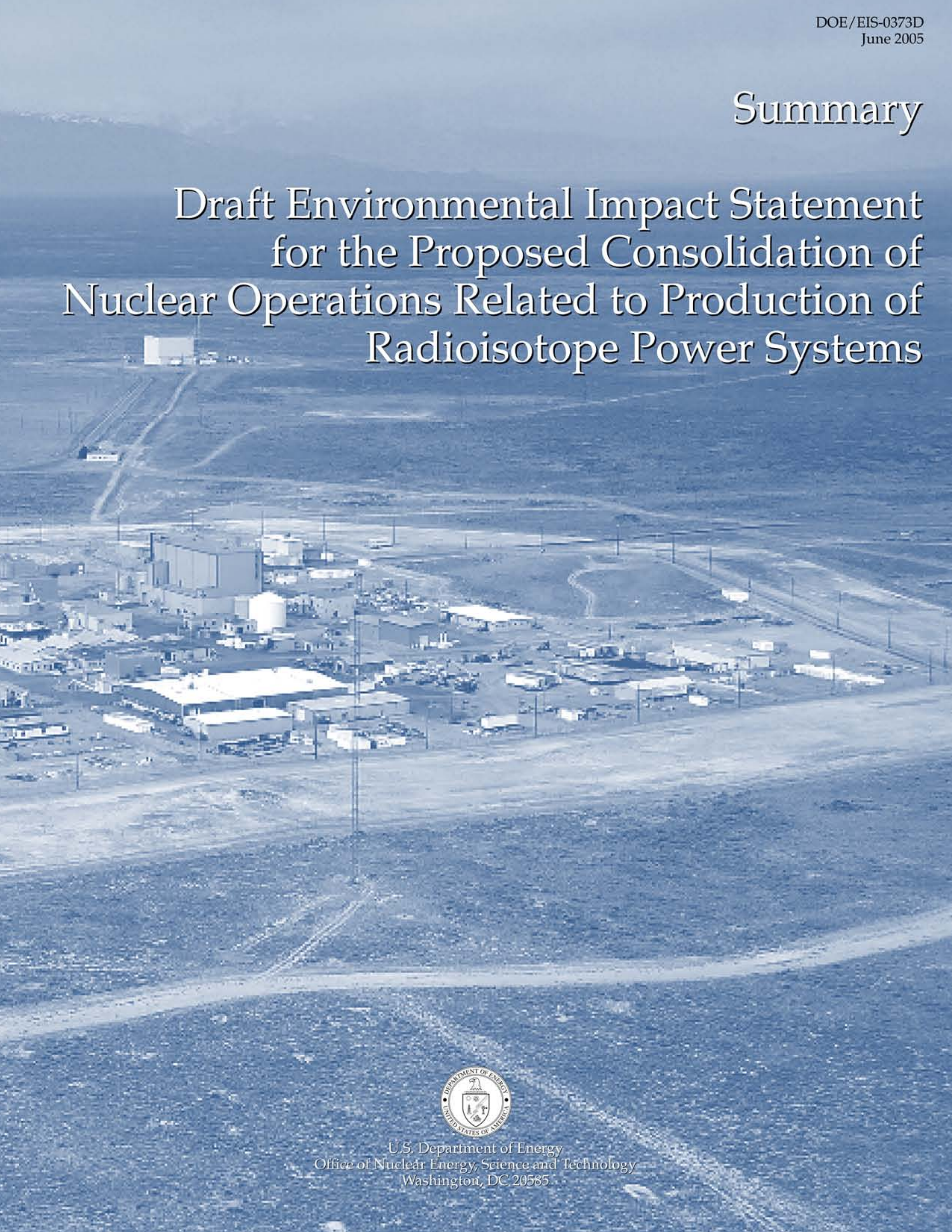
DOE/EIS-0373D
June 2005

Summary

Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems



U.S. Department of Energy
Office of Nuclear Energy, Science and Technology
Washington, DC 20585

AVAILABILITY OF THE DRAFT CONSOLIDATION EIS

For additional information or for copies of this Draft EIS, contact:

Timothy A. Frazier, EIS Document Manager
NE-50/Germantown Building
Office of Nuclear Energy, Science and Technology
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1290
Telephone: 1-800-919-3706
E-mail: ConsolidationEIS@nuclear.energy.gov

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ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ALARA	as low as is reasonably achievable
ATR	Advanced Test Reactor
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CITRC	Critical Infrastructure Test Range Complex
DOE	U.S. Department of Energy
EA	environmental assessment
EBR	Experimental Breeder Reactor
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FDF	Fluorinel Dissolution Facility
FDPF	Fluorinel Dissolution Process and Fuel Storage Facility
FFTF	Fast Flux Test Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	*Federal Register*
HEPA	high-efficiency particulate air (filter)
HFIR	High Flux Isotope Reactor
INL	Idaho National Laboratory
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
MEI	maximally exposed individual
MFC	Materials and Fuels Complex
NASA	National Aeronautics and Space Administration
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*
NNSA	National Nuclear Security Administration
NOI	Notice of Intent
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
REDC	Radiochemical Engineering Development Center
RHU	radioisotope heater unit
ROD	Record of Decision
ROI	region of influence
RPS	radioisotope power system
RTC	Reactor Technology Complex
RTG	radioisotope thermoelectric generator
SNM	special nuclear material
SRS	Savannah River Site
TA-55	Technical Area 55
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}

SUMMARY

SUMMARY

This document summarizes the U.S. Department of Energy's (DOE's) *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems* (*Consolidation EIS*) (DOE/EIS-0373D). In addition to information concerning the background, purpose and need for the Proposed Action, and the National Environmental Policy Act (NEPA) process, this Summary provides a description of the radioisotope power system (RPS) production process and the existing and planned infrastructure that supports it. This Summary also describes the alternatives evaluated in the *Consolidation EIS*, the alternatives that were considered and dismissed from detailed evaluation, and the existing or proposed facilities to be used under each alternative. A comparison of the environmental consequences of the alternatives for RPS consolidation analyzed in the *Consolidation EIS* is also provided in this Summary.

S.1 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 electricity) or batteries are not practical. As a heat source, an RPS can be used to warm critical components.

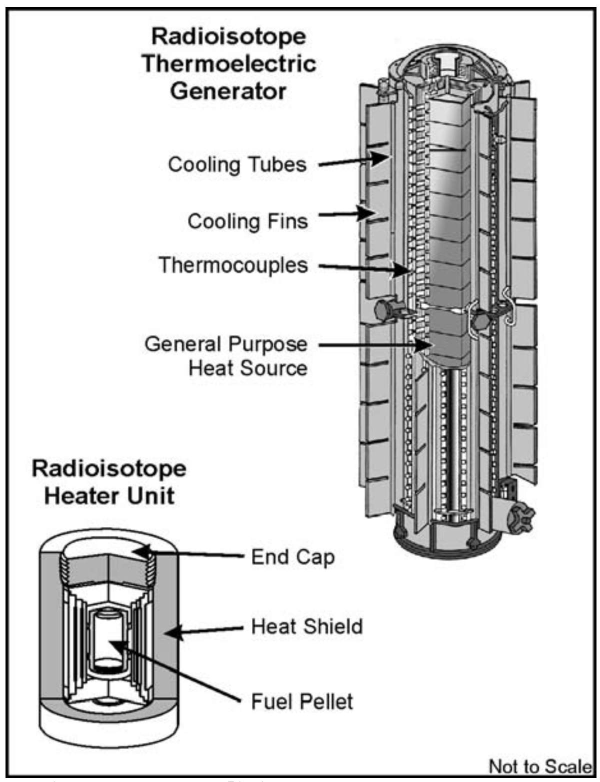

Figure S–1 Radioisotope Power Systems: Radioisotope Thermoelectric Generator and Radioisotope Heater Unit

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 S–1**).[1] The major advantages of thermoelectric conversion 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 (RHUs), 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

[1] *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.*

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 Horizons and would survey the planet Pluto.[2] DOE's role in these missions reflects established ongoing cooperation between DOE and NASA to ensure that RPS production capabilities are maintained and 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 the *Consolidation EIS* (40 *Code of Federal Regulations* [CFR] 1501.6).

Along with NASA deep space satellite applications, plutonium-238, in RHUs 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.
- 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 extraction, 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: Oak Ridge National Laboratory (ORNL), Tennessee; Los Alamos National Laboratory (LANL), New Mexico; and Idaho National Laboratory (INL) (formerly known as the Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory-West), Idaho (see **Figure S–2**). 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. The nuclear infrastructure components required to produce an RPS are shown in **Figure S–3**.

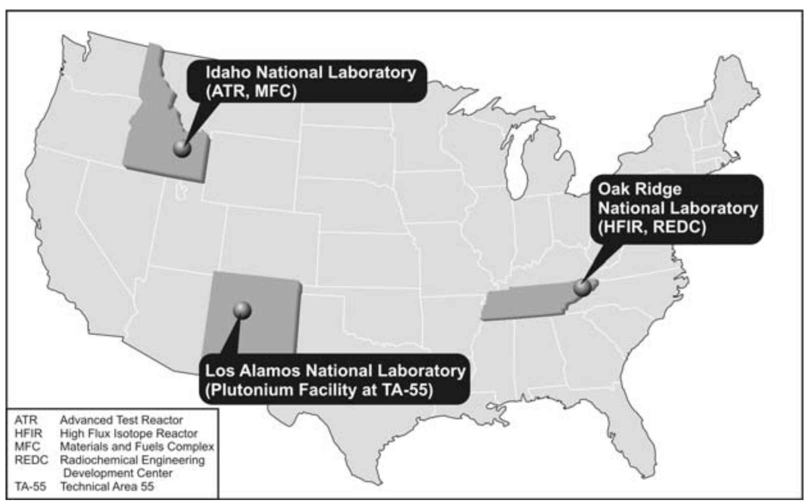

Figure S–2 Current Locations of U.S. Department of Energy Nuclear Operations Supporting Radioisotope Power System Production

[2] *NASA issued a Notice of Availability for a Draft EIS for the mission on February 25, 2005 (70 Federal Register [FR] 9387).*

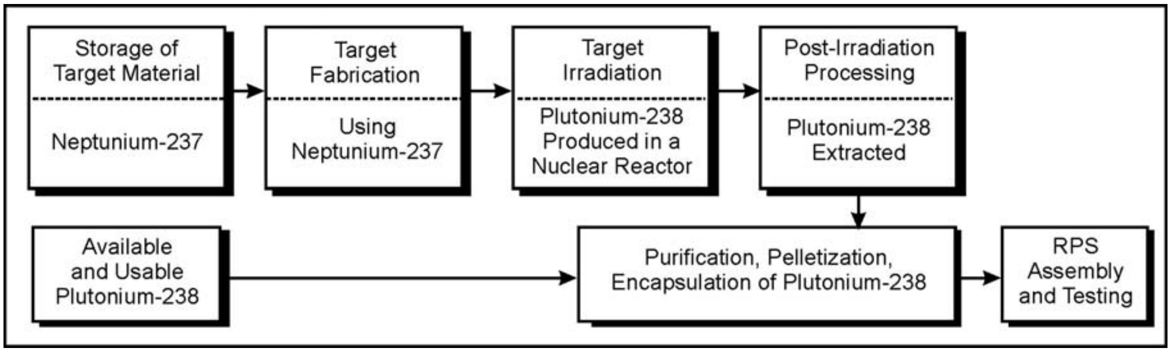

Figure S–3 Nuclear Infrastructure to Produce Radioisotope Power Systems

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.[3] 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), 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.

Plutonium-238

Plutonium-238 is a special nuclear material (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 U.S. Department of Energy safeguards, plutonium-238 is reportable in 0.1-gram (0.004-ounce) quantities.

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 special nuclear material (SNM).[4] Because REDC at

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.

[3] *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.*

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

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

> **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).

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 then shipped from LANL to INL for assembly of the RPS. 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 the *Consolidation EIS*.

RPS Assembly and Test Operations. From the early 1980s until August 2002, the 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 this environmental assessment (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 would 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, is 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 at 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).

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 environmental impact statement (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 S–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 *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 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 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 S–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 has been 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 the *Consolidation EIS*. This inventory will be available and usable by 2011.

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

S.2 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 and to reduce interstate transportation of SNM 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: ORNL, LANL, and INL. 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.

S.3 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 continued RPS production at this time. For the past 4 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 DOE's domestic plutonium-238 inventory by the end of the decade. The 2001 ROD for the *NI PEIS* authorized the reestablishment of 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 re-visited. The *Consolidation EIS* does not analyze alternative annual production rates.

S.4 Proposed Action and Scope of the *Consolidation EIS*

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 production operations at INL would require no interstate transport for new plutonium-238 production. However, the Consolidation and Consolidation with Bridge Alternative 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. Section S.7.4 describes these alternatives and discusses the reasons why they were not analyzed in detail.

S.5 Public Participation and Scoping Process

During the NEPA process, there are opportunities for public involvement (see **Figure S–4**). As a preliminary step in the 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 a 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; affected 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 facsimile line, and in person at public meetings (40 CFR 1501.7).

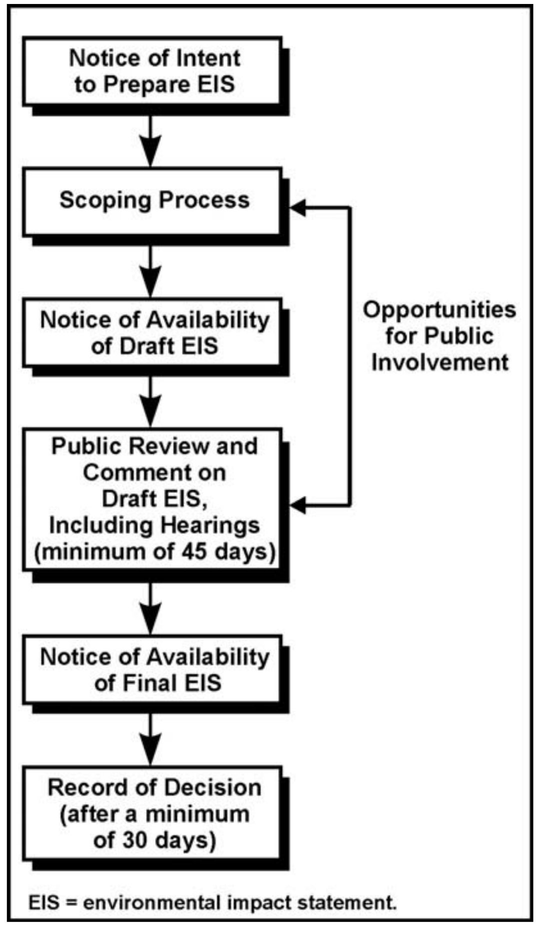

Figure S–4 National Environmental Policy Act Process for the *Consolidation EIS*

During the public scoping period (from November 16, 2004 through 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 the 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 expressions of concern 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 Fast Flux Test Facility (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 Idaho. 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 the *Consolidation EIS*:

- Consolidation alternatives at other DOE sites,
- National security and the transport 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 the *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. Information has been included in the *Consolidation EIS* 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 now discussed in detail. The *Consolidation 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 in nuclear weapons, "dirty bombs," and its attractiveness to terrorists resulted in the development of an appendix to address these concerns. Continuity between the *NI PEIS* and the *Consolidation EIS* to avoid NEPA segmentation is addressed in the EIS. The estimated cost of each alternative has been included in the description of alternatives.

S.6 Related National Environmental Policy Act Reviews

A number of related NEPA reviews have been completed or are ongoing. Two reviews that are directly related to the *Consolidation EIS* are described below:

***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 *NI PEIS* 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 enhancement of 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 this isotope production, and an alternative to permanently deactivate the 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 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 the *Consolidation EIS*. The No Action Alternative assessed in the *Consolidation EIS* is consistent with the *NI PEIS* ROD and Amendment.

***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)**. This FONSI and Final EA 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 EA to consider the potential environmental impacts associated with actions that might be taken with regard to the future location of the heat source/RPS operations. Based on the analysis in the EA, DOE determined that the Proposed Action, the relocation of the heat source/RPS operations, 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 the *Consolidation EIS* is consistent with the Proposed Action analyzed in this EA.

A number of other NEPA documents are also relevant to the *Consolidation EIS*, including:

- *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Wastes* (DOE/EIS-0200)
- *Site-Wide Environmental Impact Statement on the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EIS-0238)
- *Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* (DOE/EIS-0290)
- *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE/EIS-0306)
- *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement* (DOE/EIS-0287)

S.7 Alternatives to Be Evaluated

Consistent with NEPA implementation requirements, the *Consolidation 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 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 (new MFC Plutonium-238 Facility and ATR for targets), 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 evaluated in the EIS and the facilities to be used under each alternative are described below and summarized in **Table S–2**. **Figures S–5, S–6**, and **S–7** illustrate the differences among the No Action, Consolidation, and Consolidation with Bridge Alternatives in terms of transportation requirements. Descriptions of the existing and proposed facilities for implementation of the alternatives are provided in Section S.8.

Table S–2 Infrastructure Comparison Among Alternatives

RPS Production Component	No Action Alternative	Consolidation Alternative	Consolidation with Bridge Alternative
Storage of target material	FMF at the MFC at INL	FMF at the MFC at INL	FMF at the MFC at 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 the MFC at INL (after 2011)	Plutonium Facility at LANL (2007 to 2011); Plutonium-238 Facility and RWL at the 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.

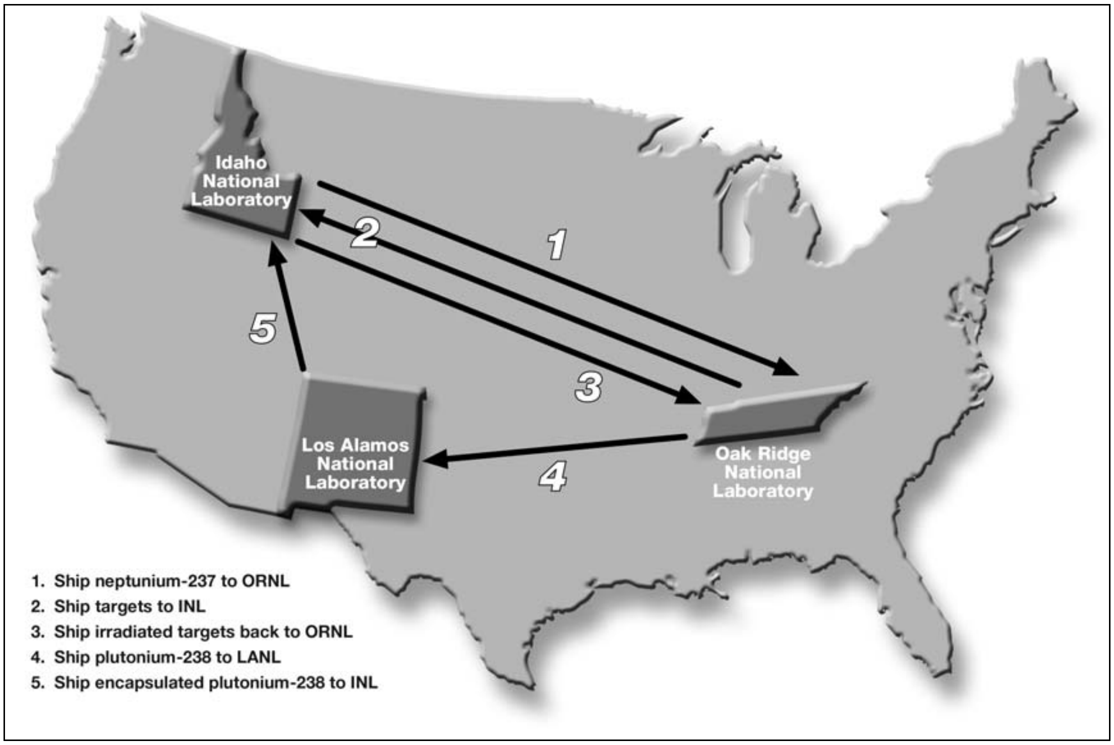

Figure S–5 Intersite Transportation Under the No Action Alternative

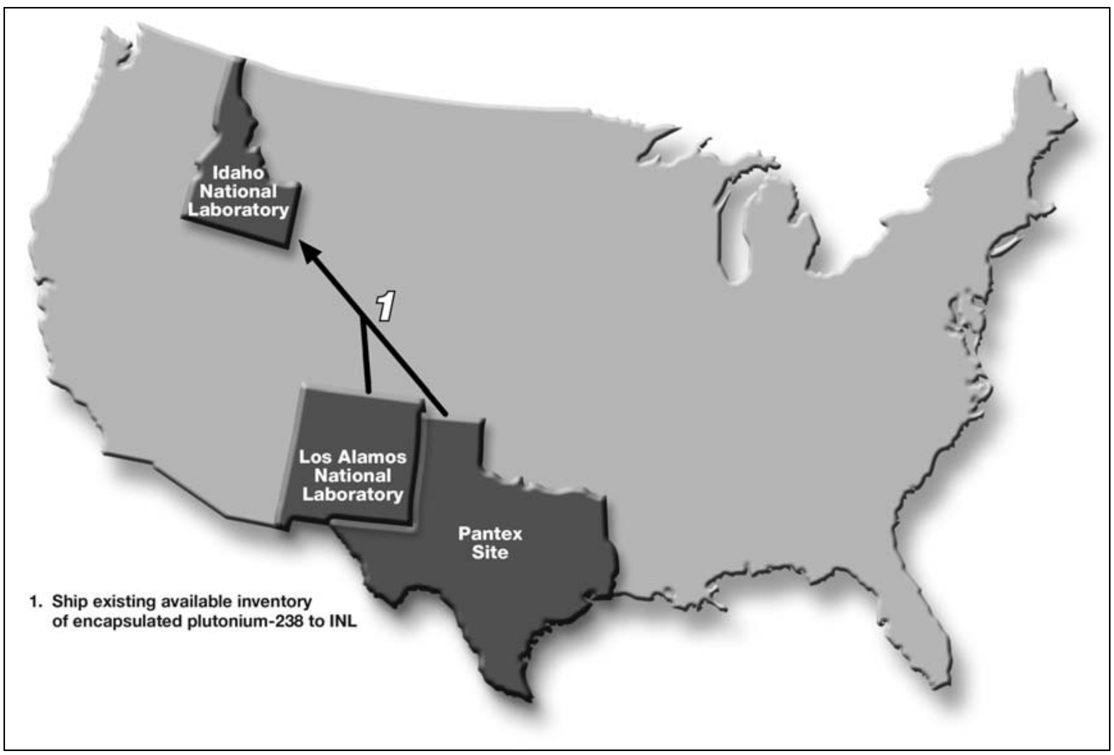

Figure S–6 Intersite Transportation Under the Consolidation Alternative and After the Bridge Period Under the Consolidation with Bridge Alternative

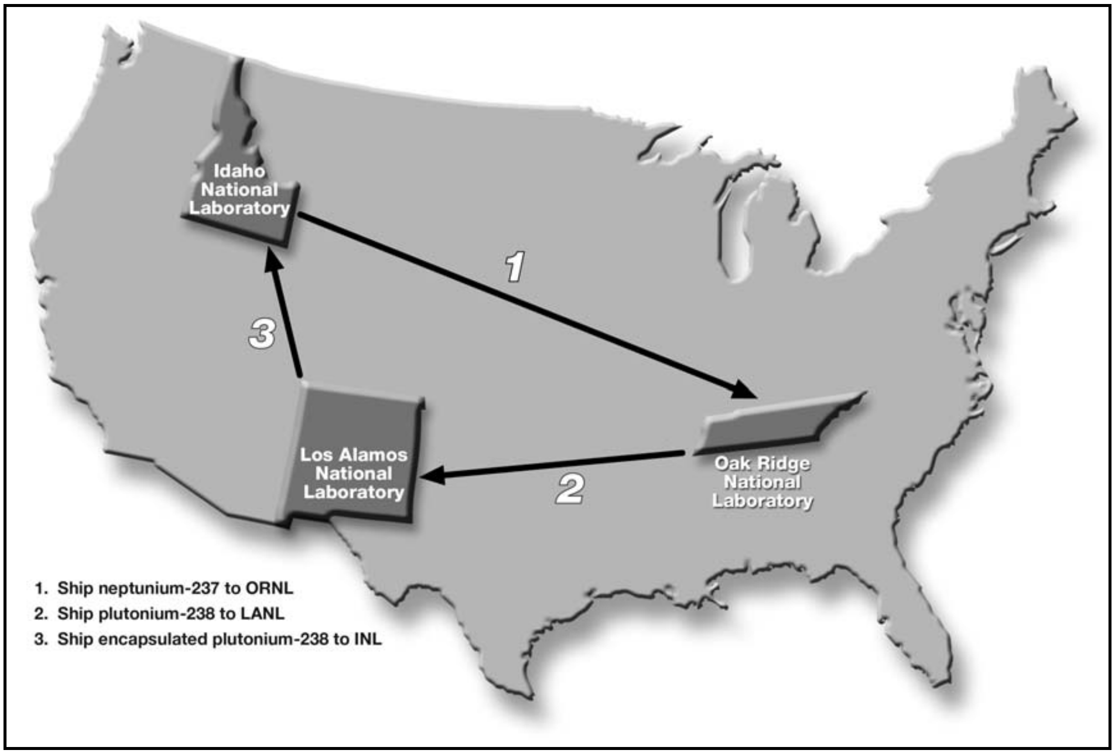

Figure S–7 Intersite Transportation During the Bridge Period Under the Consolidation with Bridge Alternative

S.7.1 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 the *Consolidation 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 Fuel Manufacturing Facility (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 time 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, 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.

The ATR is a DOE-owned light-water-cooled and -moderated reactor with a design thermal power of 250 megawatts 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.

The HFIR is a beryllium-reflected, light-water-cooled and -moderated reactor operating at a thermal power level of 85 megawatts. The HFIR is owned by DOE and is located in ORNL in the southern portion of the Oak Ridge Reservation (ORR). The 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 Available Plutonium-238 Inventory. The available and usable inventory of plutonium-238 identified in Table S–1 would remain at its current locations (i.e., INL, LANL, and Pantex).

S.7.2 Consolidation Alternative (Preferred Alternative)

Under the Consolidation Alternative, DOE would consolidate all RPS nuclear production operations within the secure area at the 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 the 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 S-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.

S.7.3 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 plutonium-238 inventory 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 the 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 the *Consolidation 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 consolidated 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. Under the Consolidation with Bridge Alternative, DOE would fully implement RPS nuclear production operations at INL after completion and testing of the new facilities in 2011.

S.7.4 Alternatives Considered and Dismissed

S.7.4.1 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 the appropriate level of Perimeter Intrusion and Detection Assessment System 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 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* (DOE/EIS-0310). 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 [EPA]), 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 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 the *Consolidation 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 the *Consolidation 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.

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 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.

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. Because SRS has no available onsite nuclear reactor, it was considered and dismissed from detailed evaluation in the *Consolidation EIS*.

S.7.4.2 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 was also proposed for storage under the same alternative. These facilities were considered and dismissed from detailed evaluation in the *Consolidation 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. The FDPF and Unirradiated Fuel Storage Facility are described below along with the status of each facility.

Fluorinel Dissolution Process and Fuel Storage Facility—FDPF is located northeast of the Central Facilities Area at the Idaho Nuclear Technology and Engineering Center, INL, 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.

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 EPA 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.

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.

Unirradiated Fuel Storage Facility—This facility 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 the facility. It is a Hazard Category 2 facility. There is no loose contamination; however, fissile material contains uranium-232 and emits alpha radiation. The Unirradiated Fuel Storage Facility 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.

As an interim disposition step, the Unirradiated Fuel Storage Facility 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.

Other INL Facilities—Due to security requirements, especially the need for an existing Perimeter Intrusion and Detection Assessment System to encompass all involved structures, all other facilities at INL were considered but dismissed from 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; or 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*.

S.7.4.3 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 S.8.2.4 and analyzed throughout the *Consolidation 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 considered infeasible and is dismissed from further evaluation.

S.8 Description of Facilities

S.8.1 Existing Facilities

S.8.1.1 Radiochemical Engineering Development Center

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 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 S–8** presents a map of ORR that depicts REDC's location. **Figure S–9** presents the layout of the facility.

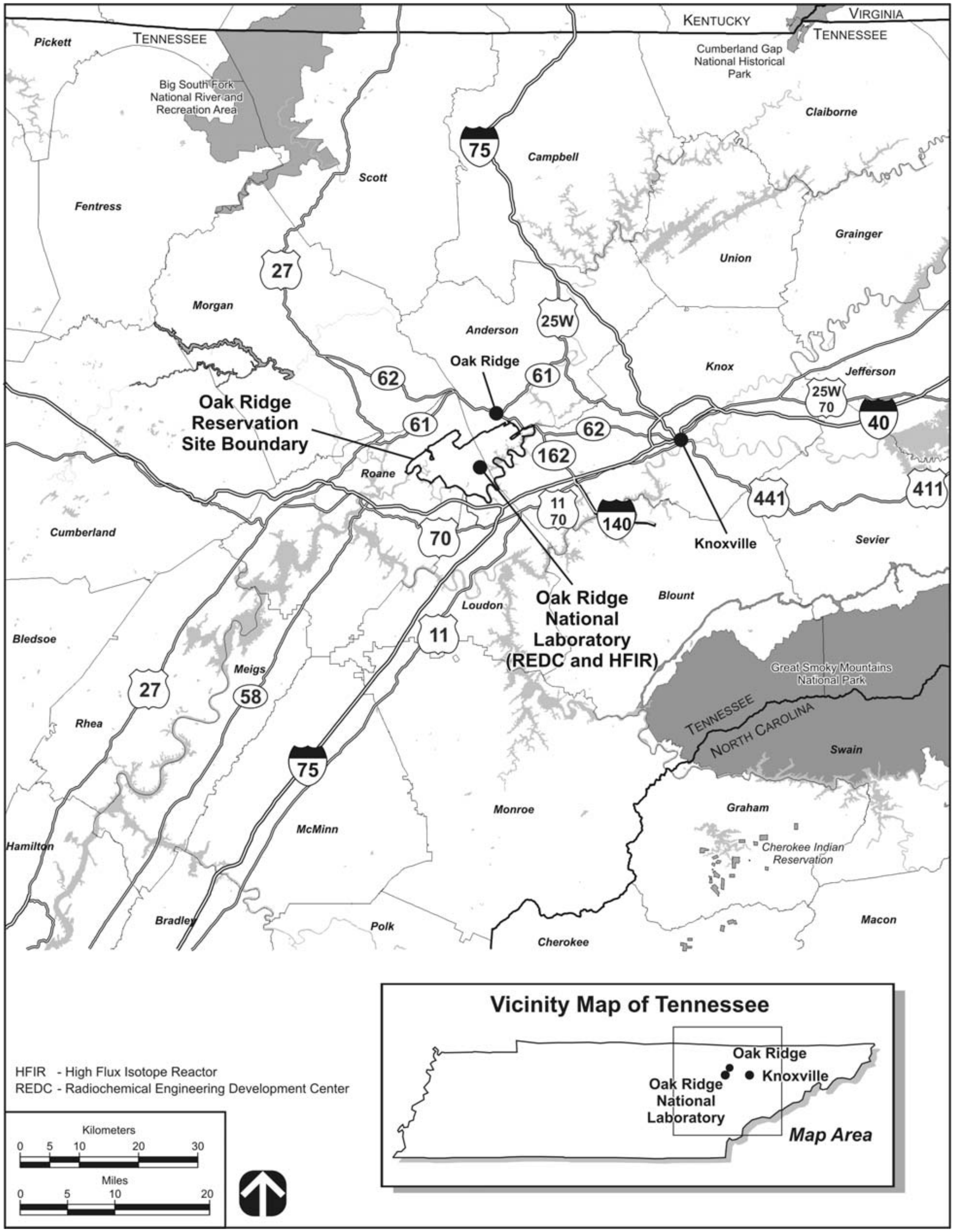

Figure S–8 Oak Ridge Reservation Site

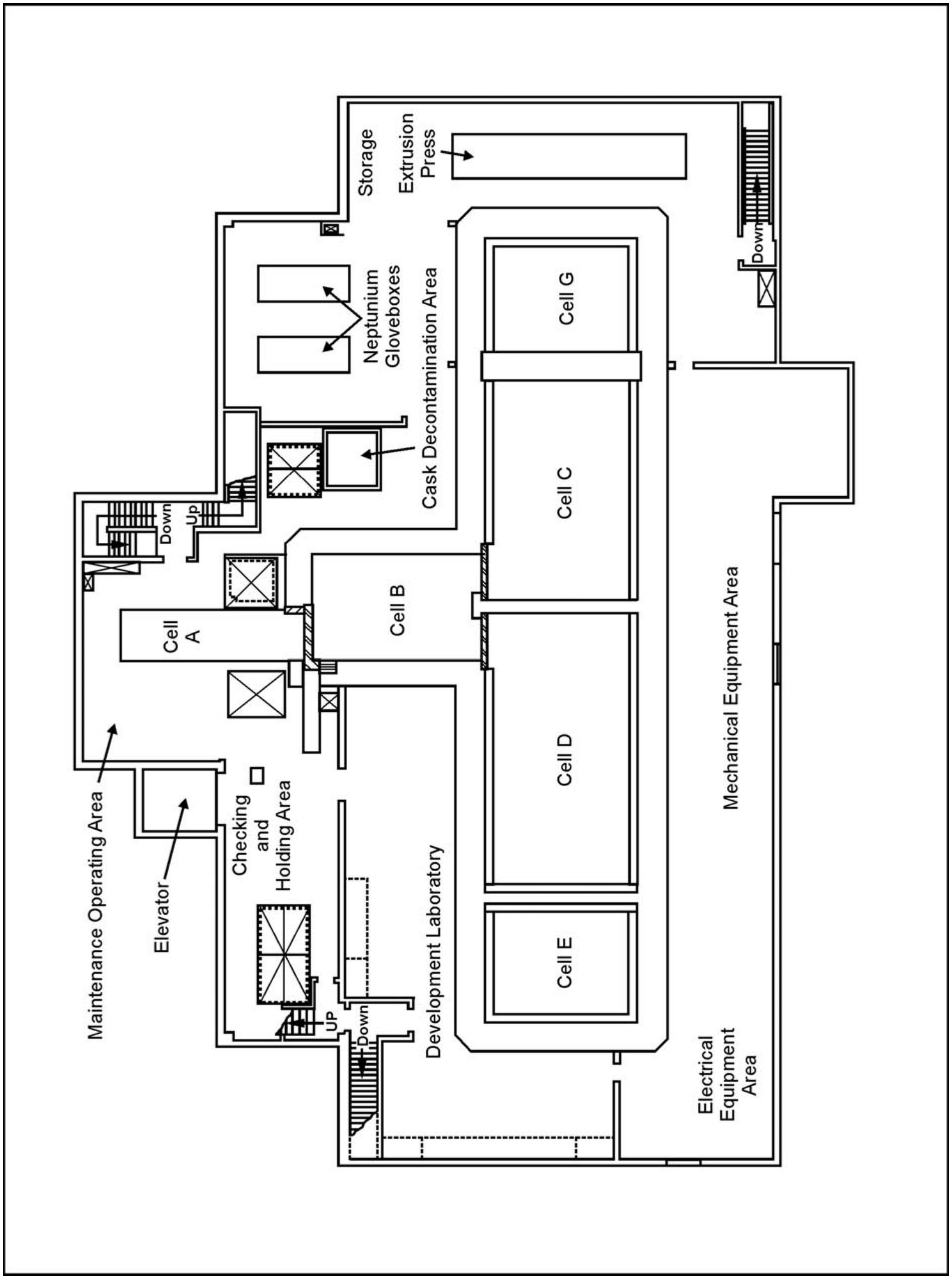

Figure S–9 Radiochemical Engineering Development Center Facility Layout

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.

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.
- 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.

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.

S.8.1.2 Advanced Test Reactor

ATR at INL is the reactor to be used for 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 S–10** 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).

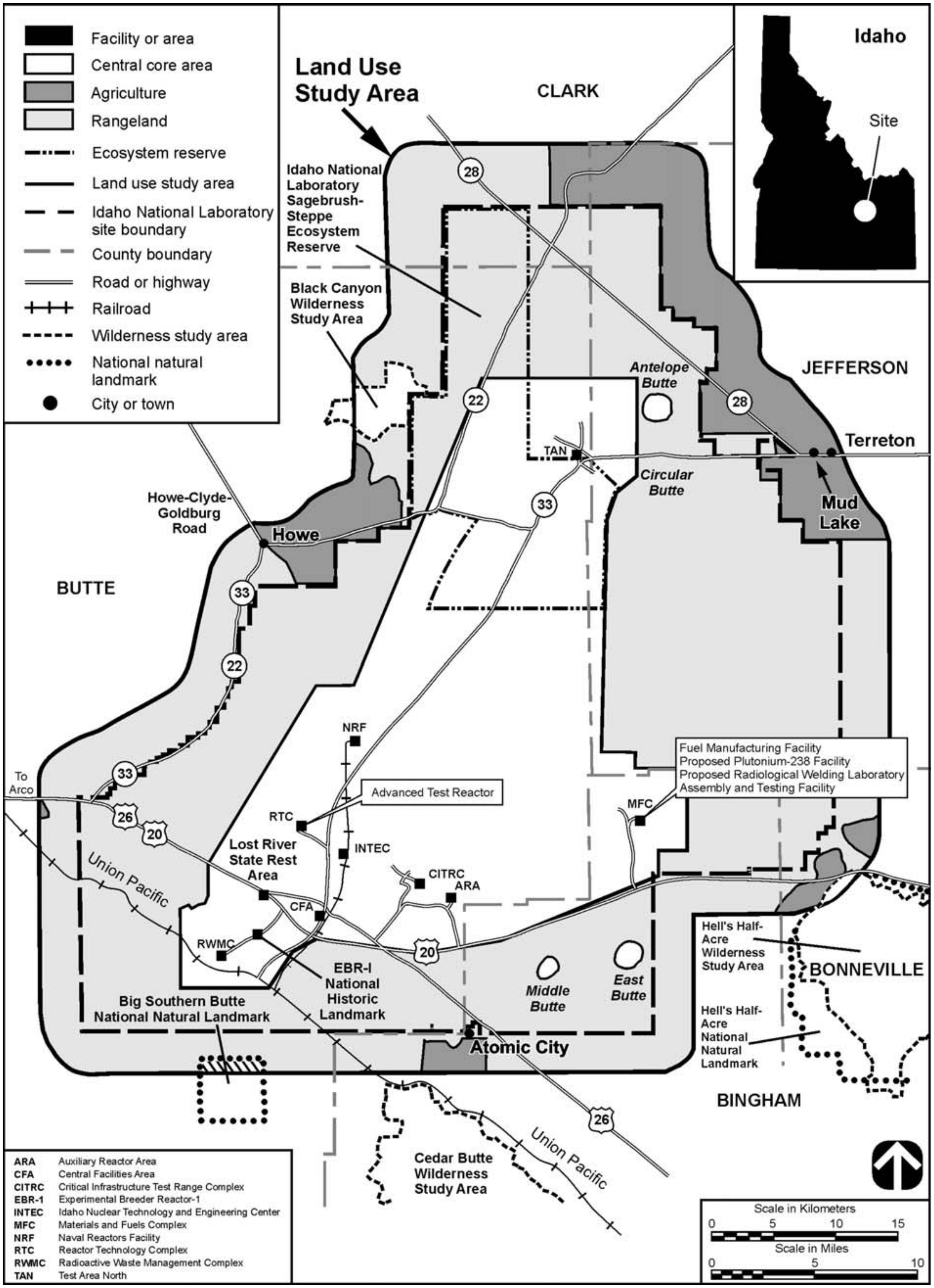

Figure S–10 Idaho National Laboratory Site

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.

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.

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.

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 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.

S.8.1.3 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-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 ORR. (See Figure S–8 for a map that depicts HFIR's location.)

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.

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). It is currently operating at a maximum authorized power level 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 will not change under any alternative for producing plutonium-238. Many experiment irradiation facilities were provided for in the original design, and several others have been added.

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.

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.

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.

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.

S.8.1.4 Plutonium Facility at 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 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 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 2 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.

All plutonium processing operations at the Plutonium Facility at TA-55 are performed in gloveboxes. For this work, the glovebox atmosphere for pellet fabrication 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.

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.

S.8.1.5 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 at INL (see **Figure S–11**) 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.

S.8.1.6 Assembly and Testing Facility

The Assembly and Testing 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 ZPPR and Building 784 and comprises Buildings 792 and 792A (see Figure S–11). 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.

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.

S.8.2 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, a Support Building, the Radiological Welding Laboratory, and a new road connecting the proposed new facilities at MFC to

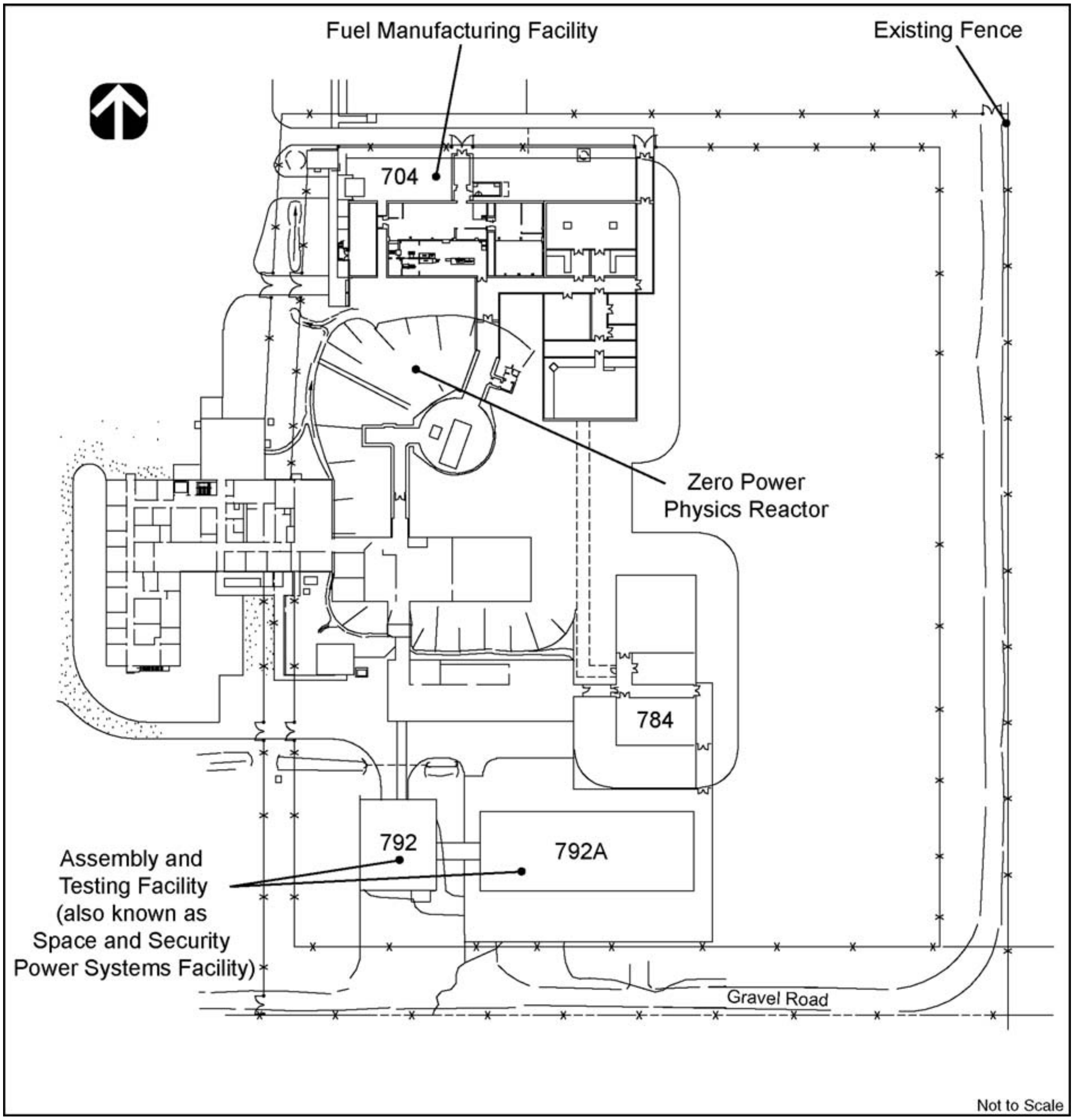

Figure S–11 Location of the Fuel Manufacturing Facility Within the Zero Power Physics Reactor Complex

the ATR at the RTC. **Figure S–12** presents the area at the MFC at INL where the new facilities would be located. The proposed new road and alternate new roads are discussed in Section S.8.2.4 and their locations are shown in Figure S–15.

The proposed new RPS nuclear production facilities are currently in the conceptual design stage and, as a result, are not described in detail in the *Consolidation 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 the *Consolidation EIS*.

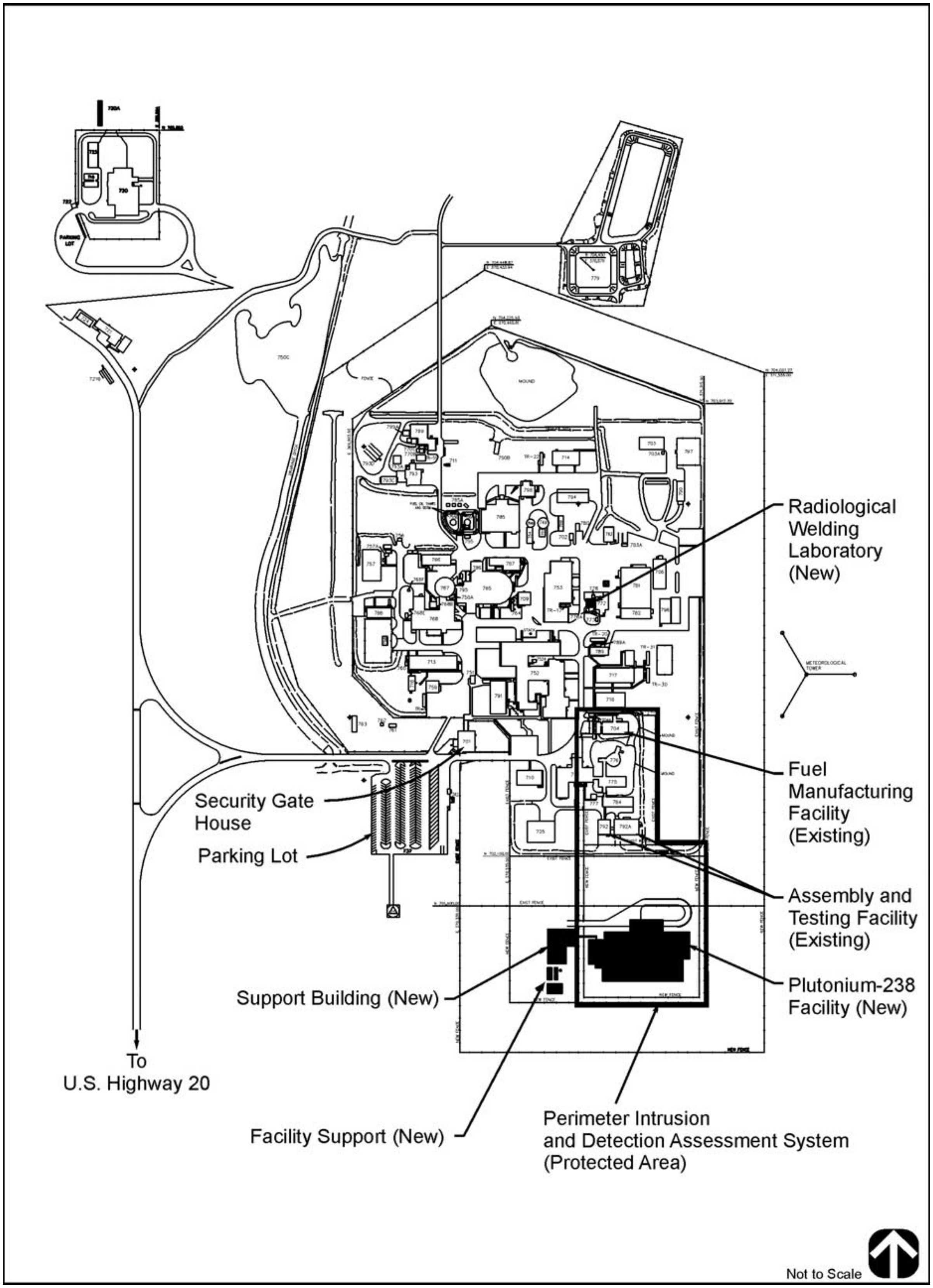

Figure S–12 Proposed Radioisotope Power Systems Consolidation Facilities at the Materials and Fuels Complex

S.8.2.1 Plutonium-238 Facility

One of the proposed new facilities to be constructed 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 S–13** shows the layout of this proposed new facility.

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 category, 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 for, 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).

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 successively 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.

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 hazard performance category because no nuclear material operations would take place there. 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).

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, ventilating, and air conditioning systems in each wing would be separate from one another to avoid mixing of air.

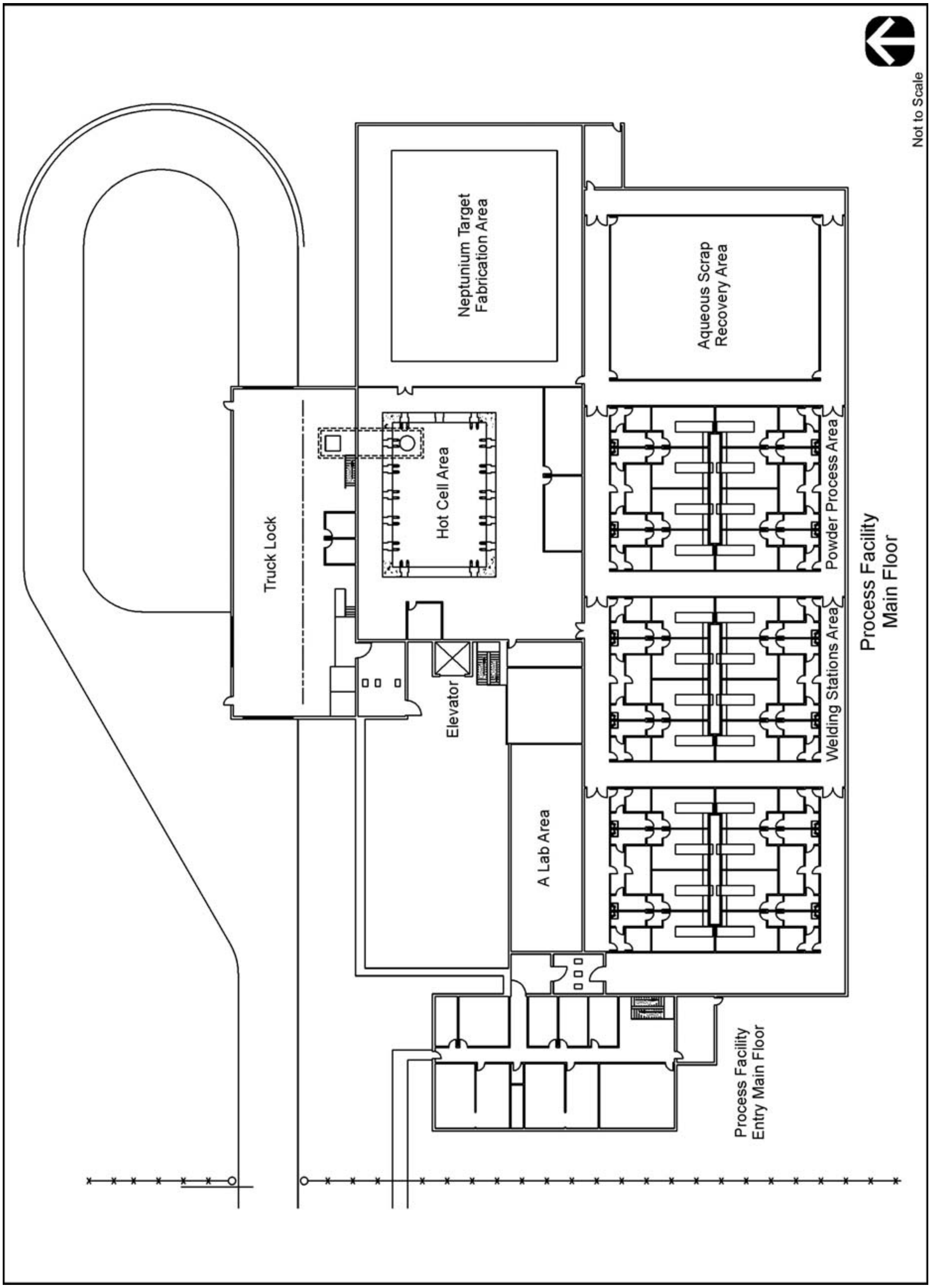

Figure S–13 Proposed New Plutonium-238 Facility at the Materials and Fuels Complex (Conceptual)

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 WIPP, 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.

S.8.2.2 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. This building would also 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.

S.8.2.3 Radiological Welding Laboratory

The proposed new Radiological Welding Laboratory would be used for weld 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 S–14**). 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).

S.8.2.4 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. **Figure S–15** presents these routes. The proposed new road at INL would be constructed between the Plutonium-238 Facility at the MFC and ATR at the RTC, as shown in Figure S–15. 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. 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.

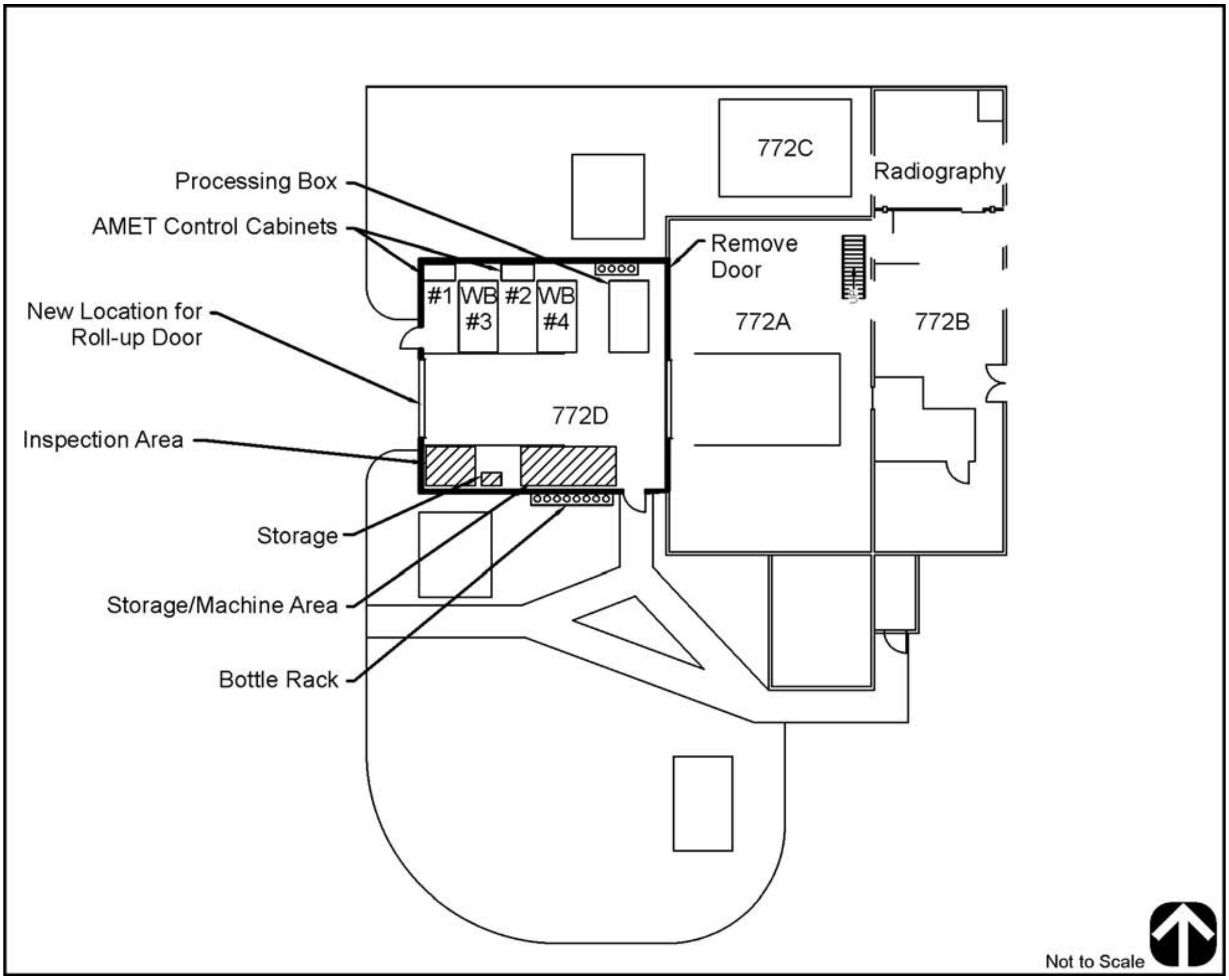

Figure S–14 Proposed New Radiological Welding Laboratory

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 in the EIS. Additional studies including 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. 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 to 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. This route would use an existing bridge crossing.

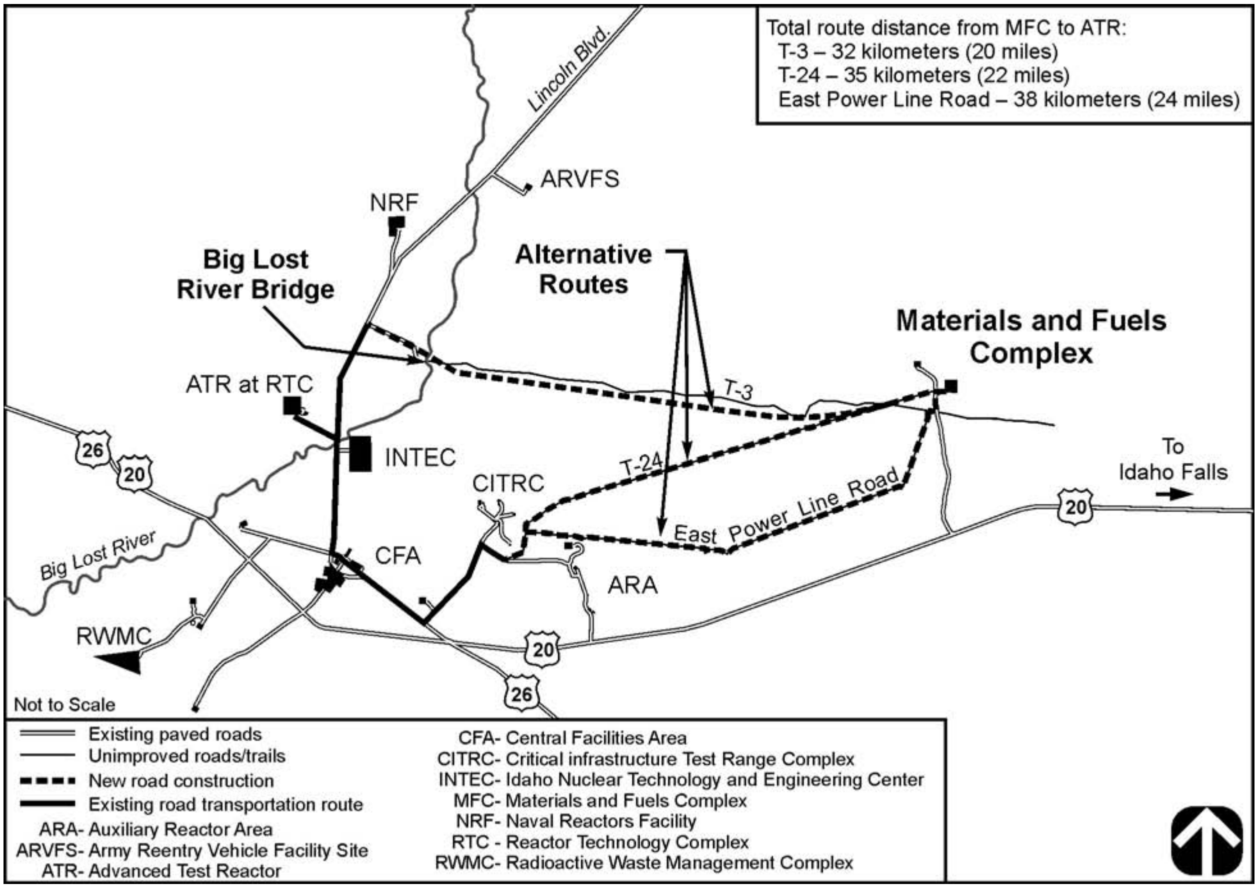

Figure S–15 New Road Alternative Routes

S.9 Affected Environment

S.9.1 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 S–16**). 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 located in Bingham, Jefferson, Bonneville, and Clark Counties. The site is roughly equidistant from Salt Lake City, Utah, and Boise, Idaho.

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).

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-level radioactive waste 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.

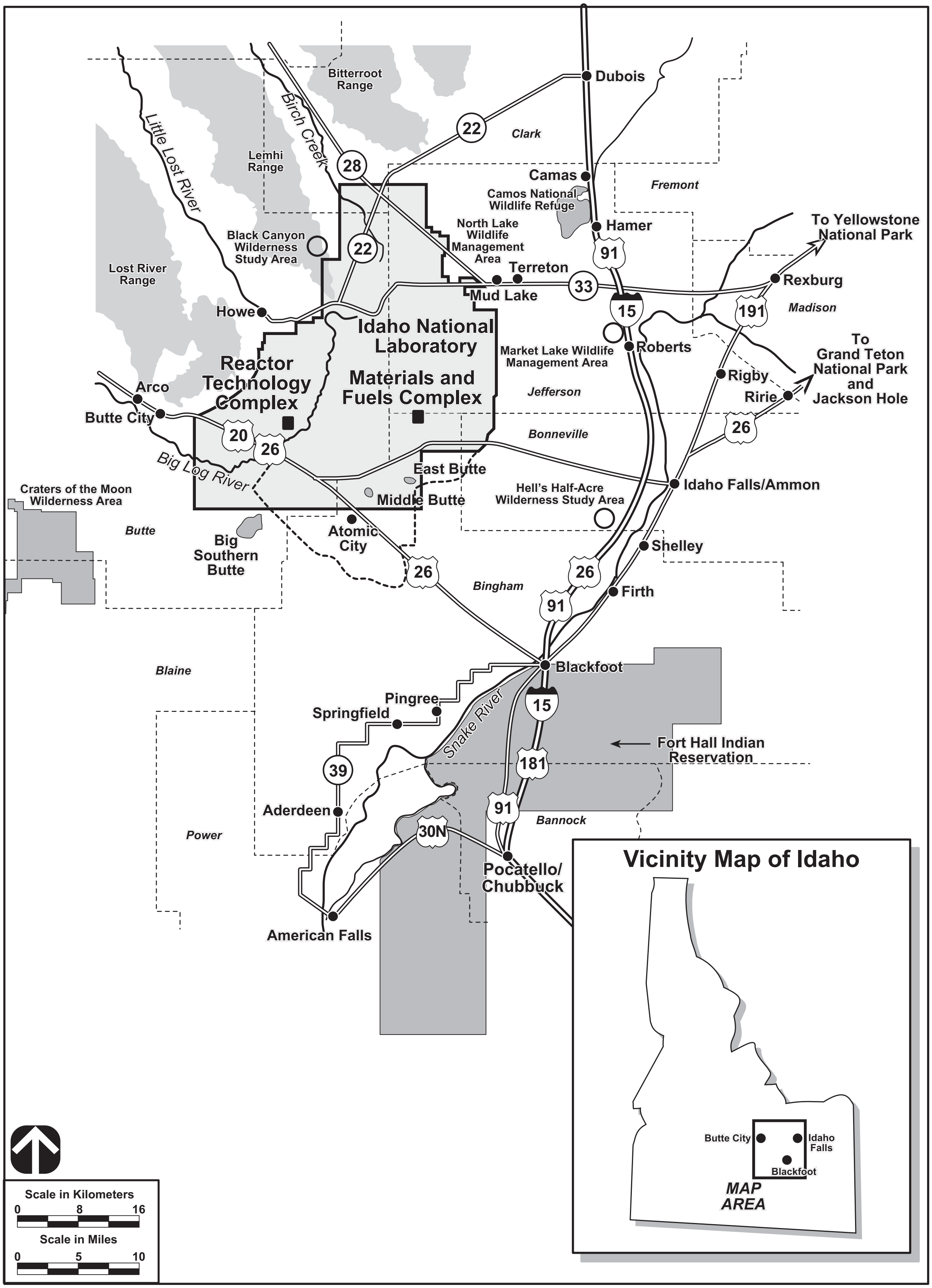

Figure S–16 Idaho National Laboratory Vicinity

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 at INL 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. 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 FMF, Assembly and Testing Facility, Transient Reactor Test Facility, Fuel Conditioning Facility, Hot Fuel Examination Facility, ZPPR, and EBR-II.

The RTC is located in the southwestern portion of INL. The Materials Test Reactor and Engineering Test Reactor (both shut down), the RTC Hot Cells, and 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.

S.9.2 Los Alamos National Laboratory

LANL is located on approximately 26,480 acres (10,716 hectares) of land in north central New Mexico (see **Figure S–17**). 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 not including Technical Area-0, which is comprised of leased space within the Los Alamos town site, with locations and spacing that reflect the site's historical development patterns, regional topography, and functional relationships. While the number of structures changes somewhat with time (e.g., as a result of the Cerro Grande Fire in 2000), there are 916 permanent structures, 512 temporary structures, and 1,362 miscellaneous buildings with approximately 538,800 square meters (5.8 million square feet) that could be occupied.

The Plutonium Facility at TA-55 at LANL is one of the facilities where RPS nuclear production infrastructure currently exists. 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.

S.9.3 Oak Ridge National Laboratory

ORNL is located within the ORR. ORR was established in 1943 as one of the three original Manhattan Project sites, and is located on 13,949 hectares (34,424 acres) in Oak Ridge, Tennessee. It includes ORNL, the Y-12 Plant (Y-12), and the East Tennessee Technology Park. 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 East Tennessee Technology Park is to maintain the infrastructure until decommissioning activities have been completed.

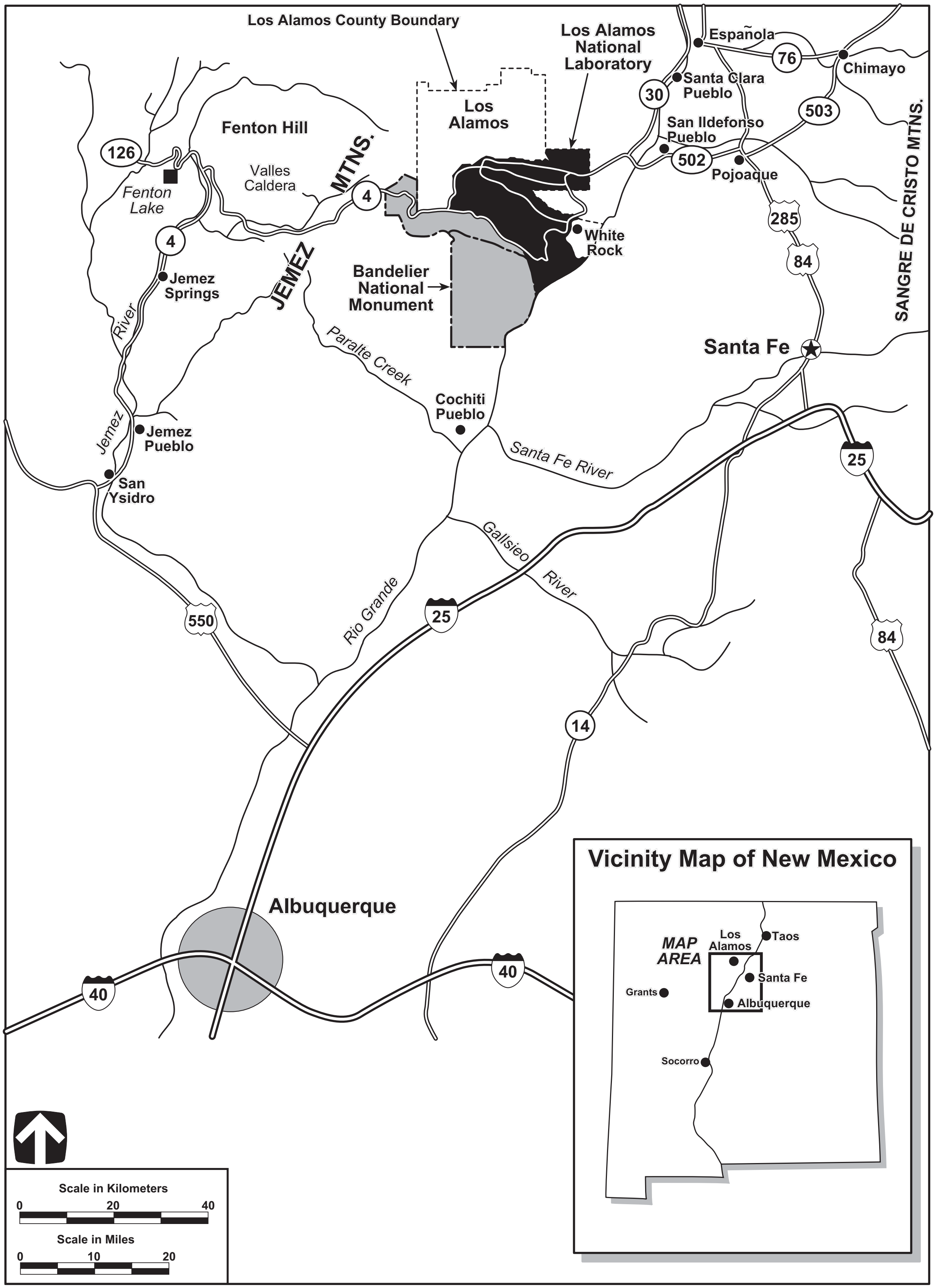

Figure S–17 Los Alamos National Laboratory Vicinity

ORNL is one of the locations where RPS nuclear production infrastructure is planned as described in the *NI PEIS* ROD. The REDC and HFIR, which could be used for RPS nuclear production, are both located within ORNL (see Figure S–8). 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.

S.10 Summary of Impacts

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 Summary and the potential environmental consequences presented in the *Consolidation EIS*. Because the potential environmental impacts associated with each of the alternatives can be described in terms of construction and operations impacts, the potential impacts are compared in those two areas. **Table S–3** provides quantitative information that supports the text in this section. Also provided in this section is a summary of potential transportation impacts; impacts common to all alternatives; cumulative impacts of implementing the proposed plutonium-238 consolidation alternatives, DOE and other agency actions in the region, and private actions; and potential mitigation measures.

S.10.1 Construction Impacts

No Action Alternative. Under the No Action Alternative, 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, 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 would not be expected to survive. Ground disturbance could be scheduled around 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.

Table S–3 Summary of Environmental Consequences of Alternatives

Resource	No Action Alternative INL	Consolidation Alternative INL	Consolidation with Bridge Alternative 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

Resource	No Action Alternative INL	Consolidation Alternative / Consolidation with Bridge Alternative INL
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 S–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.

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 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 on the health and safety of the public or facility workers. Waste generated during construction would be adequately managed by existing INL waste management infrastructure, including the use of offsite commercial waste management facilities.

Consolidation with Bridge Alternative. Under the Consolidation with Bridge Alternative, 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 those impacts.

S.10.2 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. For 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

Scientific Notation

Scientific notation is used in the *Consolidation EIS* to express numbers that are so large or so small that they can be difficult to read or write. Scientific notation is based on the use of positive and negative powers (or exponents) of 10. A number written in scientific notation is expressed as the product of a number between 1 and 10 times a positive or negative power of 10. Some positive and negative powers of 10 include:

Positive Powers of 10	Negative Powers of 10
$10^1 = 10 \times 1 = 10$	$10^{-1} = 1/10 = 0.1$
$10^2 = 10 \times 10 = 100$	$10^{-2} = 1/100 = 0.01$
and so on; therefore,	and so on; therefore,
10^6 = 1,000,000 (or 1 million), etc.	10^{-6} = 0.000001 (or 1 in 1 million), etc.

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 site alternatives, public radiation exposure would be small and well below regulatory limits and limits mandated by DOE Orders. For all sites, the maximally exposed individual (MEI) 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 operational 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 of 3.2×10^{-6} among the exposed population.

> **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).

Potential impacts of accidents were estimated using computer modeling. In the event of an accident involving operational activities, the projected excess population LCFs under the No Action Alternative would be 4.5×10^{-3}; under the Consolidation Alternative, 5.1×10^{-5}; and under the Consolidation with Bridge Alternative, 2.5×10^{-4}. Overall, the No Action Alternative would produce the highest potential accident impact, primarily because of 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.

> **Latent Cancer Fatalities (LCFs)**
>
> Deaths from cancer resulting from, and occurring sometime after, exposure to ionizing radiation or other carcinogens.

S.10.3 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 than those under the No Action Alternative for 5 years and would be the same as those 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.

S.10.4 Cumulative Impacts

In general, the following approach to cumulative impacts analysis was used:

1) The regions of influence (ROI) for impacts associated with projects in the *Consolidation EIS* were defined;
2) The affected environment and baseline conditions were identified;

3) Past, present, and reasonably foreseeable actions and the effects of those actions were identified; and
4) Aggregate (additive) effects of past, present, and reasonably foreseeable actions were assessed.

> **Region of Influence (ROI)**
>
> A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

As described above, cumulative impacts were assessed by combining the smallest and largest potential effects of *Consolidation EIS* 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 impacts air quality occur 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 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 Chapter 4 of the *Consolidation EIS*. 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 ORNL and ORR

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 maximally exposed individual 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 LANL

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 maximally exposed individual 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.

Waste Management Impacts—It is unlikely that there would be major impacts on waste management at LANL 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 LANL.

Cumulative Impacts at INL

The following resource areas have the potential for cumulative impacts at INL: land resources, site infrastructure (i.e., electricity and water use), geology and soils, air quality, ecological resources, cultural resources, socioeconomics, public health and safety, occupational health and safety, transportation, and waste management. Cumulative impacts for these INL resource areas are presented below.

Land Resources. 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 at 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 at INL would be consistent with current industrial land uses.

Site Infrastructure. *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. 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.

Geology and Soils. Construction of proposed new facilities and the new road would require the use of borrow materials such as gravel, silt, and clay. The estimated need for sand and gravel is 1,354,740 cubic meters (1,772,000 cubic yards). The estimated need for silt and clay material is 3,516,820 cubic meters (4,600,000 cubic yards) over a period of 10 years. Most of these resources would be obtained from the areas of INL set aside for the removal of borrow material (e.g., Ryegrass Flats, Spreading Areas A, and the Water Reactor Research Test Facility). 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.

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.

Air Quality. Air quality standards for carbon monoxide, nitrogen oxides, particulate matter, 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.

Ecological Resources. Cumulative impacts on the ecology of INL from habitat loss as a result of any alternative analyzed in the *Consolidation 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 from alternatives analyzed in the *Consolidation EIS*. Additional deposition resulting from any of the alternatives analyzed in the EIS are 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 ecology of INL and plant or animal populations as a result of any alternative analyzed in the *Consolidation EIS*.

Cultural Resources. 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 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 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 the *Consolidation EIS* to cumulative impacts on cultural and historic resources on INL or in southeastern Idaho is expected to be minimal.

Socioeconomics. 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 might 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. Future employment for RPS fabrication could 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 and approximately 8,100 workers in 2001, future changes in employment as a result of activities described in the *Consolidation EIS* would be within normal workforce fluctuations.

A maximum of 245 new employees could move into the area to support construction activities. These new arrivals would not strain the capacities of housing, community services, or the transportation network. Only 75 employees would be required for operation of the new facilities.

Public Health and Safety. 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.

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.

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 operation is estimated to be about one 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 the *Consolidation EIS*. The population exposed to the cumulative impact of both facilities would be minimal.

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 the *Consolidation 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.

Occupational Health and Safety. The maximum cumulative annual INL worker dose could total 390 to 422 person-rem, which could result in less than one (0.23 to 0.25) LCF. *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 (10 CFR 835) limit routine worker exposure to 5 rem per year and recommend a lower Administrative Control Level of 0.5 rem per year.

Transportation. The cumulative health effects to the transportation workers (truck or railcrew) and population over approximately 100 years of radioactive material and waste transport were analyzed. 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 the *Consolidation EIS* in the 2040s. Cumulative transportation impacts are predicted to result in approximately 180 worker (truck crews) 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 or public LCFs and a very small number (less than one) of traffic fatalities and, therefore, would not contribute substantially to cumulative impacts.

Facilities that involve the shipment of radioactive materials were surveyed for 1971 through 1993 using accident data from the U.S. Department of Transportation, U.S. Nuclear Regulatory Commission, 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. For perspective, it may be noted that several million traffic fatalities from all causes are expected nationwide during the period from 1943 to 2047.

Waste Management. 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 be a small percentage of the total waste 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 transuranic 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 lifecycles evaluated in this cumulative impacts analysis.

S.10.5 Mitigation Measures

DOE has identified mitigation measures that could be taken to avoid or reduce environmental impacts resulting from implementation of the *Consolidation EIS* alternatives. As specified in CEQ 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; and
- 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 road. 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.

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.

If needed, following completion of the *Consolidation EIS* and its associated ROD, DOE would prepare a mitigation action plan that addresses mitigation commitments expressed in the ROD. The mitigation action plan would explain how certain measures would be planned, implemented, and monitored to mitigate these commitments. A mitigation action plan would be prepared before DOE would undertake any activities that would require mitigation.

S.10.6 Key Environmental Findings

Based on the analyses completed for the *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.

S.11 Preferred Alternative

CEQ regulations require an agency to identify its Preferred Alternative(s), if one or more exists, in a 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.

S.12 Guide to the Contents of the *Consolidation EIS*

The *Consolidation EIS* is presented in one volume with a Summary available separately. The 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.

S.13 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.

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.

Advanced Test Reactor (ATR)—A light-water-cooled and moderated test reactor located within the Reactor Technology Complex of 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.

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.

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.

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.

barrier—Any material or structure that prevents or substantially delays movement of pollutants or materials containing radionuclides toward the accessible environment.

baseline—The existing environmental conditions against which impacts of the Proposed Action and its alternatives can be compared. For the *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.

bedrock—The solid rock that lies beneath soil and other loose surface materials.

beryllium—An extremely light-weight element with the atomic number 4. It is metallic and is used in reactors as a neutron reflector.

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.

carbon monoxide—A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

cell—See hot cell.

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.

***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 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 sieverts.

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.

coolant—A substance, either gas or liquid, circulated though 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.

criticality—The condition in which a system is capable of sustaining a 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).

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).

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").

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.

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.

emission—A material discharged into the atmosphere from a source operation or activity.

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 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 on the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting 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 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 (NEPA) regulations in 40 CFR 1500–1508 and the 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.

fission products—Nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.

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.

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 FDPF 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.)

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.

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.

groundwater—Water below the ground surface in a zone of saturation.

habitat—The environment occupied by individuals of a particular species, population, or community.

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 Section 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 Flux Isotope Reactor (HFIR)—A light-water-cooled and moderated test reactor located at Oak Ridge National Laboratory in the Oak Ridge Reservation. HFIR is fueled with enriched uranium-235 and has an authorized full-power level of 85 million watts.

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-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.

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 enriched uranium and 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.

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 Idaho National Engineering and Environmental Laboratory) 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.

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.

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).

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.

latent cancer fatalities (LCFs)—Deaths from cancer occurring some time after, and postulated to be due to, exposure to ionizing radiation or other carcinogens.

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.

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.

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 (i.e., 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.

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.

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) 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 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 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.

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 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 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—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.

offsite—The term denotes a location, facility, or activity occurring outside of the site boundary.

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.

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.

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 (LANL) 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 (INL). 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.

process—Any method or technique designed to change the physical or chemical character of the product.

rad—See radiation absorbed dose.

radiation (ionizing)—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.

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.

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 reasons why they were not.

Region of Influence (ROI)—A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

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.

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.

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.

sand—Loose grains of rock or mineral sediment formed by weathering that range in size from 0.0625 to 2.0 millimeters (0.0625 to 0.08 inches) in diameter, and often consists of quartz particles.

sanitary waste—Waste 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.

seismic—Pertaining to any Earth vibration, especially an earthquake.

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.

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.

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.

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.

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.

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.

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 Part 424). (See endangered species.)

total effective dose equivalent—The sum of the effective dose equivalent from external exposures and the committed effective dose equivalent from internal exposures.

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 (3,700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years.

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, low-enriched uranium, and depleted uranium.)

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.

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.