hour-a-day real-time communications to monitor the location and status of all SST/SGT shipments via DOE's Security Communication system;
- Couriers, who are armed Federal officers, and who receive rigorous specialized training and are closely monitored through DOE's Personnel Assurance Program;
- Significantly more stringent maintenance standards than those for commercial transport equipment; and
- Periodic appraisals of the Transportation Safeguards System operations by the DOE Office of Defense Programs to ensure compliance with DOE Orders and management directives, and continuous improvement in transportation and emergency management programs.

DOE realizes that the use of SST/SGT vehicles complicates package handling (limited payload mass and size capabilities). ORNL/TM-13526 (Ludwig et al. 1997) provides the following general dimensions for an SST:

Gross vehicle weight rating	36,288 kilograms (80,000 pounds)
Maximum payload	6,169 kilograms (13,600 pounds)
Trailer overall length	18.3 meters (60 feet)
Trailer overall width	259 centimeters (102 inches)
Trailer overall height	4.10 meters (13 feet)
Trailer rear door width	179.1 to 215.9 centimeters (70.5 to 85 inches)
Trailer rear door height	229 centimeters (990 inches)
Trailer floor height above roadway	144 centimeters (56.5 inches)

SGT dimensions are similar. The payload and physical dimensions of the trailer would constrain selection of a cask for transport of the irradiated targets. Therefore, the irradiated and nonirradiated targets would be transported using Type B packages shipped on commercial trailers designed specifically for the packaging being used.

Certified Type B packagings are used to transport various radioactive materials offsite. Neptunium and plutonium are packaged in 9975 and 5320 packagings, respectively. Each 9975 packaging can contain up to 6 kilograms (13.2 pounds) of neptunium-237 (DOE 2004a), and each 5320 packaging can contain up to 357 grams (12.6 ounces) of plutonium-238 (DOE 2004b). The nonirradiated and irradiated targets would be shipped in GE-2000 casks. The gross weight of this package exceeds the load limit on SST/SGTs. Therefore, this cask is transported using a commercial tractor-trailer.

Another source of available and usable plutonium-238 is the milliwatt generator heat sources that are being removed from nuclear weapons as part of the ongoing weapon dismantlement program. A total of 3,200 heat sources are projected to become available between Fiscal Year (FY) 2009 and FY 2022. DOE would transport these heat sources from the Pantex Facility[1] in Texas to INL for storage and future plutonium separation, purification, and up-blending. The need for separation, purification, and upblending (mixing lower purity plutonium-238 with higher purity plutonium-238 to achieve a desired specification purity) is due to the long time period, estimated to be greater than 25 years, since this material was produced. Over time, natural decay of plutonium-238 and concomitant production of other radioisotopes renders the heat source plutonium dioxide unusable without separation, purification, and upblending. These heat sources are encapsulated in a high-strength metal shell that provides high-pressure confinement. They are cylindrical in shape, typically about 1.91 centimeters (0.75 inches) in diameter and height. The plutonium dioxide mass in these heat sources ranges from about 9 to 10 grams, with an original plutonium composition of between 80 and 84 percent plutonium-238. DOE plans to ship these heat sources in a DOE-certified Type B packaging, known as "Mound 1KW," which is constructed for transporting plutonium-238 heat sources in various chemical forms and mechanical configurations (DOE 2004c). The package certificate limits the amount of plutonium-238 to that mass which generates 0.5 kilowatt or less of heat, and limits its transport to three packages per SST/SGT. DOE plans to transport these heat sources in 28 shipments, or 2 shipments annually, between 2009 and 2022.

About 50 kilograms (110 pounds) of neptunium-237 would need to be irradiated to produce 5 kilograms (11 pounds) of plutonium-239. About nine shipments of neptunium targets, each containing about 5.60 kilograms (12.3 pounds) of neptunium-237, are needed to produce 5 kilograms (11 pounds) of plutonium-238. **Table D–2** summarizes the masses of material and the number of shipments required under each alternative.

D.5 Incident-Free Transportation Risks

D.5.1 Radiological Risk

During incident-free transportation of radioactive materials, radiological dose results from exposure to the external radiation field that surrounds the shipping containers. The population dose is a function of the number of people exposed, their proximity to the containers, length of exposure time, and intensity of the radiation field surrounding the containers.

Radiological impacts were determined for crewworkers and the general population during incident-free transportation. For truck shipments, the drivers are the crew of the transport vehicle. For rail shipments, the crew is composed of workers in close proximity to the shipping containers during inspection or classification of railcars. Persons residing within 800 meters (0.5 miles) of the road or railway (off link), persons sharing the road or railway (on link), and persons at stops make up the general population. Exposures of workers who would load and unload the shipments are not included in this analysis, but are included in the occupational exposure estimates for plant workers. Exposures of the inspectors and escorts are evaluated and presented separately.

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[1] *Some of the milliwatt generator heat sources could be at LANL. These would be transported to INL using the same packaging method and transport as described for shipments from Pantex.*

Table D–2 Summary of Material Shipments Per Year

Materials	*Package Name*	*Number of Shipments*	*Amount per Package*	*Packages per Shipment*	*Applicable Alternative*	*Total Mass Shipped*
Neptunium oxide	9975	1	5 kilograms of neptunium-237	10	No Action and Consolidation with Bridge	50 kilograms of neptunium [a]
Irradiated targets	GE-2000	7	0.56 kilograms of plutonium-238	1	No Action	~4 kilograms of plutonium
Nonirradiated targets	GE-2000	7	5.6 kilograms of neptunium-237	1	No Action	~39 kilograms of neptunium
Plutonium oxide	5320	1	0.36 kilograms of plutonium-238	14	No Action and Consolidation with Bridge [b]	5 kilograms of plutonium
Plutonium oxide rods	5320	1	0.36 kilograms of plutonium-238	14	No Action and Consolidation with Bridge [b]	5 kilograms of plutonium
Milliwatt generators plutonium heat source	Mound 1KW	2	0.44 kilograms of plutonium-238	2	Consolidation with Bridge and Consolidation	0.88 kilograms of plutonium-238

[a] This amount of neptunium is only required for the first year under the No Action Alternative. Needs for subsequent years are about 6 to 8 kilograms per year of new neptunium, and the rest would come from recycled neptunium in target processing and plutonium separation. Under the Consolidation with Bridge Alternative, a total of 30 kilograms (or one shipment) of neptunium-237 would be needed to produce about 2 kilograms of plutonium-238 per year for 5 years.

[b] Plutonium transport under the Consolidation with Bridge Alternative would be up to 2 kilograms.

Note: To convert from kilograms to pounds, multiply by 2.2046. The program would run for 35 years. Under the No Action Alternative, seven shipments of neptunium targets would be irradiated at ATR annually.

Radiological risks from transporting radioactive materials are estimated in terms of the number of LCFs among the crew and the exposed population. A health risk conversion factor of 0.0006 LCFs per person-rem of exposure was used for both the public and workers (DOE 2003).

Collective doses for the crew and general population were calculated by using the RADTRAN 5 computer code (SNL 2003). The radioactive material shipments were assigned a dose rate based on their radiological characteristics. Offsite transportation of the neptunium, plutonium, and irradiated targets were assumed to be at the regulatory limit of 10 millirem per hour at 2 meters (about 6.6 feet) from the cask or the outer surface of the vehicle (10 CFR 71.47). The nonirradiated targets, shipped in the same shielded cask as the irradiated targets, are assumed to be at one-tenth the regulatory limit.

D.5.2 Nonradiological Risk

The nonradiological risks, or vehicle-related health risks, resulting from incident-free transport could be associated with the generation of air pollutants by transport vehicles during shipment and are independent of the radioactive nature of the cargo. The health endpoint assessed under incident-free transport conditions is the excess latent mortality due to inhalation of vehicle emissions. Unit risk factors for pollutant inhalation in terms of mortality have been generated (Rao et al. 1982). The unit risk factors account for the potential fatalities from emissions of particulates and sulfur dioxide, but they are applicable only to the urban population zone. The emission unit risk factor for truck transport in the urban area is estimated to be 5.0×10^{-8} fatalities per kilometer; for rail transport, it is 2.0×10^{-7} fatalities per kilometer (DOE 2002a). The emergence of considerable data regarding threshold values for various chemical constituents of vehicle exhaust has made linear extrapolation to estimate the risks from vehicle emissions untenable. This calculation has been dropped from RADTRAN in its recent revision (SNL 2003). Therefore, no risk factors are assigned to vehicle emissions in this analysis.

D.5.3 Maximally Exposed Individual Exposure Scenarios

The maximum individual doses for routine offsite transportation were estimated for transportation workers and members of the general population. For truck shipments, three hypothetical scenarios were evaluated to determine the MEI in the general population. These scenarios are:

- A person caught in traffic and located 1.2 meters (4 feet) from the surface of the shipping container for 30 minutes,
- A person at a rest stop/gas station working at a distance of 16 meters (52 feet) from the shipping container, and
- A resident living 30 meters (98 feet) from the highway used to transport the shipping containers.

The hypothetical MEI doses were accumulated over a single year for all transportation shipments. However, for the scenario involving an individual caught in traffic next to a shipping container, the radiological exposures were calculated for only one event because it was considered unlikely that the same individual would be caught in traffic next to all containers for all shipments. For truck shipments, the maximally exposed transportation worker is the driver who was assumed to have been trained as a radiation worker and to drive shipments for up to 2,000 hours per year, or accumulate an exposure of 2 rem per year. The maximum exposure rate for a member of a truck crew as a nonradiation worker is 2 millirem per hour (10 CFR 71.47).

D.6 Transportation Accident Risks and Maximum Reasonably Foreseeable Consequences

D.6.1 Methodology

The offsite transportation accident analysis considers the impact of accidents during the transportation of radioactive materials by truck. Under accident conditions, impacts on human health and the environment could result from the release and dispersal of radioactive material. Transportation accident impacts have been assessed using accident analysis methodologies developed by NRC. This section provides an overview of the methodologies; detailed descriptions of various methodologies are found in the *Radioactive Material Transportation Study* (NRC 1977), *Modal Study* (NRC 1987), and *Reexamination Study* (NRC 2000). Accidents that could potentially breach the shipping container are represented by a spectrum of accident severities and radioactive release conditions. Historically, most transportation accidents involving radioactive materials have resulted in little or no release of radioactive material from the shipping container. Consequently, the analysis of accident risks takes into account a spectrum of accidents ranging from high-probability accidents of low severity to hypothetical high-severity accidents that have a correspondingly low probability of occurrence. The accident analysis calculates the probabilities and consequences from this spectrum of accidents.

D.6.2 Accident Rates

For the calculation of accident risks, vehicle accident and fatality rates were taken from data provided in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with accident involvement count as the numerator of the fraction and vehicular activity (total travel distance in truck kilometers) as its denominator. Accident rates are generally determined for a multi-year period. For assessment purposes, the total number of expected accidents or fatalities was calculated by multiplying the total shipment distance for a specific case by the appropriate accident or fatality rate.

For truck transportation, the rates presented are specifically for heavy-haul combination trucks involved in interstate commerce (Saricks and Tompkins 1999). Heavy-haul combination trucks are rigs composed of a separable tractor unit containing the engine and one to three freight trailers connected to each other. Heavy-haul combination trucks are typically used for radioactive material shipments. The truck accident rates are computed for each state based on statistics compiled by the Federal Highway Administration, Office of Motor Carriers, from 1994 to 1996. A fatality caused by an accident is the death of a member of the public who is killed instantly or dies within 30 days due to injuries sustained in the accident.

For offsite commercial truck transportation, separate accident rates and accident fatality risks were used for rural, suburban, and urban population zones. The values selected are the mean accident and fatality rates given in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999) under interstate, primary, and total categories for rural, suburban, and urban population zones, respectively. The accident rates are 3.15, 3.52, and 3.66 per 10 million truck kilometers, and the fatality rates are 0.88, 1.49, and 2.32 per 100 million truck kilometers for rural, suburban, and urban zones, respectively.

For the SST/SGT transport, accident and fatality rates given in the *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* were used (DOE 2000). Based on operational experience between FY 1984 and FY 1998, the mean probability of an accident requiring towing of the SST/SGT was 0.058 accidents per million kilometers (0.096 accidents per million miles). Since its establishment in 1975, the DOE Transportation Safeguards Division has accumulated more than 24.4 million kilometers (15.2 million miles) of on-the-road experience transporting DOE-owned cargo with no accidents resulting in a fatality or release of radioactive material. DOE used influence factors from *Determination of Influence Factors and Accident Rates for the Armored Tractor/Safe Secure Trailer* (Phillips, Clauss, and Blower 1994) to estimate accident frequencies and fatality rates for rural, urban, and suburban zones (DOE 2000). The accident rates are 4.18, 5.17, and 6.15 per 100 million truck kilometers, and the fatality rates are 0.39, 0.43, and 0.41 per 100 million truck kilometers for rural, suburban, and urban zones, respectively.

D.6.3 Accident Severity Categories and Conditional Probabilities

Accident severity categories for potential radioactive material transportation accidents are described in the *Radioactive Material Transportation Study* (NRC 1977) for radioactive materials in general and in the “Modal Study,” (NRC 1987) and the *Reexamination Study* (NRC 2000) for spent fuel. This latter transportation risk study represents a refinement of the *Modal Study*. The methods described in the *Modal Study* and the *Reexamination Study* are applicable to transportation of irradiated targets in a Type B spent fuel cask. The accident severity categories presented in the *Radioactive Material Transportation Study* would be applicable to neptunium and plutonium transport.

The *Radioactive Material Transportation Study* (NRC 1977) originally was used to estimate conditional probabilities associated with accidents involving transportation of radioactive materials. The *Modal Study* and the *Reexamination Study* (NRC 1987, 2000) are initiatives taken by NRC to refine more precisely the analysis presented in the *Radioactive Material Transportation Study* for spent nuclear fuel shipping casks.

Whereas the *Radioactive Material Transportation Study* analysis was primarily performed using best engineering judgments and presumptions concerning cask response, the later studies rely on sophisticated structural and thermal engineering analysis and a probabilistic assessment of the conditions that could be experienced in severe transportation accidents. These results are based on representative spent nuclear fuel casks assumed to have been designed, manufactured, operated, and maintained according to national codes and standards. Design parameters of the representative casks were chosen to meet the minimum test criteria specified in "Packaging and Transportation of Radioactive Material" (10 CFR 71). The study is believed to provide realistic, yet conservative, results for radiological releases under transport accident conditions.

In the *Modal Study* and the *Reexamination Study*, potential accident damage to a cask is categorized according to the magnitude of the mechanical forces (impact) and thermal forces (fire) to which a cask is subjected during an accident. Because all accidents can be described in these terms, severity is independent of the specific accident sequence. In other words, any sequence of events that results in an accident in which a cask is subjected to forces within a certain range of values is assigned to the accident severity region associated with that range. The accident severity scheme is designed to take into account all potential foreseeable transportation accidents, including accidents with low probability but high consequences and those with high probability but low consequences.

As discussed earlier, the accident consequence assessment considers only the potential impacts of the most severe transportation accidents. In terms of risk, the severity of an accident must be viewed in terms of potential radiological consequences, which are directly proportional to the fraction of the radioactive material within a cask that is released to the environment during the accident. Although accident severity regions span the entire range of mechanical and thermal accident loads, they are grouped into accident categories that can be characterized by a single set of release fractions and are, therefore, considered together in the accident consequence assessment. The accident category severity fraction is the sum of all conditional probabilities in that accident category.

For the accident risk assessment, accident "dose risk" was generically defined as the product of the consequences of an accident and the probability of the occurrence of that accident, an approach consistent with the methodology used by the RADTRAN 5 computer code. The RADTRAN 5 code sums the product of consequences and probability over all accident severity categories to obtain a probability-weighted risk value referred to in this appendix as "dose risk," which is expressed in units of person-rem.

D.6.4 Atmospheric Conditions

Because it is impossible to predict the specific location of an offsite transportation accident, generic atmospheric conditions were selected for the risk and consequence assessments. On the basis of observations from National Weather Service surface meteorological stations at over 177 locations in the United States, on an annual average, neutral conditions (Pasquill Stability Classes C and D) occur 58.5 percent of the time, and stable (Pasquill Stability Classes E and G) and unstable (Pasquill Stability Classes A and B) conditions occur 33.5 and 8 percent of the time, respectively (DOE 2002a). Neutral weather conditions predominate in each season, but most frequently in the winter (nearly 60 percent of the observations).

Neutral weather conditions (Pasquill Stability Class D) compose the most frequently occurring atmospheric stability condition in the United States and are thus most likely to be present in the event of an accident involving a radioactive material shipment. Neutral weather conditions are typified by moderate windspeeds, vertical mixing within the atmosphere, and good dispersion of atmospheric contaminants. Stable weather conditions are typified by low windspeeds, very little vertical mixing within the atmosphere, and poor dispersion of atmospheric contaminants. The atmospheric condition used in RADTRAN 5 is an average weather condition that corresponds to a stability class spread between Class D (for near distance) and Class E (for farther distance).

Accident consequences for the maximum reasonably foreseeable accident (an accident with a likelihood of occurrence greater than 1 in 10 million per year) were assessed under both stable (Class F, with windspeed of 1 meter [3.3 feet] per second) and neutral (Class D, with windspeed of 4 meters [13 feet] per second) atmospheric conditions. These calculations provide an estimate of the potential dose to an individual and a population within a zone, respectively. The individual dose would represent the MEI in an accident under worst-case weather conditions (stable, with minimum diffusion and dilution). The population dose would represent an average weather condition.

D.6.5 Radioactive Release Characteristics

Radiological consequences were calculated by assigning radionuclide release fractions on the basis of the type of radioactive substance, type of shipping container, and accident severity category. The release fraction is defined as the fraction of radioactivity in the container that could be released to the atmosphere in a given severity of accident. Release fractions vary according to material type and the physical or chemical properties of the radioisotopes. Most solid radionuclides are nonvolatile and, therefore, relatively nondispersible.

Representative release fractions were developed for each radioactive material and container type on the basis of DOE and NRC reports (DOE 1994, 1995, 2002b; NRC 1977, 2000). The severity categories and corresponding release fractions provided in the NRC documents cover a range of accidents from no impact (zero speed) to impacts with speed in excess of 193 kilometers (120 miles) per hour onto an unyielding surface. For the irradiated and nonirradiated targets (neptunium-aluminum fuel clad in aluminum), which are similar in construction to the fuels used in ATR or HFIR (uranium-aluminum fuel clad in aluminum), release fractions given in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995) for the research reactor fuels were used. For the neptunium and plutonium transport in the SST/SGT, release fractions corresponding to *Radioactive Material Transportation Study* (NRC 1977) severity fractions were used (DOE 2000).

D.6.6 Acts of Sabotage or Terrorism

In the aftermath of the tragic events of September 11, 2001, DOE is continuing to assess measures to minimize the risk or potential consequences of radiological sabotage. Acts of sabotage and terrorism have been evaluated for spent nuclear fuel and high-level radioactive waste shipments (DOE 1996, 2002a). The spectrum of accidents considered ranges from direct attack on the cask from afar to hijacking and exploding the shipping cask in an urban area. Both of these actions would result in damaging the cask and its contents and releasing radioactive materials. The fraction of the materials released is dependent on the nature of the attack (type of explosive or weapon used). The sabotage event was assumed to occur in an urbanized area. The accident was assumed to involve a rail-sized cask containing immobilized high-level radioactive waste. The DOE evaluation of sabotage of a rail-size cask containing spent nuclear fuel in the *Final 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 (Yucca Mountain EIS)* calculated a population dose of 17,000 person-rem and an MEI dose (at 140 meters [460 feet]) of 40 rem, causing 9 additional cancer deaths among the population of exposed individuals and increasing the risk of a fatal cancer to the MEI by 2 percent (DOE 2002a). The radioactive materials transported under all alternatives would have lower quantities of the materials used for the above analysis. Therefore, the above estimates of risk bound the risks from an act of sabotage or terrorism involving the radioactive material transported under all alternatives in this *Consolidation EIS*.

D.7 Risk Analysis Results

Per-shipment risk factors have been calculated for the collective populations of exposed persons and for the crew for all anticipated routes and shipment configurations. The radiological risks are presented in doses per shipment for each unique route, material, and container combination. The radiological-dose-per-shipment factors for incident-free transportation are presented in **Table D–3**. To calculate the collective dose, a unit risk factor is developed to estimate the impact of transporting one shipment of radioactive material over each population density zone. The unit risk factors are combined with routing information, such as the shipment distances in various population density zones, to determine the risk for a single shipment (a shipment risk factor) between a given origin and destination. Unit risk factors were developed on the basis of travel on interstate highways and freeways, as required by 49 CFR 171–177 for highway-route-controlled quantities of radioactive material within rural, suburban, and urban population zones by using RADTRAN 5 and its default data. In addition, the analysis assumed that 10 percent of the time, travel through suburban and urban zones would encounter rush-hour conditions, leading to 50 percent of the average speed and doubling traffic volumes. The normal traffic volumes used for truck transport were: 530, 760, and 2,400 vehicles per hour for rural, suburban, and urban zones, respectively (DOE 2002b).

Table D–3 Risk Factors per Shipment of Radioactive Material

		Incident-Free				*Accident*	
Radioactive Material	***Transport Destination (origin)***	***Crew Dose (person-rem)***	***Crew Risk (LCFs)***	***Population Dose (persons rem)***	***Population Risk (LCFs)***	***Radiological Risk (LCFs)***	***Non-radiological Risk (traffic fatalities)***
Neptunium oxide	ORNL (INL)	6.09×10^{-2}	3.65×10^{-5}	4.52×10^{-2}	2.71×10^{-5}	1.75×10^{-10}	2.68×10^{-5}
Irradiated targets	ORNL (INL)	3.47×10^{-2}	2.08×10^{-5}	6.78×10^{-2}	4.07×10^{-5}	9.36×10^{-10}	4.93×10^{-5}
Nonirradiated targets	INL (ORNL)	2.18×10^{-3}	1.31×10^{-6}	4.23×10^{-3}	2.54×10^{-6}	4.02×10^{-13}	4.93×10^{-5}
Plutonium oxide	LANL (ORNL)	5.52×10^{-2}	3.31×10^{-5}	4.75×10^{-2}	2.85×10^{-5}	3.62×10^{-08}	1.90×10^{-5}
Plutonium oxide rods	INL (LANL)	4.35×10^{-2}	2.61×10^{-5}	3.45×10^{-2}	2.85×0^{-5}	2.33×10^{-08}	1.49×10^{-5}
Milliwatt generators plutonium heat source	INL (Pantex)	2.58×10^{-2}	1.55×10^{-5}	1.35×10^{-2}	8.10×0^{-6}	3.14×10^{-09}	1.35×10^{-5}
Milliwatt generators plutonium heat source	INL (LANL)	2.76×10^{-2}	1.66×10^{-5}	1.54×10^{-2}	9.23×0^{-6}	4.48×10^{-09}	1.49×10^{-5}

LCF = latent cancer fatality, ORNL = Oak Ridge National Laboratory, INL = Idaho National Laboratory, LANL = Los Alamos National Laboratory.

Doses are calculated for the crew and public (i.e., people living along the route, pedestrians, and drivers along the route, and the public at rest and at fueling stops). For onsite shipments, the stop dose (doses to the public at rest and refueling stops) is set at zero, because a truck is not expected to stop during shipment that takes less than an hour.

Both the radiological dose risk factor and nonradiological risk factor for transportation accidents are presented in Table D–3. The radiological and nonradiological accident risk factors are provided in terms of potential fatalities per shipment. The radiological risks are in terms of LCFs. For the population, the radiological risks were calculated by multiplying the accident dose risks by the health risk factor of 6×10^{-4} cancer fatalities per person-rem of exposure. As stated earlier (see Section D.6.3), the accident dose is called "dose risk" because the values incorporate the spectrum of accident severity probabilities and associated consequences (e.g., dose). The radiological accident doses are very low because accident severity probabilities (i.e., likelihood of accidents leading to confinement breach of a shipping cask or the SST/SGTs and release of its contents) are very small, and although persons are residing in an 80-kilometer (50-mile) radius of the road, they are generally quite far from the road. Because RADTRAN 5 uses an assumption of a homogeneous population from the road out to 80 kilometers (50 miles), it would greatly overestimate the actual doses. The nonradiological risk factors are nonoccupational traffic fatalities (immediate fatalities) resulting from transportation accidents.

Table D–4 shows the risks of transportation under each alternative. The risks are calculated by multiplying the previously given per-shipment factors by the number of shipments over the duration of the program and, for the radiological doses, by the health risk conversion factors. The values presented in Table D–4 show that the total radiological risks (the product of consequence and frequency) are very small under all alternatives. Note that, under the Consolidation Alternative, irradiated targets would be transported onsite (on a private road between MFC and ATR at INL). Multiple transfers of irradiated and nonirradiated targets between these two locations could occur annually. Because the road is closed to the public, DOE could choose to use a formerly certified Type B cask, and no incident-free transportation risk analysis would be necessary. Worker dose would be included in the handling analysis. No accident analysis is necessary, because potential accidents during transportation would be bounded in frequency and consequence by operational activities and handling accidents. Once the cask is closed for the low speed transportation between the onsite facilities, the likelihood of any foreseeable accident that could expose the cask to conditions severe enough to breach the cask would be very small. The same discussions are also applicable to the onsite transport of these materials at ORNL under the No Action and Consolidation with Bridge Alternatives.

Table D–4 Risks of Transporting Radioactive Materials

			Incident-Free				***Accident***	
			Crew		***Population***			
Alternative	***Number of Offsite Shipments***	***Kilometers Traveled***	***Dose (person-rem)***	***Risk*** [a]	***Dose (person-rem)***	***Risk*** [a]	***Radiological Risk*** [a]	***Non-radiological Risk*** [a]
No Action	595 [b]	1.92×10^{6}	14.63	0.009	22.12	0.013	2.32×10^{-6}	0.036
Consolidation	28 [c]	5.26×10^{4}	0.77	0.00046	0.43	0.00026	1.25×10^{-7}	0.00042
Consolidation with Bridge	39 [d]	7.72×10^{4}	1.33	0.0008	0.89	0.000530	2.44×10^{-7}	0.00061

[a] Risk is expressed in terms of latent cancer fatalities, except for nonradiological risk, which refers to the number of accident fatalities.

[b] Number of offsite shipments over 35 years.

[c] These offsite shipments are for the transport of the milliwatt generator heat sources to INL over a 14 year period.

[d] These offsite shipments include both the transport of milliwatt generator heat sources and the bridge time period offsite shipments over the first 5 years.

Note: To convert kilometers to miles, multiply by 0.6214.

Risks to various exposed individuals under incident-free transportation conditions have been estimated for hypothetical exposure scenarios identified in Section D.5.3. The estimated doses to workers, and the public are presented in **Table D–5**. Doses are presented on a per-event basis (person-rem per event), as it is unlikely that the same person would be exposed to multiple events; for those that could have multiple exposures, the cumulative dose could be calculated. The maximum dose to a crewmember is based on the same individual being responsible for driving every shipment for the duration of the campaign. Note that the potential exists for larger individual exposures if multiple exposure events occur. For example, the dose to a person stuck in traffic next to a shipment of irradiated targets for 30 minutes is calculated to be 20 millirem. This is considered a one-time event for that individual.

A member of the public residing along the route would likely receive multiple exposures from passing shipments. The cumulative dose to this resident can be calculated assuming all shipments passed his or her home. The cumulative doses are calculated assuming that the resident is present for every shipment and is unshielded at a distance of 30 meters (about 98 feet) from the route. Therefore, the cumulative dose depends on the number of shipments passing a particular point and is independent of the actual route being considered. The maximum dose to this resident, if all the materials were to be shipped via this route, would be less than 0.01 millirem.

Table D–5 Estimated Dose to Maximally Exposed Individuals During Incident-Free Transportation Conditions

Receptor	*Dose to Maximally Exposed Individual*
Workers	
Crewmember (truck/rail driver)	2 rem per year [a]
Public	
Resident (along the truck route)	5.6×10^{-7} rem per event
Person in traffic congestion	0.02 rem per event per 0.5-hour stop
Person at a rest stop/gas station	3.7×10^{-4} rem per event per hour of stop

[a] Maximum administrative dose limit per year for a trained radiation worker (i.e., truck crewmember) (DOE 1999).

The accident risk assessment and the impacts shown in Table D–4 take into account the entire spectrum of potential accidents, from the fender bender to extremely severe. To provide additional insight into the severity of accidents in terms of the potential dose to an MEI and the public, an accident consequence assessment has been performed for a maximum reasonably foreseeable hypothetical transportation accident with a likelihood of occurrence greater than 1 in 10 million per year. The results, presented in Table D–4, include all conceivable accidents, irrespective of their likelihood.

The maximum reasonably foreseeable offsite transportation accident under the No Action Alternative (probability of occurrence more than 1 in 10 million per year) is a medium-to-high impact with fire accident involving a shipment of irradiated neptunium targets. The accident has a likelihood of occurrence of 1.4×10^{-5}, 3.6×10^{-6}, and 3.2×10^{-7} per year in rural, suburban, and urban zones, respectively. The consequences of such an accident in terms of dose and risk of LCFs to an MEI, an individual standing 100 meters (330 feet) downwind from the accident, and to the population residing within 80 kilometers (50 miles) in the rural, suburban, and urban zones are provided in **Table D–6.** The consequences of such an accident in terms of population dose in the rural, suburban, and urban zones are: 0.019, 0.43, and 3.0 person-rem, respectively. This accident could result in a dose of 0.008 rem to a hypothetical individual exposed to the accident plume for 2 hours at a distance of 100 meters (330 feet), with a corresponding LCF risk of 4.8×10^{-6}. The consequences of such an accident in terms of population dose in the rural, suburban, and urban zones are: 0.019, 0.43, and 3.0 person-rem, respectively.

Under the action alternatives, the maximum reasonably foreseeable offsite transportation accident would not lead to a breach of the transportation package. The consequences of the most severe accident that could breach the transportation vehicle (e.g., SST/SGT) and its contents and release radioactive materials were estimated to have a likelihood of less than 1 in 10 million per year.

Table D–6 Estimated Dose to the Population and to Maximally Exposed Individuals During Most-Severe Accident Conditions

Material and Accident Location		*Population* [a]		*Maximally Exposed Individual* [b]	
		Dose (person-rem)	*Risk (latent cancer fatalities)*	*Dose (rem)*	*Risk (latent cancer fatalities)*
Irradiated targets	Rural	0.019	1.14×10^{-5}	0.008	4.8×10^{-6}
	Suburban	0.43	2.58×10^{-4}	0.008	4.8×10^{-6}
	Urban	3.0	1.8×10^{-3}	0.008	4.8×10^{-6}

[a] Population extends at a uniform density to a radius of 80 kilometers (50 miles). The weather condition was assumed to be Pasquill Stability Class D, with a windspeed of 4 meters per second (9 miles per hour).

[b] The individual is assumed to be 100 meters (300 feet) downwind from the accident and exposed to the entire plume of the radioactive release from a 2-hour high-temperature fire. The weather condition was assumed to be Pasquill Stability Class F, with a windspeed of 1 meter per second (2.2 miles per hour).

D.8 Conclusions

Transportation of any commodity involves a risk to both transportation crewmembers and members of the public. This risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of certain materials, such as hazardous or radioactive substances, can pose an additional risk due to the nature of the material itself.

All alternatives would require intersite shipments of radioactive materials. Based on the results presented in the previous sections, the following conclusions have been reached (see Tables D–4, D–5, and D–6):

- It is unlikely that transportation of radioactive substances under alternatives presented in this EIS would cause an additional fatality as a result of radiation from either incident-free operations or postulated transportation accidents.

- Nonradiological accident risks (the potential for fatalities as a direct result of traffic accidents) present the greatest risks.

D.9 Long-Term Impacts of Transportation

The *Yucca Mountain EIS* (DOE 2002a) analyzed the cumulative impacts of radioactive material transportation, consisting of impacts of radioactive waste and spent nuclear fuel historical shipments; reasonably foreseeable actions that include transportation of radioactive material; and general radioactive material transportation that is not related to a particular action. The collective dose to the general population and workers was the measure used to quantify cumulative transportation impacts. This measure of impact was chosen because it may be directly related to the LCFs using a cancer risk coefficient. **Table D–7** provides a summary of the total worker and general population collective doses from various transportation activities. The table shows that the impacts of this program are quite small compared with the overall transportation impacts. The total worker collective dose from all types of shipments (historical, EIS alternative, reasonably foreseeable actions, and general transportation) was estimated to be 368,244 person-rem (221 LCFs) for the period 1943 through 2047 (104 years). The total general population collective dose was estimated to be 338,252 person-rem (203 LCFs). The majority of the collective dose for workers and the general population was due to the general transportation of radioactive material. Examples of these activities are shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial low-level radioactive waste to commercial disposal facilities. The total number of LCFs estimated to result from radioactive material transportation over the period between 1943 and 2047 is 203. Over this same period (104 years), approximately 31 million people would die from cancer, based on 300,000 cancer fatalities per year unrelated to radioactive material transportation. It should be noted that the estimated number of transportation-related LCFs would be indistinguishable from other LCFs, and the transportation-related LCFs are 0.0014 percent of the total number of LCFs.

D.10 Uncertainty and Conservatism in Estimated Impacts

The sequence of analyses performed to generate estimates of radiological risk for transportation includes: (1) determination of the inventory and characteristics, (2) estimation of shipment requirements, (3) determination of route characteristics, (4) calculation of radiation doses to exposed individuals (including estimating of environmental transport and uptake of radionuclides), and (5) estimation of health effects. Uncertainties are associated with each of these steps. Uncertainties exist in the way that the physical systems being analyzed are represented by the computational models; in the data required to exercise the models (due to measurement errors, sampling errors, natural variability, or unknowns caused simply by the future nature of the actions being analyzed); and in the calculations themselves (e.g., approximate algorithms used by the computers).

Table D–7 Cumulative Transportation-Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2047)

Category	*Collective Worker Dose (person-rem)*	*Collective General Population Dose (person-rem)*
Transportation Impacts in this *Consolidation EIS*	15 [a]	22 [b]
Other Nuclear Material Shipments		
Historical	330	230
Reasonably foreseeable	21,000	45,000
General transportation (1943 to 2033)	310,000	260,000
General transportation (1943 to 2047)	330,000	290,000
Yucca Mountain EIS (maximum transport) (up to 2047)	17,000	3,000
Total collective dose (up to 2047)	368,244	338,252
Total latent cancer fatalities	221	203

Yucca Mountain EIS = Final 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.

[a] Maximum value from this *Consolidation EIS*, Table D–4: No Action Alternative.

[b] Maximum value from this *Consolidation EIS*, Table D–4: No Action Alternative.

Source: DOE 2002a.

In principle, one can estimate the uncertainty associated with each input or computational source and predict the resultant uncertainty in each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final, or absolute, result. However, conducting such a full-scale quantitative uncertainty analysis is often impractical and sometimes impossible, especially for actions to be initiated at an unspecified time in the future. Instead, the risk analysis is designed to ensure, through uniform and judicious selection of scenarios, models, and input parameters, that relative comparisons of risk among the various alternatives are meaningful. In the transportation risk assessment, this design is accomplished by uniformly applying common input parameters and assumptions to each alternative. Therefore, although considerable uncertainty is inherent in the absolute magnitude of the transportation risk under each alternative, much less uncertainty is associated with the relative differences among the alternatives in a given measure of risk.

In the following sections, areas of uncertainty are discussed for the assessment steps enumerated above. Special emphasis is placed on identifying whether the uncertainties affect relative or absolute measures of risk. The reality and conservatism of the assumptions are addressed. Where practical, the parameters that most significantly affect the risk assessment results are identified.

D.10.1 Uncertainties in Material Inventory and Characterization

The inventories and the physical and radiological characteristics are important input parameters in the transportation risk assessment. The potential number of shipments under all alternatives is primarily based on the projected dimensions of package contents, the strength of the radiation field, the heat that must be dissipated, and assumptions concerning shipment capacities. Physical and radiological characteristics are important in determining the material released during accidents and the subsequent doses to exposed individuals through multiple environmental exposure pathways.

Uncertainties in the inventory and characterization are reflected in the transportation risk results. If the inventory is overestimated (or underestimated), the resulting transportation risk estimates are also overestimated (or underestimated) by roughly the same factor. However, the same inventory estimates are used to analyze the transportation impacts of each *Consolidation EIS* alternative. Therefore, for comparative purposes, the observed differences in transportation risks among the alternatives, as given in Table D–4, are believed to represent unbiased, reasonably accurate estimates from current information in terms of relative risk comparisons.

D.10.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments

The transportation required under each alternative is based in part on assumptions concerning the packaging characteristics and shipment capacities for commercial trucks. Representative shipment capacities have been defined for assessment purposes based on probable future shipment capacities. In reality, the actual shipment capacities may differ from the predicted capacities such that the projected number of shipments and, consequently, the total transportation risk, would change. However, although the predicted transportation risks would increase or decrease accordingly, the relative differences in risks among alternatives would remain about the same.

D.10.3 Uncertainties in Route Determination

Routes have been determined between all origin and destination sites considered in this *Consolidation EIS.* The routes have been determined to be consistent with current guidelines, regulations, and practices, but may not be the actual routes that would be used in the future. In reality, the actual routes could differ from the analyzed ones with regard to distances and total population along the routes. Moreover, because materials could be transported over an extended time starting at some time in the future, the highway infrastructures and the demographics along routes could change. These effects have not been accounted for in the transportation assessment; however, it is not anticipated that these changes would significantly affect relative comparisons of risk among the alternatives considered in this EIS.

D.10.4 Uncertainties in the Calculation of Radiation Doses

The models used to calculate radiation doses from transportation activities introduce a further uncertainty in the risk assessment process. Estimating the accuracy or absolute uncertainty of the risk assessment results is generally difficult. The accuracy of the calculated results is closely related to the limitations of the computational models and to the uncertainties in each of the input parameters that the model requires. The single greatest limitation facing users of RADTRAN, or any computer code of this type, is the scarcity of data for certain input parameters. Populations (off and on link) along the routes, shipment surface dose rates, and individuals residing near the roads are the most uncertain data in dose calculations. In preparing these data, one makes assumptions that the off-link population is uniformly distributed; the on-link population is proportional to the traffic density, with an assumed occupancy of two persons per car; the shipment surface dose rate is the maximum allowed dose rate; and a potential exists for an individual to be residing at the edge of the road. It is clear that not all assumptions are accurate. For example, the off-link population is mostly heterogeneous, and the on-link traffic density varies widely from road to road. Finally, added to this complexity are the assumptions regarding the expected distance between the public and the shipment at a traffic stop, rest stop, or traffic jam and the afforded shielding.

Uncertainties associated with the computational models are reduced by using state-of-the-art computer codes that have undergone extensive review. Because many uncertainties are recognized but difficult to quantify, assumptions are made at each step of the risk assessment process intended to produce conservative results (i.e., overestimate the calculated dose and radiological risk). Because parameters and assumptions are applied consistently to all alternatives, this model bias is not expected to affect the meaningfulness of relative comparisons of risk; however, the results may not represent risks in an absolute sense.

D.11 References

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APPENDIX E
RELATIONSHIP TO NUCLEAR WEAPONS AND THE U.S. NUCLEAR WEAPONS COMPLEX

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RELATIONSHIP TO NUCLEAR WEAPONS AND THE U.S. NUCLEAR WEAPONS COMPLEX

E.1 Neptunium-237 and Plutonium-238 Proliferation Risks

E.1.1 Designations for Nuclear Materials

Special Nuclear Material (SNM) is a U.S. statutory designation used by the U.S. Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) to indicate materials bearing uranium enriched above natural in the isotopes uranium-235, -233, and several plutonium isotopes -238, -239, -240, -241, and -242. The designation SNM captures material containing stable fissile isotopes of uranium and plutonium.

Special Fissionable Material (SFM) is an international statutory designation used by the International Atomic Energy Agency (IAEA) to indicate materials bearing uranium enriched above natural in the isotopes uranium-235, uranium-233, and plutonium-239. The designation SFM captures weapons-usable uranium and mixtures of plutonium isotopes through capture of plutonium-239.

Other Nuclear Material is a recent designation for neptunium-237. This designation captures weapons-usable materials that are not legally recognized as SNM or SFM (DOE 2003b).

Source Material (SM) is a universal statutory designation to indicate materials bearing uranium that is depleted in the isotope uranium-235, or at the natural isotopic ratio, and thorium. The designation SM captures materials from which fissile materials may be derived.

High Enriched Uranium Reactor Fuel

All uranium enriched in uranium-235 with an isotope weight percent equal to or greater than 20 is called high enriched uranium (HEU). HEU fuel is required to operate the two irradiation facilities proposed in the *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems (Consolidation EIS):* the High-Flux Isotope Reactor (HFIR) and the Advanced Test Reactor (ATR). Both research reactors use aluminum clad HEU oxide plate fuel. The HEU contained in the HFIR and ATR fuel plate is 93 percent enriched and could be used as a fissile material in nuclear weapons following chemical separation from the fuel matrix and metallurgical processing.

International and domestic safeguards regulations treat uranium that is enriched above 20 percent, as material that is usable as fissile material for nuclear weapons. However, higher assays are more readily usable than lower assays.

E.1.2 Neptunium-237

Plutonium-238 production requires the production and irradiation of neptunium-237 targets. Neptunium-237 targets are typically made of purified, concentrated neptunium-237 dioxide with an aluminum binder, canned or clad in aluminum. The production of plutonium-238 requires:

- The production of purified neptunium-237 dioxide from neptunium-237 solution followed by target fabrication;
- Irradiation to build in plutonium-238 via neutron capture and beta decay, solvent extraction, and ion exchange processing to separate and purify neptunium-237 and plutonium-238 from fission products and other waste products; and
- A repeat of the cycle to produce additional plutonium-238.

Each cycle reduces the inventory of neptunium-237 available for plutonium-238 production, since neptunium-237 is converted to plutonium-238 in the process. During the production cycle, neptunium-237 is in different solid (e.g., oxide powders and pressed solid matrices) and liquid (e.g., nitrate solutions) forms.

Neptunium-237 is designated as other nuclear material by DOE (DOE 2003b). The U.S. Government and the international community recognize the utility of neptunium-237 in nuclear weapons. For the purposes of DOE safeguards, neptunium-237 is treated as equivalent to uranium-235 (DOE 2003b). As such, it is subject to DOE safeguards that are similar to those for very highly enriched uranium and is reportable in gram quantities.

Neptunium-237 is a fissionable material that could be used in a nuclear fission weapon. Its critical mass needed for such a weapon has been estimated to be about 40 to 60 kilograms (88 to 132 pounds) and, unlike plutonium-238, it does not render such a weapon unrealistic because it does not emit significant amounts of decay heat (NRC 1978). Less than 40 kilograms (88 pounds) of neptunium-237 would be used annually to produce plutonium-238 at DOE facilities.

E.1.3 Plutonium-238

One method for the production of plutonium-238 requires the production of purified neptunium-237 dioxide targets followed by target irradiation to build in plutonium-238 via neutron capture and beta decay, solvent extraction, and ion exchange processing to separate and purify neptunium-237 and plutonium-238 from fission products and other waste products, and a repeat of the cycle to produce further plutonium-238. During the production cycle, plutonium-238 is in different solid (e.g., oxide powders and pressed solid matrices) and liquid forms (e.g., nitrate solutions). During the process of production of plutonium-238 from neptunium-237 targets, a small amount of plutonium-239 is also produced by second neutron captures by plutonium-238. Since the desired product is relatively pure plutonium-238, the secondary production of plutonium-239 is intentionally limited. This limits the buildup of plutonium-238 to about 10 to 15 percent of the neptunium-237 content of the fresh target.

Plutonium-238 is designated as SNM. However, isotopically concentrated plutonium-238 (above 80 percent) is generally not recognized as a nuclear proliferation threat. However, this material is rigorously protected against loss, theft, and sabotage (through physical protection and accounting) and is strictly contained (to prevent accidental release), due to the health and safety risks presented by the material. Under DOE safeguards, plutonium-238 is reportable in 0.1-gram quantities.

E.1.4 Summary

Neptunium-237 and plutonium-238 are fissionable materials capable of undergoing and sustaining a fission reaction. As such, they are theoretically capable of being used in a nuclear weapon. However, the unique high decay heat per unit mass of plutonium-238 renders it untenable for use in a fission nuclear weapon because the inherent heat would deform any shape they could be formed into for the quantity needed for such a weapon. The generated heat would also deleteriously affect other components of a nuclear weapon that are collocated with the fissionable material and would cause unacceptably high temperatures in a nuclear weapon precluding its ability to achieve detonation. Neptunium-237 can be used in a nuclear fission weapon without concerns regarding heat generation, although its required weapons mass is much greater than that of plutonium-239 and larger than its expected annual use to produce plutonium-238 (DOE 2000).

E.2 Non-Defense National Security Plutonium-238 Applications

Along with National Aeronautics and Space Administration (NASA) deep space satellite applications, plutonium-238, in radioisotope heater units and radioisotope thermoelectric generators, is needed to support non-defense national security missions. By contract, no imported Russian plutonium-238 can be used for national security (DOE 2002a). Due to its classified nature, a non-defense national security application can be characterized by what it is not, as delineated below.

- It is not used in any nuclear weapons.
- It is not used in any nonnuclear weapons.
- It is not used in any military satellites or in space.
- It is not used in any missile defense systems.

E.3 Relationship of Plutonium-238 to the DOE Plutonium Nuclear Weapons Complex

Concerns have been raised regarding the relationship of plutonium-238 production, handling, and management with DOE nuclear weapons complex plutonium. Plutonium-238 is not a viable material for nuclear weapons because of its high natural decay heat production, which causes numerous complications and daunting technological problems in designing a functioning nuclear weapon. However, since plutonium-238 is an isotope of plutonium, it may be mistaken for a component of the DOE plutonium nuclear weapons complex.

Weapons grade plutonium is considered to be about 93 to 94 percent plutonium-239, with the balance being principally plutonium-240, and plutonium-238 constituting much less than 1 percent. DOE has reported that, as of 1994, it had an inventory of approximately 99.5 metric tons (218,900 pounds) of plutonium throughout the DOE complex and at U.S. Department of Defense (DOD) facilities (DOE 1996b). Of these 99.5 metric tons (218,900 pounds) of plutonium, only 4.5 percent was located at Idaho National Laboratory (INL), with the majority of the inventory at DOD facilities as well as the DOE Pantex Plant in Texas, and the DOE Hanford Site in Washington. In contrast, the total mass of neptunium-237 to be shipped from the Savannah River Site (SRS) to INL is expected to be about 0.3 metric tons (660 pounds) (DOE 2000), which could be converted to about 0.1 to 0.2 metric tons (220 to 440 pounds) of plutonium-238 by irradiation in ATR and HFIR over a period of 35 years. This mass of plutonium-238 represents less than 0.1 percent of the DOE complex inventory of plutonium (mostly weapons grade plutonium-239).

A number of DOE publications (DOE 2003a, DOE 2003c, DOE 2002b, DOE 1999, DOE 1996a, and DOE 1996b) have indicated the location of current and planned future weapons grade plutonium management and operations. These documents provide the following relevant information:

- The U.S. nuclear weapon stockpile stewardship program mission (i.e., DOE National Nuclear Security Administration [NNSA] nuclear weapons complex) has activities and/or tools at the Pantex Plant, Kansas City Plant, Y-12 Plant at Oak Ridge Reservation, SRS, Lawrence Livermore National Laboratory (LLNL), Sandia National Laboratories (SNL), Los Alamos National Laboratory (LANL), and the Nevada Test Site (NTS).

- Handling, storage, management, waste handling, and refurbishment of plutonium used in nuclear weapons is performed at the Pantex Plant, SRS, LLNL, and LANL.

- The DOE NNSA *Modern Pit Facility EIS* (DOE 2003a) evaluated the environmental impacts of a new plutonium pit fabrication facility for refurbishment of aging nuclear weapons. Potential sites considered were LANL; Pantex; Carlsbad, New Mexico; NTS; and SRS.

- DOE evaluated the environmental impact of managing up to 50 metric tons (55 tons) of surplus plutonium (DOE 1999). The preferred alternative, selected in the Record of Decision (ROD), involved plutonium operations at SRS, LANL, and ORNL.

- In 1996, DOE evaluated the environmental impact of long-term storage of weapons-usable fissile materials from U.S. nuclear weapon dismantlement (DOE 1996b). Weapons-usable fissile materials were defined as all isotopes of plutonium except plutonium-238 and HEU with a minimum enrichment of at least 20 percent uranium-235. The 1994 surplus weapons grade plutonium supply of 38.2 metric tons (42 tons) included 0.4 metric tons (0.44 tons) located at INL. The Preferred Alternative, implemented in the ROD, expanded plutonium storage at Pantex and SRS, leaving the existing inventory at INL.

- DOE evaluated stockpile stewardship and management environmental impacts within the nuclear weapons complex in 1996 (DOE 1996a). That EIS identified alternative sites for stockpile stewardship and the continuing DOE sites for the nuclear weapons complex as LLNL, LANL, NTS, SNL, Pantex Plant, Kansas City Plant, Oak Ridge Reservation, and SRS. Ongoing and planned future activities and structures in support of the nuclear weapons complex were evaluated at those sites.

E.4 Idaho National Laboratory, Plutonium-238, and the DOE Nuclear Weapons Complex

INL has never been part of the U.S. nuclear weapons complex, and has not been involved in the design, analysis, testing, management, and handling of nuclear weapons. All new DOE construction plans and disposition decisions documented since 1996 regarding weapons-usable plutonium, HEU, and nuclear weapons have not included INL.

At the isotopic concentration produced and used for RPSs, plutonium-238 is not considered to be a weapons-usable fissile material. The total mass of neptunium-237 and plutonium-238 to be produced from the neptunium-237 in the Proposed Action of this EIS (0.4 metric tons [0.44 tons] of neptunium-237 and plutonium-238 combined) is a very small fraction of the total DOE weapons-usable plutonium-239 inventory (about 99.5 metric tons [109.5 tons]) and of DOE surplus weapons-usable plutonium-239 inventory (about 38.2 metric tons [42 tons]). In addition, DOE has no plans to expand the proposed Consolidation Alternative plutonium-238 production mission at INL to include any plutonium-239 or nuclear weapons related activities.

E.5 References

DOE (U.S. Department of Energy), 1996a, *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236, Office of Technical and Environmental Support, Washington, DC, September.

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

DOE (U.S. Department of Energy), 1999, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, Office of Fissile Materials Disposition, Washington, DC, November.

DOE (U.S. Department of Energy), 2000, *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*, DOE/EIS-0310, Office of Nuclear Energy, Science and Technology, Washington, DC, December.

DOE (U.S. Department of Energy), 2002a, Joint Announcement by the United States Department of Energy and the Russian Federation Ministry for Atomic Energy Concerning Continued Purchases of Plutonium-238 for Peaceful Purposes, Washington, DC, May.

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DOE (U.S. Department of Energy), 2003b, "Manual for Control and Accountability of Nuclear Materials", DOE M 474.1-1B, Office of Security, Washington, DC, June 13.

DOE (U.S. Department of Energy), 2003c, *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0350, Los Alamos Site Office, Los Alamos, New Mexico, November.

NRC (U.S. Nuclear Regulatory Commission), 1978, Nuclear Safety Guide, TID-7016. Revision 12, NUREG/CR-0095, ORNL/NUREG/CSD-6, Washington, DC, June.

APPENDIX F
PRELIMINARY FLOODPLAIN/WETLAND ASSESSMENT

APPENDIX F
PRELIMINARY FLOODPLAIN/WETLAND ASSESSMENT

F.1 Introduction

The U.S. Department of Energy (DOE) has prepared this *Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (*Consolidation EIS*) to assess the range of reasonable alternatives regarding DOE's proposal to consolidate radioisotope power systems (RPS) nuclear production operations at a single, highly secure site within its complex. Specifically, the *Consolidation EIS* evaluates the environmental impacts of two action alternatives (Consolidation and Consolidation with Bridge Alternatives) and a No Action Alternative. DOE's Proposed Action is to consolidate all RPS nuclear production operations at a single, highly secure site within its complex. These operations include plutonium-238 production, purification, pelletization, and encapsulation, and RPS assembly and testing.

Under the Consolidation and Consolidation with Bridge Alternatives, DOE would consolidate all RPS nuclear production operations within a secure area at the Materials and Fuels Complex (MFC) within the Idaho National Laboratory (INL). Both alternatives would require new construction. Construction would consist of two new facilities, an addition to an existing facility, several miscellaneous new equipment pads and enclosures for support utilities, and miscellaneous site work for drainage, connection to electrical and mechanical utilities, and paving from new buildings to existing site roads. In addition, construction of a new road is required to connect these proposed new facilities to the Advanced Test Reactor (ATR) within the Reactor Technology Complex (RTC) at INL to provide appropriate security measures for the transfer of unirradiated and irradiated targets, while eliminating transportation over any public road.

Three possible transportation routes for this new road are being evaluated in this EIS (T-3, T-24, and East Power Line Road routes). The northernmost route, while more direct, would require that a new bridge be constructed across the Big Lost River. A new bridge would impact the floodplain and associated wetlands of the Big Lost River.

This Preliminary Floodplain/Wetland Assessment has been prepared in accordance with 10 *Code of Federal Regulations* (CFR) 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements," (68 FR 51429, August 27, 2003) for the purpose of fulfilling DOE's responsibilities under Executive Order 11988, "Floodplain Management," and Executive Order 11990, "Protection of Wetlands." Executive Order 11988 encourages measures to preserve and enhance the natural and beneficial functions of floodplains. It also requires Federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains, and to avoid direct and indirect support of floodplain development whenever there is a practicable alternative. Executive Order 11990 requires Federal agencies to minimize the destruction or degradation of wetlands, and to avoid undertaking new construction located in wetlands unless they find there is no practicable alternative to such construction.

Definition of "Floodplain" Under 10 CFR 1022.4

A floodplain is defined as the lowlands adjoining inland and coastal waters and relatively flat areas and flood prone areas of offshore islands. It includes the *base floodplain* and the *critical action floodplain*. The *base floodplain* means the 100-year floodplain, that is, a floodplain with a 1.0 percent chance of flooding in any given year. The *critical action floodplain* means, at a minimum, the 500-year floodplain, that is, a floodplain with a 0.2 percent chance of flooding in any given year.

Definition of "Wetland" Under 10 CFR 1022.4

Wetland means an area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs, and similar areas.

When maintained in a natural state, floodplains provide valuable services by moderating the extent of flooding, thereby (1) reducing the risk of downstream flood loss; (2) minimizing the impacts of floods on human safety, health, and welfare; and (3) providing support to wetlands, fish, and wildlife. Wetlands serve a variety of functions within the ecosystem including, but not limited to, helping to maintain and improve water quality by removing and transforming pollutants, providing for erosion control and flood protection by storing water during periods of high runoff or high flows in adjacent streams, and providing fish and wildlife habitat while enhancing overall biological productivity. Wetlands also offer cultural, aesthetic, economic, and scientific value.

DOE, in accordance with 10 CFR 1022, seeks to identify, evaluate, and as appropriate, implement alternative actions that may avoid or mitigate adverse floodplain or wetlands impacts, and provide early and adequate opportunities for public review of plans or proposals for floodplain and wetland actions. This Preliminary Floodplain/Wetland Assessment serves to inform the public of proposed activities that have the potential to affect the floodplain and wetlands, and to present alternative actions that may avoid or mitigate adverse floodplain or wetland actions. Upon publication and distribution of this Draft *Consolidation EIS*, DOE will consider comments on this Preliminary Floodplain/Wetland Assessment during the ensuing 60-day public comment period.

If DOE finds that no practicable alternative to locating or conducting the action in the floodplain or wetland is available, DOE would, before taking action, design or modify its action in order to minimize potential harm to or within the floodplain or wetland, consistent with the policies set forth in Executive Orders 11988 and 11990. For actions that would be located in a floodplain, DOE must prepare a statement of findings. This statement of findings would include (1) a description of the Proposed Action; (2) an explanation indicating why the action is proposed to be located in the floodplain; (3) a list of alternatives considered; (4) a statement indicating whether the action conforms to applicable floodplain protection standards; and (5) a brief description of steps to be taken to minimize potential harm to or within the floodplain (10 CFR 1022.14). The statement of findings will be published in the Final EIS distributed to the public. The Final EIS will include all comments received from the public during the 60-day public comment period, as well as DOE's responses to those comments.

F.2 Proposed New Road

The proposed new road at INL would be constructed between the proposed new Plutonium-238 Facility at the MFC and ATR at the RTC, (see **Figure F–1)**. The road would be paved with asphalt over a compacted granular base. Width of the asphalt pavement would be approximately 6.7 meters (22 feet) with 2.7-meter (9-foot) granular shoulders on either side. The width of the construction corridor would be 18 meters (60 feet). Due to security requirements, the new road would be a government road, with access restricted to INL contractor material transfers and other official DOE projects only. The entire length of this restricted access road would be on DOE property. Each end would have swing-type closure gates, which would be padlocked shut when not in use. Additionally, warning signs would be posted on either side of each gate advising that the use of this road is for official DOE business only (INL 2005).

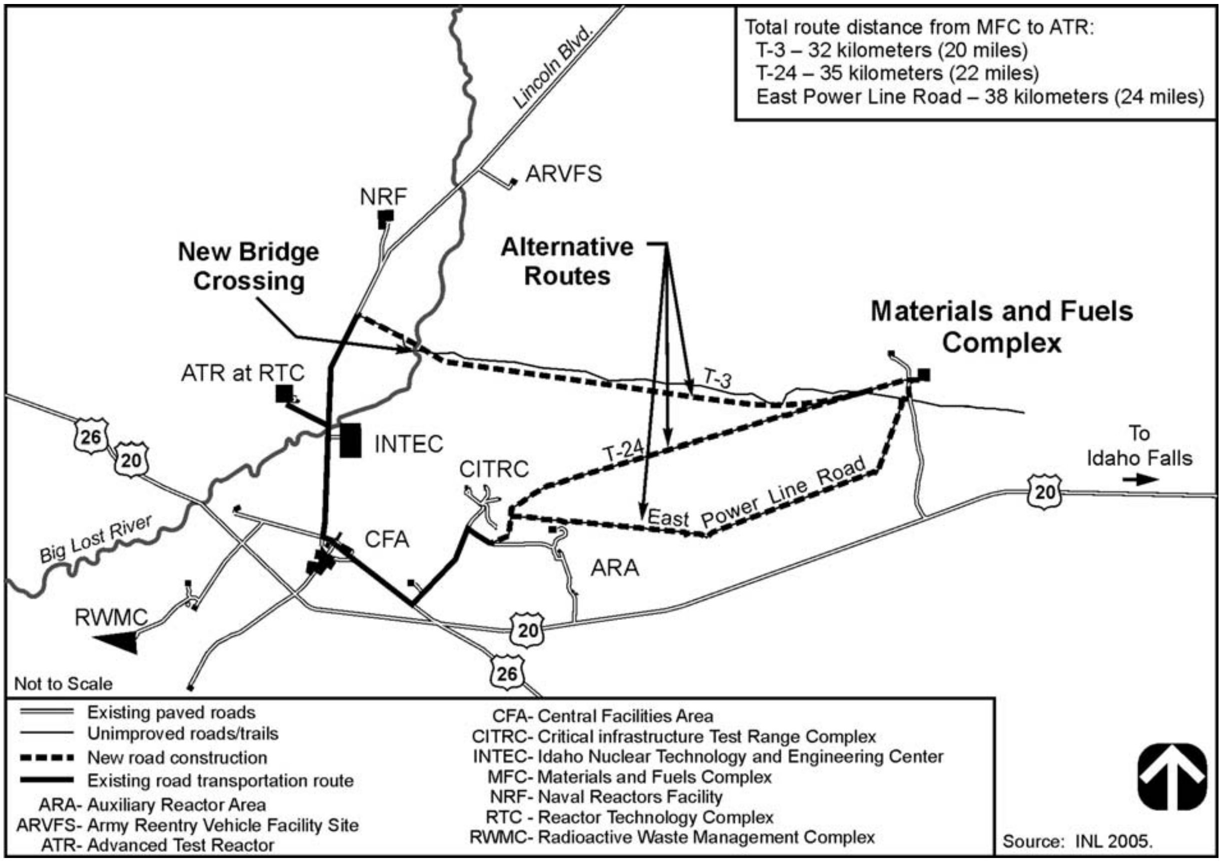
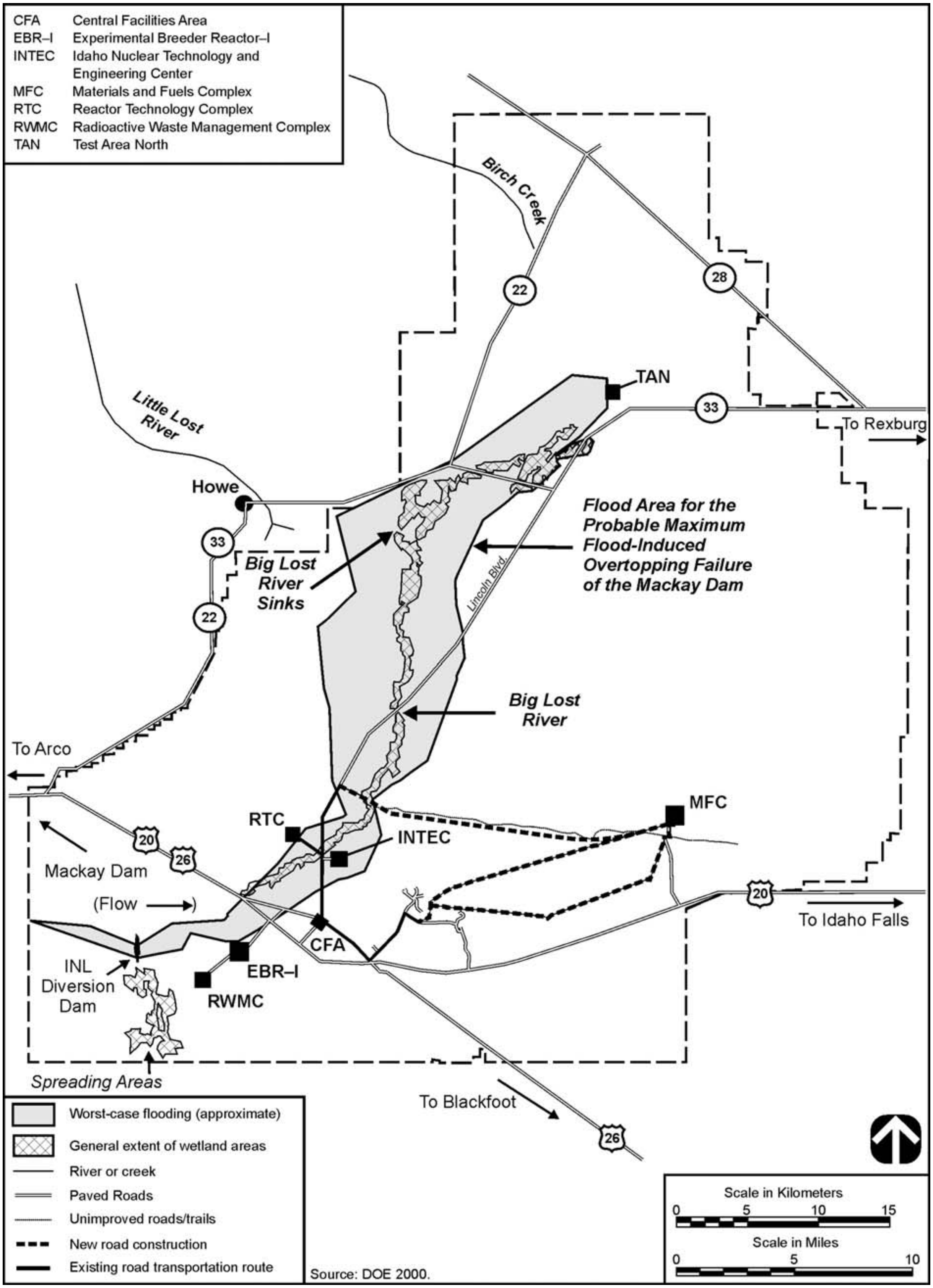


Figure F–1 New Road Alternative Routes

F.3 Nature and Extent of the Flood Hazard, Floodplain, and Associated Wetlands

During dry years, there is little or no surface water flow on the INL. Otherwise, the Big Lost River flows southeast from Mackay Dam, located 72 kilometers (45 miles) upstream of the INL, past Arco and onto the Snake River Plain. On INL, near the southwestern boundary, a diversion dam prevents the flooding of downstream areas during periods of heavy runoff by diverting water to a series of natural depressions or spreading areas (see **Figure F–2**). During periods of high flow or low irrigation demand, the Big Lost River continues northeastward past the diversion dam, passes within about 60 meters (200 feet) of the Idaho Nuclear Technology and Engineering Center (INTEC), and ends in a series of playas where the water infiltrates the ground (DOE 2002b). The INL diversion dam constructed in 1958 and enlarged in 1984 was designed to secure INL from the 300-year flood (estimated peak flow of slightly above 142 cubic meters [5,000 cubic feet] per second) of the Big Lost River (DOE 2002a, INL 2005).

Flooding on the Big Lost River has been evaluated for the potential impact on INL facilities and included examination of the flooding potential due to the failure of Mackay Dam from a probable maximum flood (see Figure F–2). The maximum flood evaluated was assumed to be caused by a probable maximum flood resulting in the overtopping and rapid failure of Mackay Dam, and included the effects of systematic (non-instantaneous) failure of the diversion dam. This flood would result in a peak surface water elevation at INTEC of 1,499 meters (4,917 feet), with a peak flow of 1,892 cubic meters (66,830 cubic feet) per second in the Big Lost River measured near INTEC. The average elevation at INTEC is 1,499 meters (4,917 feet). At this peak water surface elevation, portions of INTEC would be flooded, especially at the north end. However, the RTC (formerly the Test Reactor Area) would not be flooded.



Source: DOE 2000.

Figure F–2 Surface Water Features, Wetlands, and Flood Hazard Areas at Idaho National Laboratory

Because the ground surface at INL and INTEC is relatively flat, floodwaters outside the banks of the Big Lost River would spread over a large area and pond in the lower lying areas. Although predicted flood velocities would be relatively slow with shallow water depths, some facilities could be impacted. There is no record of any historical flooding at INTEC from the Big Lost River, although evidence of flooding in geologic time exists (DOE 2002b).

Nevertheless, other than natural topography, the primary choke points for probable maximum flood flows are the diversion dam on the INL and the culverts under Lincoln Boulevard near INTEC that allow the Big Lost River to flow beneath Lincoln Boulevard between INTEC and the RTC. The probable maximum flood would quickly overtop the diversion dam. The Lincoln Boulevard culverts are capable of passing about 42 cubic meters (1,500 cubic feet) per second (DOE 2002b).

Probable Maximum Flood

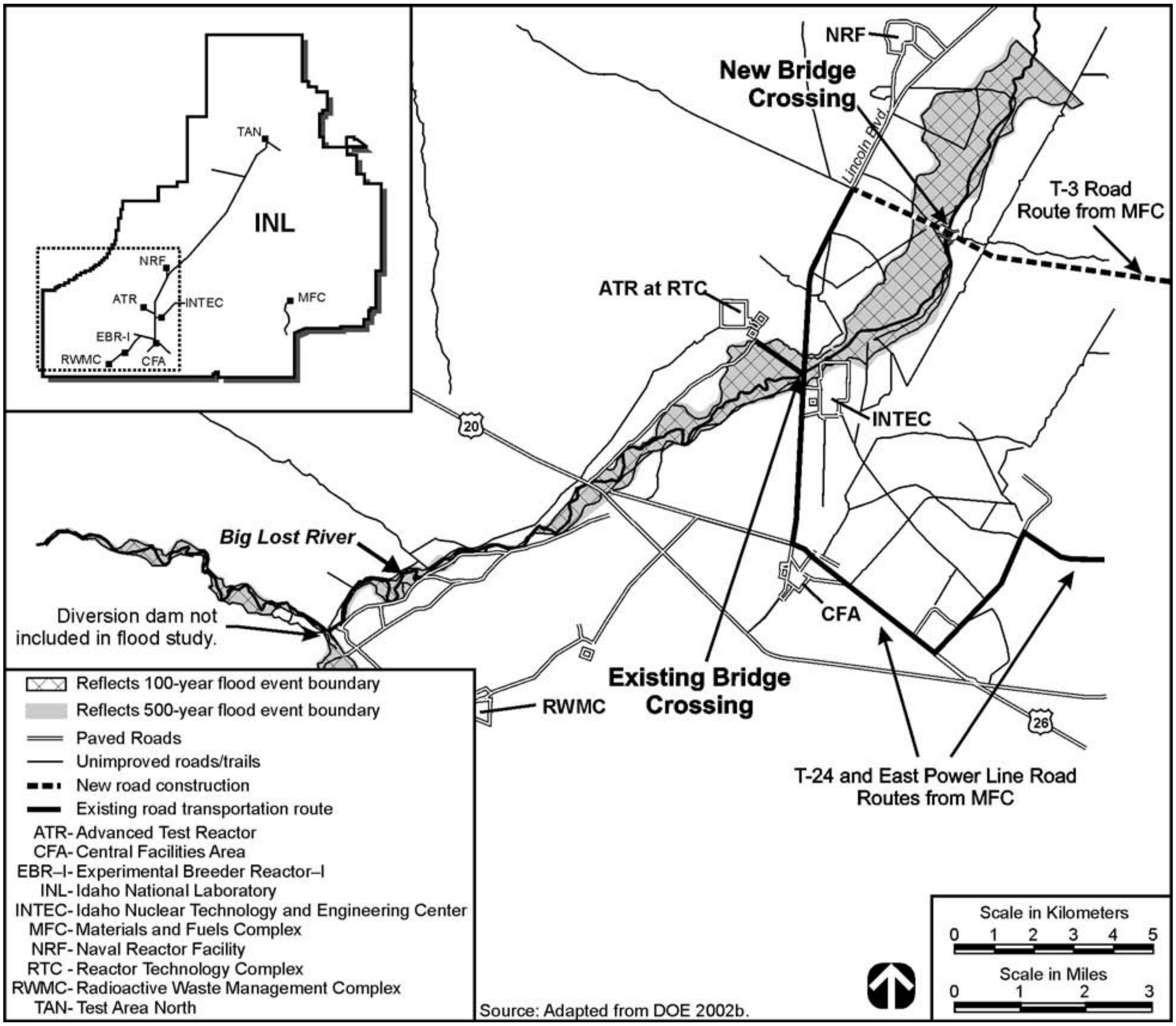
The probable maximum flood is the hypothetical flood considered to be the most severe reasonably possible flood, based on the comprehensive hydrometeorological application of maximum precipitation and other hydrological factors favorable for maximum flood runoff (e.g., sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.

A preliminary map of the 100-year floodplain for the Big Lost River prepared by the U.S. Geological Survey (USGS) in 1998 indicated INTEC may be subject to flooding from a 100-year flood. The USGS 100-year flow estimate is approximately 206 cubic meters (7,260 cubic feet) per second at the Arco gauging station 19 kilometers (12 miles) upstream of the INL diversion dam. This estimate and the preliminary 100-year floodplain map is based on 60 years of stream gauge data and conservative assumptions. It was assumed that the INL diversion dam did not exist and that some 30 cubic meters (1,040 cubic feet) per second would be captured by the diversion channel and flow to the spreading areas southwest of the diversion dam. The analysis then assumed the remaining 176 cubic meters (6,220 cubic feet) per second of flow would run down the Big Lost River channel on the INL. A U.S. Army Corps of Engineers analysis and an INL geotechnical analysis both concluded that the INL diversion dam could withstand flows up to 170 cubic meters (6,000 cubic feet) per second. Culverts running through the diversion dam could convey a maximum of an additional 25 cubic meters (900 cubic feet) per second, but their condition and capacity as a function of water elevation is unknown. A subsequent DOE-commissioned flood hazard study published in 1999 by the U.S. Bureau of Reclamation is based on analyses with inputs from stream gauge data and two-dimensional flow modeling constrained by geomorphic evidence. Floodplain maps were produced using a flow estimate of 93 cubic meters (3,270 cubic feet) per second for the 100-year flow and 116 cubic meters (4,086 cubic feet) per second for the 500-year Big Lost River flow. These associated floodplain maps were generated assuming one-dimensional flow, no infiltration or flow loss along the Big Lost River flow path, and no diversion dam. Under these conservative assumptions, small areas of the northern portion of INTEC could flood at the estimated 100 and 500 year flows (DOE 2002b). Additional work is currently being performed by DOE at the INL to further refine the floodplain boundaries of the Big Lost River as a basis to support future flood hazard assessments. The results of this effort, if available, will be included in the Final EIS.

National Wetland Inventory maps prepared by the U.S. Fish and Wildlife Service (USFWS) have been completed for most of INL. These maps indicate that the primary wetland areas are associated with the Big Lost River (see Figure F–2). Wetlands associated with the Big Lost River are classified as riverine/intermittent, indicating a defined stream channel with flowing water during only part of the year. However, wetland vegetation that exists along the Big Lost River is in poor condition because of recent years of only intermittent flows (DOE 2002a).

F.4 Floodplain/Wetland Impacts from the Proposed New Road Construction

Of the three alternative routes initially considered by DOE, construction of the new road as described in Section F.2 along the existing T-3 route would provide the most direct route between the MFC and the ATR in the RTC. However, this route would require construction of a new bridge across the Big Lost River to carry the new roadway (see **Figure F–3**) and has been dismissed from further evaluation (see Chapter 2, Section 2.2.4.3 of this EIS). Associated activities would specifically include placement of a construction laydown pad (typically consisting of rock) beneath the proposed bridge span and construction of cofferdams to support placement of the bridge piers. These activities would be facilitated by the fact that the river is normally dry. Figure F–3 depicts the area of potential impact on the 100- and 500-year floodplains of the Big Lost River, as defined by the U.S. Bureau of Reclamation (see Section F.3), and associated riverine wetlands.



Source: Adapted from DOE 2002b.

Figure F–3 Alternate Road Routings and Impact on the Floodplains of the Big Lost River

In the short term, the floodplain and floodway (channel) of the Big Lost River and associated riverine wetlands would be directly impacted by clearing, grading, and embankment excavation work during road and bridge construction. As discussed in Section F.3, mapped wetlands along the Big Lost River are classified as riverine/intermittent. Site-wide vegetation mapping indicates that most vegetation along the segment of the new road traversing the Big Lost River is sagebrush steppe habitat. In general, wetland and other vegetation would be preserved in the area of the bridge/road crossing to the extent possible, and adjacent areas would be restored and enhanced after construction is complete. Potential impacts of this proposed new road construction on ecological and cultural resources, as well as on other resource areas, are further described in Chapter 4 of this *Consolidation EIS*.

Although the arid climate reduces the potential for water erosion from precipitation events, construction-related land disturbance would also expose soils and sediments to possible erosion. Storm-water runoff, if present, from areas exposed during construction could convey soil and sediments and other pollutants (e.g., construction waste materials) to surface waters or infiltrate the subsurface and impact the underlying groundwater. Appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked hay bales, mulching disturbed areas, etc.) and spill prevention practices would be employed during construction to minimize suspended sediment and material transport and potential water quality impacts. Scheduling construction activities during the dryer months and when river flow is unlikely to be present would further reduce the potential for water quality impacts.

A bridge design has not been completed for the T-3 Road crossing. However, bridge abutments at either end of the bridge span, associated retaining walls, and piers supporting the bridge span would have a relatively small footprint on the river channel and floodplain and would be designed to have a minor impact on hydraulic flow and floodwaters over the long term. Design and construction of the crossing would ensure that the change in runoff from pre- to post-development conditions would be small.

The proposed T-3 route would traverse the floodplain before linking up with Lincoln Boulevard to the west of the river (see Figure F–3) would include structures (e.g., culverts) to allow inflow and outflow of water into the floodplain. This would ensure that there would be minimal impact on floodwater elevations (no rise), with no impact on downstream facilities.

The T-24 Road route is located south of the T-3 Road. Approximately 16 kilometers (10 miles) would need to be paved from the MFC until the road reaches the Critical Infrastructure Test Range Complex (CITRC) (formerly the Power Burst Facility) and connects to approximately 19 kilometers (12 miles) of INL existing internal roads leading to the RTC (INL 2005). Although less direct than following the T-3 Road, this route would use an existing bridge across the Big Lost River, with no impacts on the floodplain of the Big Lost River or associated wetlands.

The East Power Line Road route is located south of both the T-3 Road and the T-24 Road. An advantage is that this road is currently maintained to a higher level than the T-3 and T-24 routes because of ongoing activities related to power line maintenance. As with the T-24 Road, approximately 19 kilometers (12 miles) would need to be paved from the MFC before the new road connects to existing INL paved roads at CITRC (INL 2005). Also, this route would use an existing bridge across the Big Lost River, with no impacts on the floodplain of the Big Lost River or associated wetlands.

F.5 Conclusion

The proposed construction of the new road along the existing T-3 Road and associated bridge crossing would have short-term impacts on the floodplain, floodway, and associated wetlands of the Big Lost River. Following their completion, the new bridge crossing and road traversing the Big Lost River floodplain would have only a minor impact on hydraulic flow and floodwaters. Overall, floodplain values of infiltration and conveyance would be minimally affected due to the fact that the majority of the floodplain will not have any significant floodplain altering development. No long-term adverse impacts would be expected from the proposed construction.

The T-24 and East Power Line Road routes as described in Section F.4 would have no impacts on the floodplain, floodway, and associated wetlands of the Big Lost River because they do not require any new bridge crossing. These alternative roads also are shorter and require less road construction.

Additional studies of all three routes including ecological and cultural resource surveys and regulatory consultations will be completed with the results presented in the Final EIS. In total, these studies would define the acreage of vegetation types that could be impacted, establish the occurrence and legal status of animal species residing in the corridor, identify the presence and significance of any potentially affected cultural resources, help to define permitting requirements, and would facilitate construction planning and post-construction mitigation for impacted areas. These additional studies will ultimately support a decision on selecting a final road routing to be published in the ROD.

F.6 References

DOE (U.S. Department of Energy), 2000, *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, DOE/EIS-0306, Office of Nuclear Energy, Science and Technology, Washington, DC, July.

DOE (U.S. Department of Energy), 2002a, *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, DOE/EIS-0319, National Nuclear Security Administration, Washington, DC, August.

DOE (U.S. Department of Energy), 2002b, *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement*, DOE/EIS-0287, Idaho Operations Office, Idaho Falls, Idaho, September.

INL (Idaho National Laboratory), 2005, *Consolidation EIS* Information document, Data call materials, Idaho Falls, Idaho.

APPENDIX G
FEDERAL REGISTER NOTICES

DEPARTMENT OF ENERGY

Notice of Intent To Prepare an Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems

AGENCY: Department of Energy.

ACTION: Notice of Intent.

SUMMARY: The Department of Energy (DOE) announces its intent to prepare an environmental impact statement (EIS), pursuant to the National Environmental Policy Act (NEPA) of 1969, for the proposed consolidation of nuclear activities related to production of radioisotope power systems (RPS) required for Government national security and space exploration missions at a single, highly secure DOE site. Currently, DOE's ongoing RPS-related production operations are located at three DOE sites in Idaho, New Mexico and Tennessee, requiring the transport of radioactive material that could be avoided by consolidation of these activities at a single site. The proposed consolidation of these operations, which includes production, purification, and encapsulation of plutonium-238 (Pu-238), would be consistent with DOE's approach on consolidating nuclear materials, increasing the security of nuclear materials, and reducing risks associated with transportation of nuclear materials. The EIS will analyze all reasonable alternatives for the consolidation of the RPS operations as well as the No Action alternative.

DATES: DOE invites public comments on the proposed scope of this EIS. The public scoping period begins with the publication of this notice and concludes on January 31, 2005. DOE invites the general public, Native American Tribes, State and local governments, other Federal agencies, DOE stakeholders, and other interested parties to comment on the scope of this EIS. To ensure that comments are considered in the preparation of the EIS, the comments should be transmitted or postmarked by January 31, 2005. Late comments will be considered to the extent practicable.

DOE will conduct seven public scoping meetings in Idaho Falls, Twin Falls, and Fort Hall, Idaho; Jackson Hole, Wyoming; Los Alamos, New Mexico; Oak Ridge, Tennessee; and Washington, DC. During the scoping meetings, DOE will provide information on the proposed consolidation project and receive oral and written comments on the scope of the EIS, including those regarding reasonable alternatives and environmental issues that DOE should consider. The location, date, and time for these public meetings are as follows:

Idaho Falls, ID: Monday, December 6, 2004, from 6–8:30 p.m. at the Shilo Inn, Riverview Room, 780 Lindsay Blvd., Idaho Falls, ID 83402
Jackson, WY: Tuesday, December 7, 2004, from 7–9:30 p.m. at the Jackson Hole Middle School, Commons Room, 1230 South Park Loop Road, Jackson, WY 83001
Fort Hall, ID: Wednesday, December 8, 2004, from7–9:30 p.m. at the Fort Hall Tribal Business Center, Tribal Council Chambers, Pima Drive (I–15, Exit 80), Fort Hall Town Site, Fort Hall, ID 83203
Twin Falls, ID: Thursday, December 9, 2004, from 7–9:30 p.m. at the Shilo Inn, Twin Falls B Meeting Room, 1586 Blue Lake Blvd., Twin Falls, ID 83301
Los Alamos, NM: Monday, December 13, 2004, from 6–8:30 p.m. at the Los Alamos Golf Course, Golf Course Main Room, 4250 Diamond Drive, Los Alamos, NM 87544
Oak Ridge, TN: Wednesday, December 15, 2004, from 6–8:30 p.m. at the Oak Ridge Comfort Inn, Magnolia Conference Room, 433 S. Rutgers Ave., Oak Ridge, TN 37830
Washington, DC: Friday, December 17, 2004, from 1–3:30 p.m. at the Hyatt Regency on Capitol Hill, 400 New Jersey Avenue, NW., Washington, DC 20001

ADDRESSES: Comments or suggestions on the scope for the EIS, questions concerning the proposed action, requests to participate at the public scoping meetings, requests for special arrangements that would enable participation at the scoping meetings (*e.g.*, an interpreter for the hearing impaired), and requests to be placed on the EIS distribution list may be directed to: Timothy A. Frazier, Document Manager, NE–50/Germantown Building, Office of Space and Defense Power Systems, Office of Nuclear Energy, Science and Technology, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585–1290, telephone 301–903–9420, or submitted via e-mail to *ConsolidationEIS@nuclear.energy.gov*. You may also leave a message at (800) 919–3716, or send a fax to (800) 919–3765. Comments may also be submitted to DOE via the RPS EIS Web site at *ConsolidationEIS.doe.gov*.

FOR FURTHER INFORMATION CONTACT: For general information on the DOE NEPA process, please contact: Carol Borgstrom, Director, Office of NEPA Policy and Compliance, Office of Environment, Safety and Health, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, 202–586–4600, or leave a message at 1–800–472–2756.

SUPPLEMENTARY INFORMATION:

Background

The RPS is a unique technology for missions that require a long-term, unattended source of heat and/or electrical power for use in harsh and remote environments—such as deep-space. The Pu-238 in these units serves as the source for generating heat and electricity. The heat source can be used directly to warm critical spacecraft components.

Currently, DOE plans to produce RPS in support of Government national security and space exploration missions at three geographically separate and distant DOE sites: the Oak Ridge National Laboratory (ORNL), Tennessee; Los Alamos National Laboratory (LANL), New Mexico; and the Idaho Site, Idaho. DOE proposes to consolidate all nuclear activities of the existing and future RPS production operations at a single, highly secure DOE site. This consolidation would be consistent with DOE's approach on consolidating nuclear materials, increasing the security of nuclear materials, and reducing risks associated with the transportation of nuclear materials.

The nuclear infrastructure required to produce RPS is comprised of three major components: (1) The production of Pu-238; (2) the purification and encapsulation of Pu-238 into a fuel form; and (3) the assembly, testing, and delivery of the RPS to the Federal users. The three major components of the existing infrastructure, including their current status, are briefly described below:

Production of Pu-238: The Pu-238 production process consists of the fabrication of neptunium-237 (Np-237) targets, irradiation of the targets in a suitable irradiation facility, and the recovery of Pu-238 from the irradiated targets through chemical processing. In the past, Pu-238 was produced at DOE's Savannah River Site (SRS), using reactors that are no longer operating. After SRS stopped producing Pu-238, DOE satisfied its Pu-238 requirement by using DOE's available inventory in storage at LANL. This inventory was augmented by Pu-238 purchased from Russia for use in space missions. DOE analyzed the need for reestablishment of Pu-238 production capability in the Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS) (DOE/EIS–0310), issued in December 2000. On the basis of the analysis in the NI PEIS, DOE issued a Record of Decision (ROD) (66 FR 7877, January 26, 2001) to reestablish Pu-238 production capability at ORNL using the Radiochemical Engineering Development Center (REDC) for the fabrication of targets and extraction of Pu-238 from the irradiated targets. The Advanced Test Reactor (ATR) located at the Idaho National Engineering and Environmental Laboratory (also referred to as the Idaho Site), supplemented by the High Flux Isotope Reactor (HFIR) located at ORNL, would be used in the irradiation of targets, and the irradiated targets would be returned to REDC/ORNL for extraction of Pu-238. This decision, however, has not yet been implemented and the DOE has expended no resources to establish the Pu-238 production at the Oak Ridge Site.

Np-237, the feed material for fabrication of targets for Pu-238 production, had been stored at the SRS where Pu-238 was historically produced. In the NI PEIS ROD, DOE decided to transfer this material to ORNL since the Pu-238 capability was planned to be reestablished there. However, Np-237 is a special nuclear material and, after the events of September 11, 2001, it required a higher level of security than could be reasonably provided at REDC/ORNL. Therefore, DOE amended the ROD for the NI PEIS to change the storage location for Np-237 from ORNL to the Idaho Site (69 FR 50180, August 13, 2004). Np-237, in the form of an oxide, will be shipped from SRS to the Idaho Site beginning in FY 2005 (and ending in FY 2006) for storage until needed for Pu-238 production.

Purification and Encapsulation of Pu-238: Pu-238 is purified and encapsulated in a metal capsule and welded closed. These fuel capsules are used as a heat source in the RPS. The purification and encapsulation work is currently conducted within the Technical Area-55 (TA–55) complex at LANL. The finished Pu-238 fuel capsules are shipped from LANL for assembly of the RPS at the Idaho Site.

Assembly and Test Operations: From the early 1980s until late-2002, DOE conducted its assembly and test operations for the RPS at the Mound Site in Miamisburg, Ohio. Increased security requirements and concerns resulting from the attacks on September 11, 2001, led DOE to transfer these operations to the Idaho Site to provide enhanced security in a cost effective manner at a highly secure DOE site. The environmental impacts of the transfer from the Mound Site to the Idaho Site were assessed in an Environmental Assessment (DOE/EA–1343). A Finding of No Significant Impact was signed by DOE on August 30, 2002, and the transfer of the assembly and testing capability was initiated. The first RPS will be assembled and tested at the Idaho Site by September 2005 in support of the National Aeronautics and Space Administration's (NASA) planned mission to survey the planet Pluto.

In summary, the current RPS production capability and infrastructure resides at or was planned to reside within the DOE complex at the following different locations:

- Np-237, used in preparation of targets as the feed material for Pu-238 production, was to be transferred and stored at the Idaho Site (amendment to the NI PEIS ROD).
- The production capability was planned to be located at ORNL (NI PEIS ROD) where the targets would be fabricated in REDC, irradiated at ATR in Idaho (supplemented by HFIR in Oak Ridge) and then processed in REDC to recover Pu-238. Pu-238 was then to have been transported to LANL.
- Pu-238 was to be purified and encapsulated in TA–55 at LANL and transported to the Idaho Site.
- RPS assembly and test operations was to be conducted at the Idaho Site.

Purpose and Need for Agency Action

As described above, RPS production infrastructure exists at or is planned for DOE sites in three locations: ORNL, LANL, and the Idaho Site. Consolidation of these operations at a single site would significantly increase security of the nuclear material while reducing risks associated with the transport of radioactive material.

Proposed Action

DOE proposes to consolidate all Pu-238 operations at a single, highly secure site within its complex. These operations include the production of Pu-238, purification and encapsulation of Pu-238, and the assembly and testing of the RPS.

Preliminary Alternatives

Consistent with NEPA implementation requirements, the EIS will assess the range of reasonable alternatives regarding DOE's need to consolidate nuclear operations related to RPS. DOE has identified the following two alternatives for the proposed RPS Production Consolidation Project.

A. *No Action Alternative:* Under the No Action Alternative, DOE would continue the RPS production operations as explained above. The operations would consist of: (1) Np–237 storage at the Idaho Site and shipments to ORNL as needed for target fabrication; (2) Pu-238 production at ORNL using HFIR and ATR (Idaho) for irradiation and processing in REDC located at ORNL; (3) Pu-238 purification and encapsulation in TA–55 facility at LANL; and (4) RPS assembly and test operations at the Idaho Site.

B. *Consolidation of Nuclear Operations Related to Production of RPS at the Idaho Site, the Preferred Alternative:* Under this alternative, DOE would consolidate all activities related to RPS production within the secure area at the Idaho Site. New construction for the Pu-238 production, purification, and encapsulation part of the infrastructure would be required due to the very limited capability of existing facilities in the secure area. No new construction would be required for the assembly and test operations that are already being located in the secure area at the Idaho Site. As previously stated, the consolidation of the RPS production infrastructure would include the following activities: (1) Np-237 would be stored at the Idaho Site as already decided; (2) Pu-238 production capability (including Np–237 target fabrication and processing) would be established at the Idaho Site with ATR serving as the primary irradiation facility, and HFIR would be used only as a back-up facility if necessary; (3) Pu-238 operations carried out at the TA–55 complex at LANL would be transferred to the Idaho Site; and (4) the existing facility, the Space and Security Power Systems Facility, at the Idaho Site would continue to be established and maintained for RPS assembly and test operations as already planned. This area of the Idaho Site where RPS nuclear operations are proposed to be consolidated is a highly secure location within the DOE complex.

C. *Other Reasonable Alternatives:* Any other reasonable alternatives identified through the scoping process will be evaluated as appropriate.

DOE considered whether consolidation at another site is reasonable. The proposed consolidation is not achievable at LANL since there is no operating reactor at the site for irradiation of targets.

Consolidation at ORNL would not allow the DOE to meet its programmatic need. Because the reactor at ORNL, HFIR, is a dedicated facility for projects related to basic energy sciences and isotope production, use of this reactor for the RPS program would only be on an ''as available'' basis and could not be guaranteed. Consolidation at ORNL, therefore, could only partially meet the programmatic objective. Also, as analyzed in the NI PEIS, irradiation of targets in HFIR would be limited due to reactor design and could not produce enough Pu-238 to meet programmatic objectives.

Preliminary Identification of Environmental Issues

The issues listed below have been tentatively identified for analysis in the EIS. This list is presented to facilitate public comment on the scope of the EIS. It is not intended to be all-inclusive or to predetermine the potential impacts of any of the alternatives. DOE seeks public comments on the adequacy and completeness of the following issues:

- Potential impacts on ecosystems, including air quality, surface, and groundwater quality, and plants and animals.
- Potential health and safety impacts to on-site workers and to the public resulting from operations including reasonably foreseeable accidents.
- Potential health and safety, environmental, and other impacts related to the transport of radioactive materials to the consolidation location.
- Considerations related to the generation, treatment, storage, and disposal of wastes including the potential acceptability of waste at appropriate disposal facilities.
- Potential cumulative impacts of Pu-238 mission operations, including relevant impacts from other past, present, and reasonably foreseeable activities at the consolidation site.
- Potential impacts on cultural resources.

- Potential socioeconomic impacts including any disproportionate impacts on minority and low-income populations.
- Pollution prevention and waste minimization opportunities.

Related NEPA Documentation

NEPA documents that have been prepared for activities related to the proposed action include, but are not limited to, the following:

- Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States including the Role of the Fast Flux Test Facility (DOE/EIS–0310) (December 2000); and
- Environmental Assessment for Consolidation of Heat Source/Radioisotope Thermoelectric Generator (HS/RTG) Assembly and Testing Operations (DOE/EA–1343) (August 2002).

These NEPA documents (DOE/EIS–0310) and (DOE/EA–1343) are available on the DOE NEPA Web site at *http://www.eh.doe.gov/nepa.*

Public Reading Rooms

Documents referenced in this NOI and other related information are available at DOE-Idaho Operations Office Public Reading Room, 1776 Science Center Drive, Idaho Falls, ID 83415 (telephone 208–526–0271) and U.S. Department of Energy, Freedom of Information Reading Room, Forrestal Building, Room 1E–190,1000 Independence Avenue, SW., Washington, DC 20585–0117 (telephone 202–586–3142). As mentioned above, DOE's NEPA documents, including this NOI, are available at the DOE NEPA Web site (*http://www.eh.doe.gov/nepa*) and the RPS EIS Web site *ConsolidationEIS.doe.gov.*

Public Involvement Opportunities

DOE seeks public involvement in the preparation of the EIS and solicits public comments on its scope and content as well as participation at the public scoping meetings in Idaho, Wyoming, New Mexico, Tennessee, and Washington, DC. DOE personnel will be available at the scoping meetings to explain the proposed project and answer questions. DOE will designate a neutral facilitator for the scoping meetings. During the first hour of each meeting, attendees may register, view displays, and discuss issues and concerns informally with DOE representatives. Following registration and the informal session, there will be a formal presentation and a period for questions, answers, and comments. To ensure that all persons wishing to express their comments are given an opportunity, a five-minute limit may be applied for each person; however, public officials and representatives of groups would be allotted ten minutes each. DOE encourages those presenting comments orally to also submit written comments, if possible.

Comment cards will be available at the meetings for those who prefer to submit their comments in writing. Participants may be asked clarifying questions to ensure that DOE representatives fully understand the comments and suggestions.

NEPA Process

The EIS for the proposed consolidation of nuclear operations related to the production of RPS will be prepared pursuant to the NEPA of 1969, the Council on Environmental Quality's Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500–1508), and DOE NEPA Implementing Procedures (10 CFR Part 1021). A 45-day comment period on the draft EIS is planned, during which public hearings will be held to receive comments. The draft EIS is scheduled to be issued in late spring 2005. Availability of the draft EIS, the dates of the public comment period, and information about the public hearings will be announced in the **Federal Register** and in local news media when the draft EIS is distributed. The final EIS is scheduled to be issued in late 2005. No sooner than 30 days after the U.S. Environmental Protection Agency's notice of availability of the final EIS is published in the **Federal Register**, DOE may issue its ROD.

Issued in Washington, DC on November 10, 2004.

John Spitaleri Shaw,

Acting Assistant Secretary for Environment, Safety and Health.

[FR Doc. 04–25406 Filed 11–15–04; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Notice of Intent To Prepare an Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems; Correction

AGENCY: Department of Energy.

ACTION: Notice of Intent; correction.

SUMMARY: The Department of Energy published a notice of intent in the **Federal Register** on November 16, 2004, (69 FR 67139) announcing its intent to prepare an environmental impact statement (EIS), for the proposed consolidation of nuclear activities related to production of radioisotope power systems required for Government national security and space exploration missions at a single, highly secure DOE site. The document contained an incorrect telephone number and an incorrect street address for a public meeting.

Corrections

In the **Federal Register** of November 16, 2004, in FR Doc. 04–25406, on page 67140, the following corrections should be made:

First column, first paragraph,
Twin Falls, ID: 1586 Blue Lakes Blvd. North,
Second column, under **ADDRESSES** heading, first paragraph,
You may leave a message at (800) 919–3706.

FOR FURTHER INFORMATION CONTACT: Timothy A. Frazier, Document Manager, NE–50/Germantown Building, Office of Space and Defense Power Systems, Office of Nuclear Energy, Science and Technology, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585–1290, telephone 301–903–9420, or submitted via e-mail to ConsolidationEIS@nuclear.energy.gov.

Issued in Washington, DC on November 18, 2004.

Carol M. Borgstrom,

Director, Office of NEPA Policy and Compliance.

[FR Doc. 04–26035 Filed 11–23–04; 8:45 am]

BILLING CODE 6450–01–P

APPENDIX H
CONTRACTOR DISCLOSURE STATEMENT

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF AN EIS FOR THE PROPOSED CONSOLIDATION OF NUCLEAR OPERATIONS RELATED TO PRODUCTION OF RADIOISOTOPE POWER SYSTEMS

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term “financial interest or other interest in the outcome of the project,” for the purposes of this disclosure, is defined in the March 23, 1981 guidance “Forty Most Asked Questions Concerning CEQ’s National Environmental Policy Act Regulations,” 46 FR 18026-18038 at Question 17a and b.

“Financial or other interest in the outcome of the project ‘includes’ any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm’s other clients).” 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal)

(a) ___X___ Offeror and any proposed subcontractor have no financial interest in the outcome of the project.

(b) _______ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

Certified by:

Elizabeth C. Saris

Signature

Elizabeth C. Saris

Name

Vice President
Energy Solutions Operations

April 2005

Date

Science Applications International Corporation