US Exhibit 5

Final Surplus Plutonium SEIS

DOE/EIS-0283-S2
April 2015

Final

Surplus Plutonium Disposition Supplemental Environmental Impact Statement

Summary

U.S. Department of Energy
Office of Material Management and Minimization
and
Office of Environmental Management
Washington, DC

AVAILABILITY OF THE
FINAL SURPLUS PLUTONIUM DISPOSITION
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
(SPD Supplemental EIS)

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COVER SHEET[1]

Lead Agency: U.S. Department of Energy (DOE) / National Nuclear Security Administration (NNSA)

Cooperating Agency: Tennessee Valley Authority (TVA)

Title: *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* (DOE/EIS-0283-S2)

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

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

In this *SPD Supplemental EIS*, DOE describes the environmental impacts of alternatives for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned, including 7.1 metric tons (7.8 tons) of plutonium from pits that were declared excess to national defense needs after publication of the 2007 NOI, and 6 metric tons (6.6 tons) of surplus non-pit plutonium. The analyses also encompass potential use of MOX fuel in reactors at the Sequoyah and Browns Ferry Nuclear Plants of TVA, and at generic reactors.

In this *SPD Supplemental EIS*, DOE evaluates the No Action Alternative and four action alternatives for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium: (1) Immobilization to DWPF Alternative –

[1] *Vertical change bars in the margins of this Final Summary indicate revisions and new information added since the Draft Summary was issued in July 2012. Editorial changes are not marked.*

glass can-in-canister immobilization for both surplus non-pit and disassembled and converted pit plutonium and subsequent filling of the canister with high-level radioactive waste (HLW) at DWPF; (2) MOX Fuel Alternative – fabrication of the disassembled and converted pit plutonium and much of the non-pit plutonium into MOX fuel at MFFF for use in domestic commercial nuclear power reactors to generate electricity, as well as potential disposition of the surplus non-pit plutonium that is not suitable for MFFF as contact-handled transuranic (CH-TRU) waste at the Waste Isolation Pilot Plant (WIPP); (3) H-Canyon/HB-Line to DWPF Alternative – processing the surplus non-pit plutonium in H-Canyon/HB-Line and subsequent vitrification with HLW (in DWPF) and fabrication of the pit plutonium into MOX fuel at MFFF; and (4) WIPP Alternative – preparing for potential disposal as CH-TRU waste at WIPP the surplus non-pit and disassembled and converted pit plutonium in H-Canyon/HB-Line and the K-Area Complex at SRS, or preparing the surplus non-pit plutonium in H-Canyon/HB-Line and the K-Area Complex at SRS and preparing the surplus disassembled and converted pit plutonium in Technical Area 55 (TA-55) facilities at Los Alamos National Laboratory (LANL). Under all alternatives, DOE would also disposition as MOX fuel 34 metric tons (37.5 tons) of surplus plutonium in accordance with previous decisions. The 34 metric tons (37.5 tons) of plutonium would be fabricated into MOX fuel at MFFF for use at domestic commercial nuclear power reactors. Within each action alternative, DOE also evaluates options for pit disassembly and conversion of plutonium metal to an oxide form for disposition. Under three of the options, DOE would not build a stand-alone Pit Disassembly and Conversion Facility at F-Area at SRS, which DOE had previously decided to construct (65 FR 1608).

Preferred Alternative: DOE has no Preferred Alternative at this time for the disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium that is the subject of this *SPD Supplemental EIS*. Also, DOE has no Preferred Alternative regarding the sites or facilities to be used to prepare surplus plutonium metal for disposition (i.e., pit disassembly and conversion capability). Consistent with the requirements of NEPA, once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a preference.

This *SPD Supplemental EIS* evaluates disposition alternatives that include irradiation of MOX fuel in TVA reactors, subject to appropriate amendments to the applicable licenses from the U.S. Nuclear Regulatory Commission. TVA is a cooperating agency for this *SPD Supplemental EIS* and, as such, is not required to declare a preferred alternative. TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.

Public Comments: In preparing this *Final SPD Supplemental EIS*, DOE considered comments received during the three scoping periods (2007, 2010, 2012), during the public comment period on the *Draft SPD Supplemental EIS* (July 27 through October 10, 2012), and late comments received after the close of the public comment period. Public hearings on the *Draft SPD Supplemental EIS* were held in Tanner, Alabama; Chattanooga, Tennessee; North Augusta, South Carolina; and Carlsbad, Española, Los Alamos, and Santa Fe, New Mexico. DOE considered every comment received at the public hearings and by U.S. mail, email, and toll-free phone and fax lines during preparation of this *Final SPD Supplemental EIS*.

This *Final SPD Supplemental EIS* contains revisions and new information based in part on comments received on the *Draft SPD Supplemental EIS*. Volume 3 contains the comments received on the *Draft SPD Supplemental EIS* and DOE's responses to the comments. DOE will use the analysis presented in this *SPD Supplemental EIS*, as well as other information, in preparing a Record of Decision regarding the Surplus Plutonium Disposition Program. Consistent with the requirements of NEPA, once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a preference. TVA, as a cooperating agency, may adopt this *Final SPD Supplemental EIS* after independently reviewing the environmental impact statement and determining that its comments and suggestions have been satisfied.

Note: A Foreword was added to the *Final SPD Supplemental EIS*. The Foreword describes two ongoing activities that may affect the implementation of the proposed action in this *SPD Supplemental EIS*. These activities are: (1) DOE's reassessment of surplus plutonium disposition strategies; and (2) DOE's recovery effort at WIPP following two February 2014 incidents at the facility.

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FOREWORD

This *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* has been prepared to evaluate the potential environmental impacts from disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition pathway is not yet assigned. This *SPD Supplemental EIS* is being issued in parallel with two ongoing U.S. Department of Energy (DOE) activities that may affect the implementation of the proposed action in this *SPD Supplemental EIS*. These activities are: (1) DOE's reassessment of surplus plutonium disposition strategies; and (2) DOE's recovery effort at the DOE Waste Isolation Pilot Plant (WIPP) following two February 2014 incidents at the facility near Carlsbad, New Mexico. DOE issued the *Draft SPD Supplemental EIS* in July 2012; issuing the *Final SPD Supplemental EIS* at this time enables DOE to complete the evaluation of the environmental impacts of the disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium while neither prejudging nor impacting a separate ongoing DOE analysis of potential plutonium disposition strategies (see below).

Evolution of DOE's National Environmental Policy Act Decisions for Surplus Plutonium Disposition. DOE has pursued a program for safe storage and disposition of surplus weapons-grade plutonium since the mid-1990s. In 1996, DOE issued the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition PEIS)* (DOE 1996), which considered a comprehensive range of 37 programmatic alternatives and subalternatives for disposition of plutonium surplus to the Nation's defense needs. DOE decided to pursue a combination of disposition approaches, including fabrication of surplus plutonium into mixed oxide (MOX) fuel for irradiation in domestic commercial nuclear reactors (62 *Federal Register* [FR] 3014). Tiering from the *Storage and Disposition PEIS*, DOE issued the *Surplus Plutonium Disposition Environmental Impact Statement (SPD EIS)* in 1999 (DOE 1999). Subsequent to the analyses in the *SPD EIS* and other documents, DOE decided to disposition 34 metric tons (37.5 tons) of surplus plutonium by fabricating it into MOX fuel in a MOX Fuel Fabrication Facility (MFFF) to be constructed at the Savannah River Site (SRS), followed by use of the MOX fuel in domestic commercial nuclear power reactors. DOE also decided to construct and operate a stand-alone Pit Disassembly and Conversion Facility (PDCF) at SRS to prepare surplus plutonium for the MFFF (65 FR 1608 and 68 FR 20134). DOE began construction of MFFF in August 2007. In addition, the *Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated As No Longer Required for Defense Purposes and Related Cooperation* (PMDA) that entered into force in 2011 calls for the United States and the Russian Federation to each dispose of at least 34 metric tons (37.5 tons) of weapons-grade plutonium, by fabricating it into MOX fuel or any other method as may be agreed to by the Parties in writing.

The purpose of this *SPD Supplemental EIS* is to evaluate the environmental impacts from alternatives for safe and timely disposition of approximately 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition pathway is not yet assigned, not to reconsider DOE's previous decisions about pursuing the MOX fuel approach for 34 metric tons (37.5 tons) of weapons-grade plutonium. The alternatives addressed in this *SPD Supplemental EIS* for the 13.1 metric tons (14.4 tons) of surplus plutonium are the No Action Alternative and action alternatives that entail combinations of one or more of the following disposition technologies: glass can-in-canister immobilization and subsequent filling of the canister with high-level radioactive waste (HLW) at the Defense Waste Processing Facility (DWPF), fabrication into MOX fuel followed by irradiation in domestic commercial nuclear power reactors, combination with HLW and subsequent vitrification at DWPF, and preparation as contact-handled transuranic waste for potential disposal at WIPP. In this *SPD Supplemental EIS*, DOE also evaluates options for pit disassembly and conversion in addition to a new stand-alone PDCF.

Evaluation of Alternative Surplus Plutonium Disposition Strategies. In April 2014, DOE's Plutonium Disposition Working Group issued its report, *Analysis of Surplus Weapon-Grade Plutonium Disposition Options* (DOE 2014), which assesses options that could potentially provide a more cost-effective approach for disposition of surplus U.S. weapons-grade plutonium and provides the foundation for further analysis and independent validation. The primary options assessed were irradiation as MOX fuel in light water reactors (i.e., domestic commercial nuclear power reactors), irradiation in fast reactors, immobilization with HLW, downblending and disposal, and deep borehole disposal. Variations on the assessed options were also considered. For each option, the Working Group assessed costs; compliance with international agreements; the time required to disposition 34 metric tons (37.5 tons) of surplus plutonium; technical viability; and legal, regulatory, and other issues. Completion of this *Final SPD Supplemental EIS* is independent of DOE's ongoing assessment of potential plutonium disposition strategies identified by the Plutonium Disposition Working Group.

February 2014 Incidents at WIPP. DOE has suspended operations at WIPP following two events that occurred in February 2014. On February 5, an underground salt haul truck caught fire, leading to the evacuation of all underground workers. Several workers were treated for smoke inhalation, but no other injuries were sustained as a result of this incident. The fire was extinguished and the underground operations at WIPP were suspended. On February 14, the WIPP facility experienced a second event unrelated to the fire, when a continuous air monitor (CAM) within the mine alarmed, indicating the presence of airborne radioactive material.

DOE has suspended waste disposal operations at WIPP and has implemented a recovery plan comprising several steps and processes to be completed before WIPP returns to operations. Detailed information on the status of recovery activities can be found at http://www.wipp.energy.gov/wipprecovery/recovery.html. Pending the return of WIPP to operations, transuranic waste generated by DOE activities is being safely stored at DOE or commercial sites.

Potential Decisions Supported by this *SPD Supplemental EIS*. In light of the circumstances described above, DOE is not in a position to make decisions on the issues presented in this *SPD Supplemental EIS* in the short term. On the other hand, DOE wishes to be able to move forward as rapidly as possible once issues concerning the availability of WIPP and the future of the MFFF are clarified. By completing this *SPD Supplemental EIS*, DOE will be in the best position to take actions to remove surplus plutonium from the State of South Carolina, and to disposition 13.1 metric tons (14.4 tons) of weapon-usable plutonium. For example, after the path for resumption of operations at WIPP is clarified, it would be possible for DOE to issue a Record of Decision for potential disposal at WIPP of certain surplus plutonium currently at SRS because the environmental implications of taking this step have already been analyzed in this *SPD Supplemental EIS*.

DOE has no Preferred Alternative at this time. Consistent with the requirements of the National Environmental Policy Act (NEPA), once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a Preferred Alternative.

References

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

DOE (U.S. Department of Energy), 1999, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, Office of Fissile Materials Disposition, Washington, DC, November.

DOE (U.S. Department of Energy), 2014, *Report of the Plutonium Disposition Working Group: Analysis of Surplus Weapon-Grade Plutonium Disposition Options*, Washington, DC, April.

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
ARIES	Advanced Recovery and Integrated Extraction System
BWR	boiling water reactor
CAM	continuous air monitor
CCO	criticality control overpack
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CH-TRU	contact-handled transuranic
CRD	Comment Response Document
DOE	U.S. Department of Energy
DNFSB	Defense Nuclear Facilities Safety Board
DWPF	Defense Waste Processing Facility
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
FR	*Federal Register*
HC/HBL	H-Canyon/HB-Line
HLW	high-level radioactive waste
ISFSI	Independent Spent Fuel Storage Installation
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LEU	low-enriched uranium
LLW	low-level radioactive waste
LTA	lead test assembly
MEI	maximally exposed individual
MFFF	Mixed Oxide Fuel Fabrication Facility
MLLW	mixed low-level radioactive waste
MOX	mixed oxide
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NOI	Notice of Intent
NRC	U.S. Nuclear Regulatory Commission
Pantex	Pantex Plant
PDC	Pit Disassembly and Conversion Project
PDCF	Pit Disassembly and Conversion Facility
PF-4	Plutonium Facility
PM	particulate matter

PMDA	*Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated As No Longer Required for Defense Purposes and Related Cooperation*
POC	pipe overpack container
PWR	pressurized water reactor
ROD	Record of Decision
ROI	region of influence
SRS	Savannah River Site
TA	Technical Area
TRU	transuranic
TRUPACT-II	Transuranic Package Transporter Model 2
TVA	Tennessee Valley Authority
WIPP	Waste Isolation Pilot 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	16,018.5	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Radiation					
Sieverts	100	Rem	Rem	0.01	Sieverts
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2,118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.7854	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1,233.49	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

S.1 Introduction

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

On March 28, 2007, DOE published a Notice of Intent (NOI) in the *Federal Register* (FR) (72 FR 14543) to prepare this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)*[4] to evaluate the potential environmental impacts at the Savannah River Site (SRS) of alternative disposition pathways for surplus plutonium originally planned for immobilization as announced in the Record of Decision (ROD) (65 FR 1508) for the *Surplus Plutonium Disposition Environmental Impact Statement (SPD EIS)* (DOE 1999).[5] The proposed actions and alternatives included construction and operation of a new vitrification capability in K-Area, processing in H-Canyon/HB-Line and the Defense Waste Processing Facility (DWPF), and fabricating mixed oxide (MOX) fuel in the Mixed Oxide Fuel Fabrication Facility (MFFF) currently under construction in F-Area at SRS.

> **Weapons-usable plutonium** is plutonium in forms that can be readily converted for use in nuclear weapons. Weapons-grade plutonium, as well as some forms of fuel-grade, and power-reactor-grade plutonium can be considered weapons-usable plutonium.
>
> **Surplus plutonium** has no identified programmatic use and does not fall into one of the categories of national security reserves.

On July 19, 2010, DOE issued an amended NOI (75 FR 41850) announcing its intent to modify the scope of this *SPD Supplemental EIS* and to conduct additional public scoping. Under the revised scope, DOE would refine the quantity and types of surplus plutonium, evaluate additional alternatives, and no longer consider in detail one of the alternatives identified in the 2007 NOI (72 FR 14543) (i.e., ceramic can-in-canister immobilization). In addition, DOE had identified in the 2007 NOI a glass can-in-canister immobilization approach as its Preferred Alternative for the non-pit plutonium then under consideration; the 2010 amended NOI explained that DOE would evaluate a glass can-in-canister immobilization alternative in this *SPD Supplemental EIS*, but that DOE did not have a preferred alternative.

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[1] *On September 1, 2000, the* Agreement Between the Government of the United States and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation *(referred to as "the PMDA") (USA and Russia 2000) was signed. The PMDA (and its 2010 Protocol) calls for each country to dispose of at least 34 metric tons (37.5 tons) of excess weapons-grade plutonium by fabrication into MOX fuel and irradiation in reactors in each country or by any other method as may be agreed to by the Parties in writing.*

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

[3] *Non-pit plutonium may exist in metal or oxide form and may be combined with other materials that were used in the process of manufacturing plutonium for use in nuclear weapon or related research and development activities.*

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

[5] *Vertical change bars in the margins of this Final Summary indicate revisions and new information added since the Draft Summary was issued in July 2012. Editorial changes are not marked.*

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

This *SPD Supplemental EIS* updates the previous DOE National Environmental Policy Act (NEPA) analyses (described in Appendix A, Section A.1, of this *SPD Supplemental EIS*) to evaluate alternatives for the disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned. This *SPD Supplemental EIS* also considers options for pit disassembly and conversion of plutonium metal to oxide. It also analyzes the use of fuel fabricated from surplus plutonium in Tennessee Valley Authority (TVA) reactors and other domestic commercial nuclear power reactors to generate electricity.

S.2 Purpose and Need for Agency Action

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

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

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

S.3 Proposed Action

DOE proposes to disposition 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned; to provide the appropriate capability to disassemble surplus pits and convert surplus plutonium to a form suitable for disposition; and to provide for the use of MOX fuel in TVA's and other domestic commercial nuclear power reactors.

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

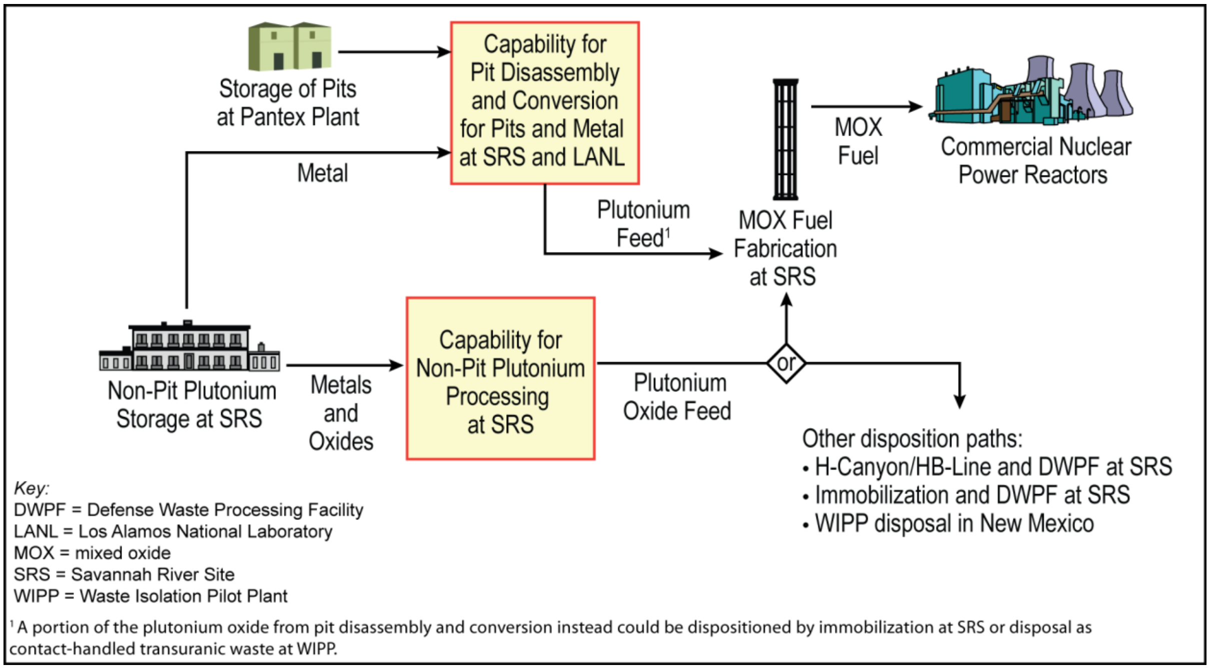


Figure S–1 Surplus Plutonium Disposition Program Activities

S.4 Disposition Paths Identified for Surplus Plutonium

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

Plutonium with Identified Disposition Paths

Figure S–7 summarizes the various plutonium disposition paths decided to date for 45.3 metric tons (49.9 tons) of surplus plutonium.

In the 2000 *SPD EIS* ROD (65 FR 1608) and 2003 amended ROD (68 FR 20134), DOE decided to fabricate 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at MFFF, which is being constructed at SRS. DOE's prior decisions with respect to the disposition path for the 34 metric tons (37.5 tons) of surplus plutonium are not addressed in this *SPD Supplemental EIS*. In 2012, DOE issued an interim action determination relative to this *SPD Supplemental EIS* to prepare 2.4 metric tons (2.6 tons) of plutonium metal and oxide as feed material for MFFF using H-Canyon/HB-Line (DOE 2012a). This material is a subset of the 6.5 metric tons (7.2 tons) of non-pit metal and oxides that DOE decided to prepare as MOX fuel in 2003 (68 FR 20134).

Seven metric tons (7.7 tons) of surplus plutonium are contained in used fuel (also known as spent fuel) and are, therefore, already in a proliferation-resistant form. Following appropriate NEPA analyses as described in Appendix A, Section A.1, of this *SPD Supplemental EIS*, DOE has already disposed of 3.2 metric tons (3.5 tons) of surplus plutonium scrap and residues at WIPP as transuranic (TRU) waste. In 2008 and 2009, DOE completed interim action determinations and concluded that 0.6 metric tons (0.66 tons) of surplus non-pit plutonium could be disposed of through H-Canyon/HB-Line and DWPF (DOE 2008a, 2009); in 2011, DOE amended this determination to add WIPP as a disposal alternative for about 85 kilograms (187 pounds) of these 0.6 metric tons (0.66 tons) (DOE 2011a). Also in 2011, DOE decided to use H-Canyon/HB-Line to prepare another 0.5 metric tons (0.55 tons) of surplus plutonium for disposal at WIPP (DOE 2011b); DOE amended this determination in 2013 to also allow preparation in the K-Area Complex (DOE 2013c). Thus, DOE has determined that a total of 1.1 metric tons (1.2 tons) of surplus plutonium could be dispositioned through H-Canyon/HB-Line and the K-Area Complex to DWPF and WIPP.

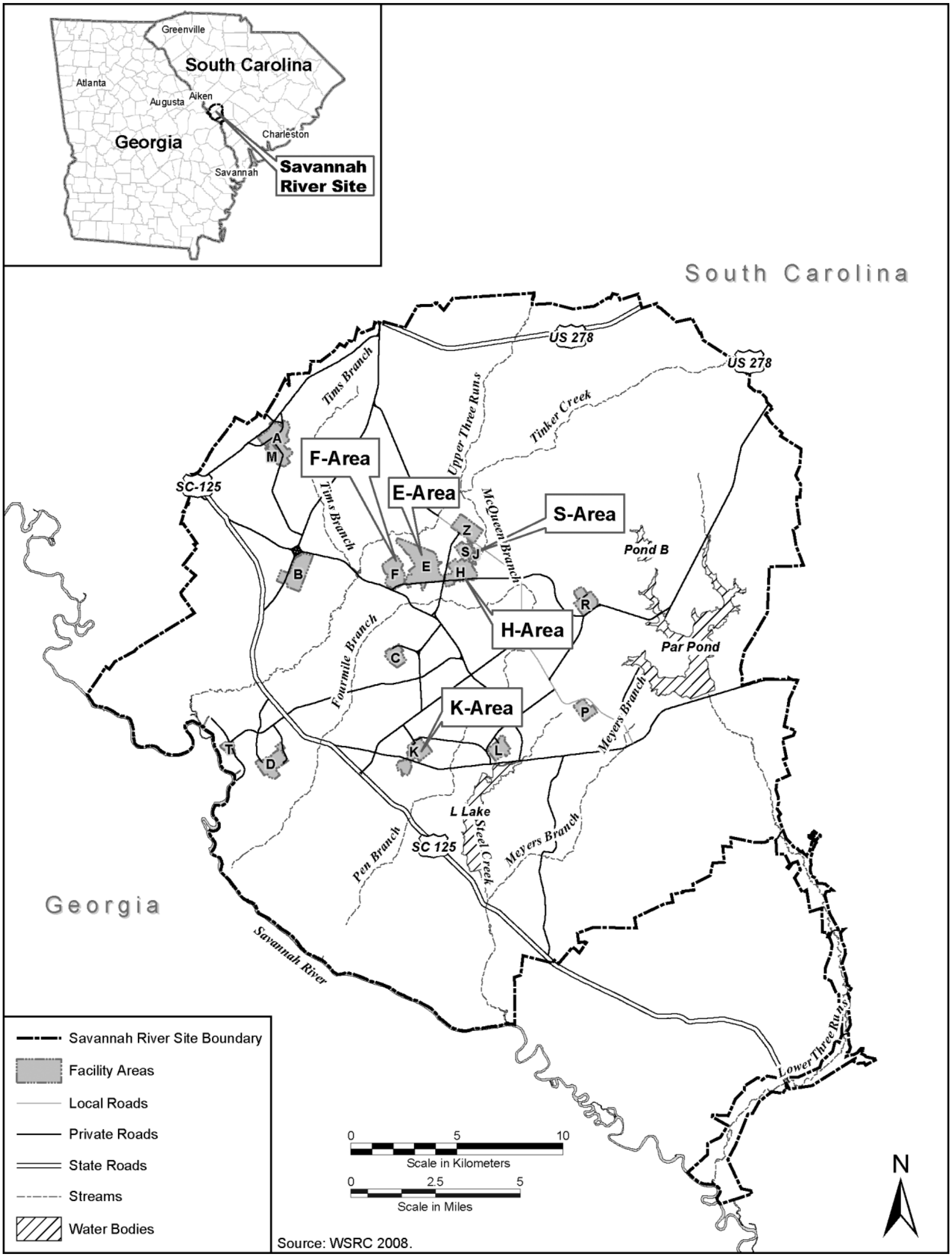


Figure S–2 Savannah River Site Location and Operations Areas

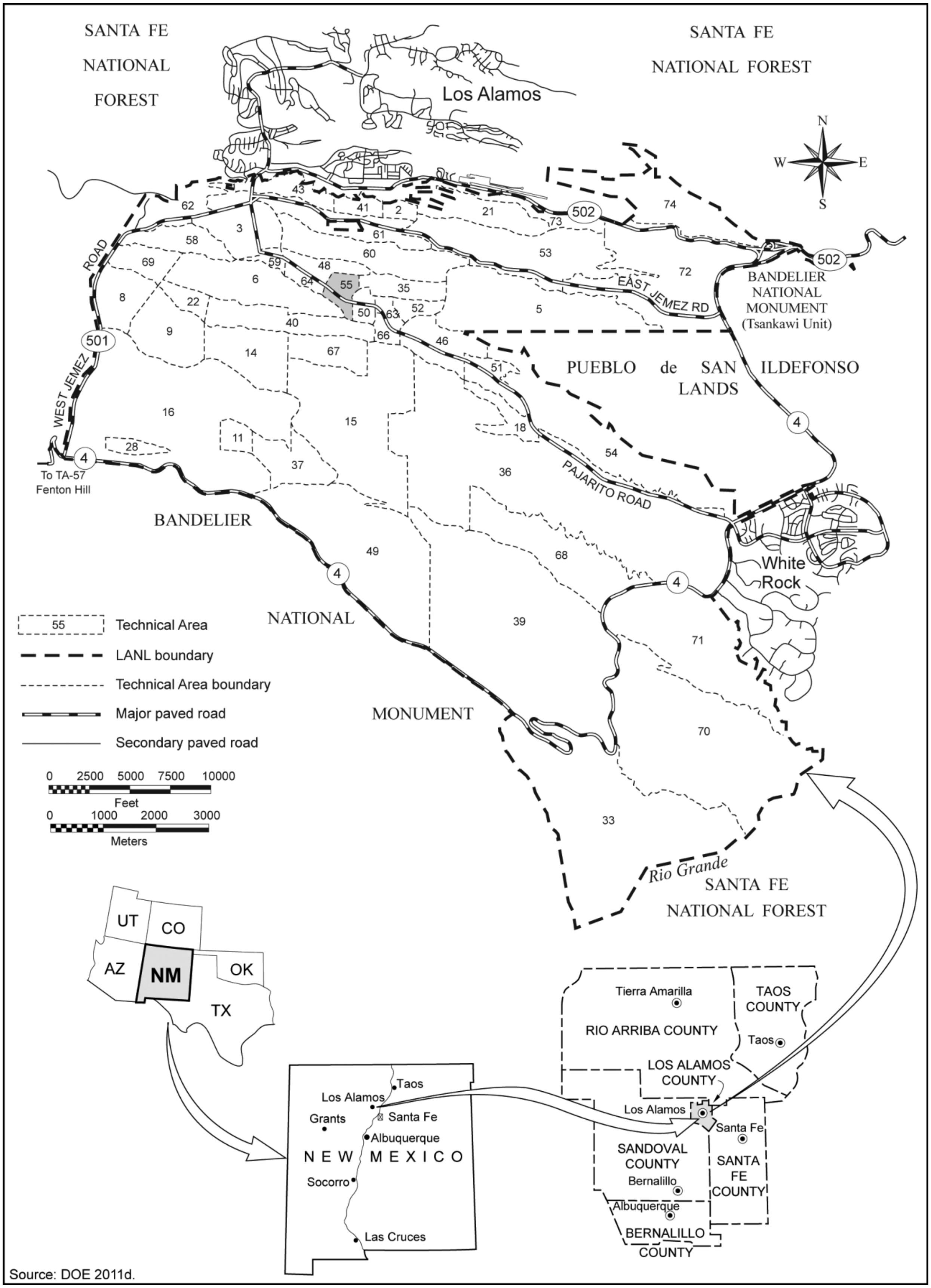
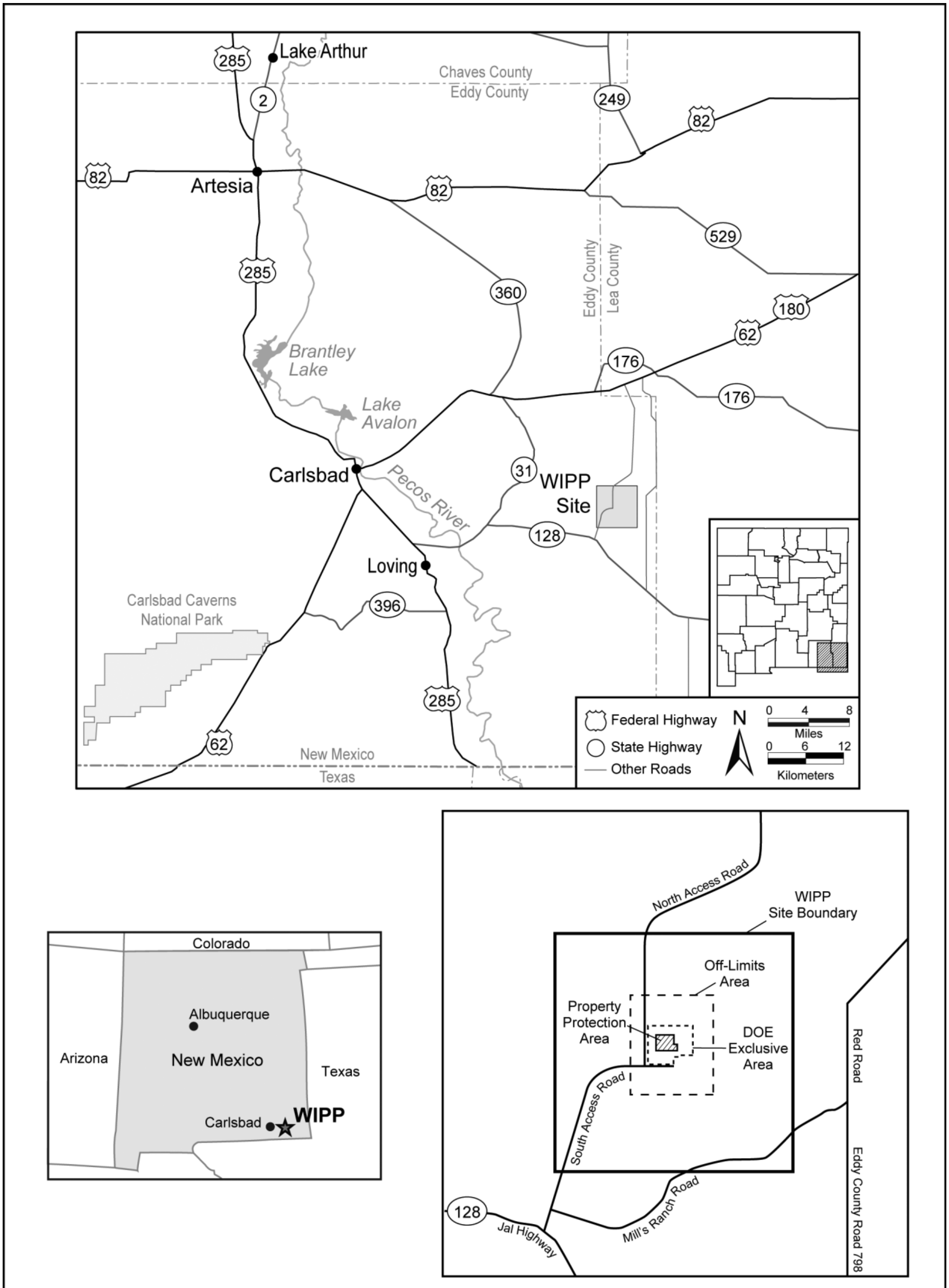
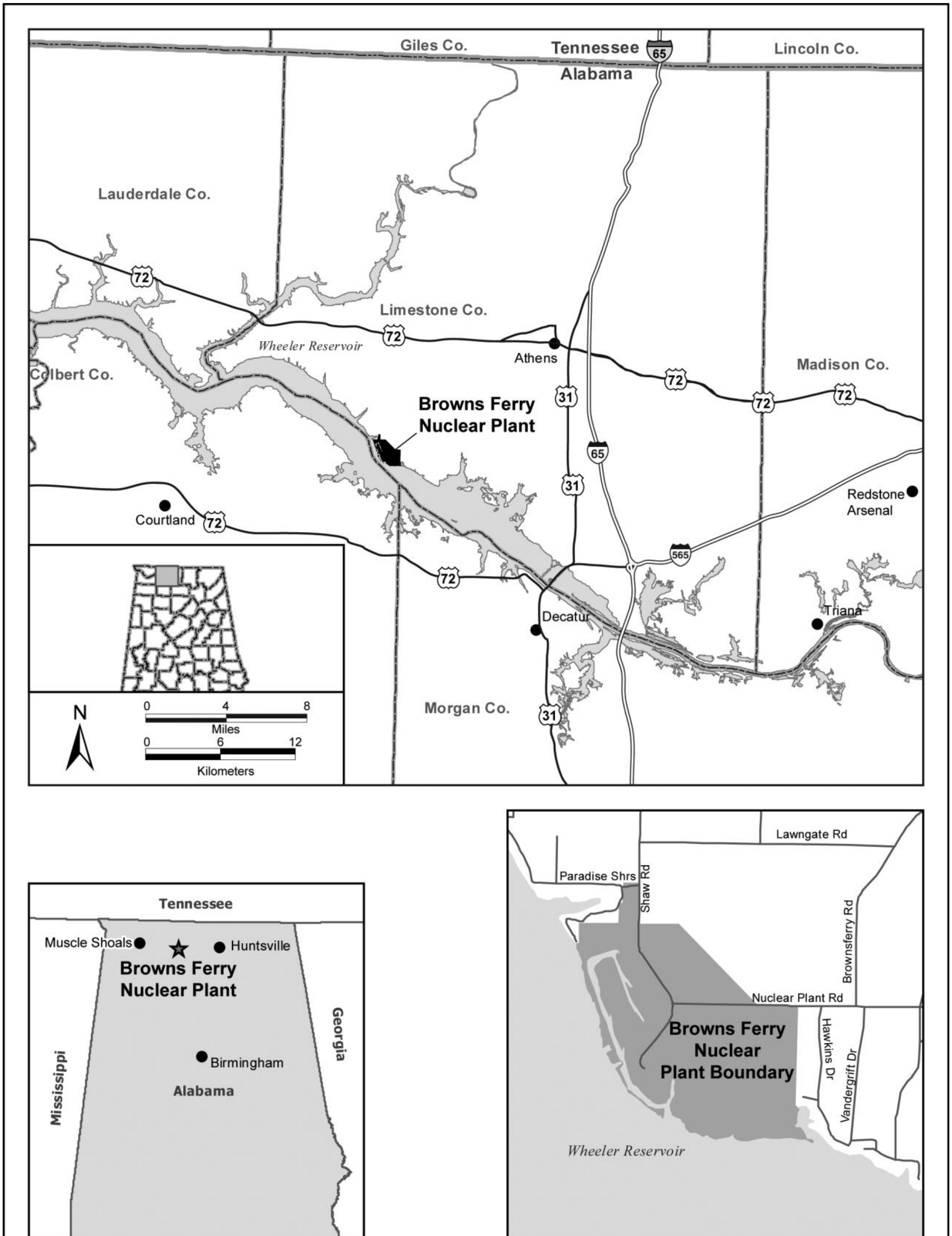


Figure S–3 Los Alamos National Laboratory Location and Technical Areas



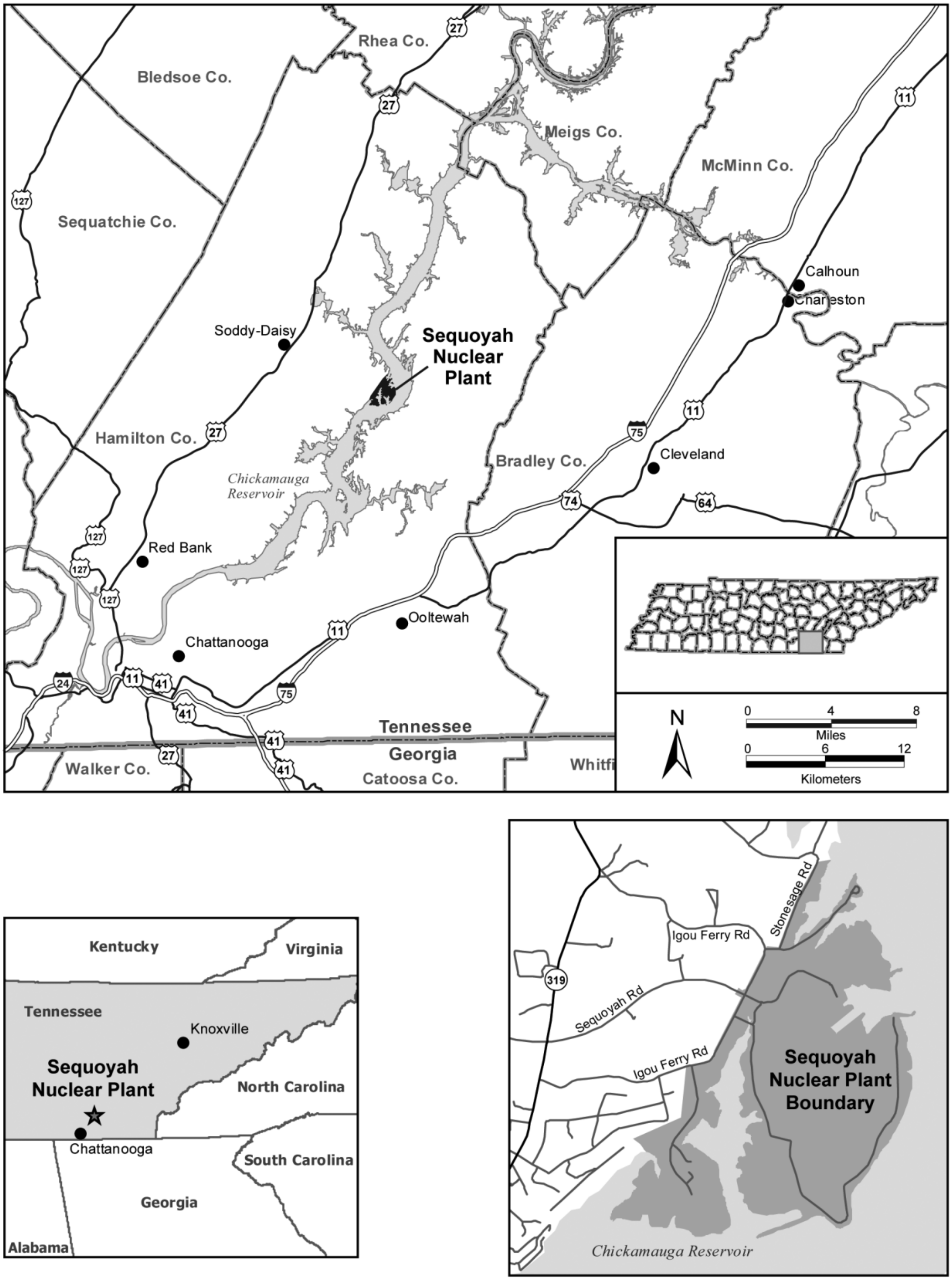
Source: DOE 2011e.

Figure S–4 Waste Isolation Pilot Plant Location



Source: TVA 2012.

Figure S–5 Browns Ferry Nuclear Plant Location



Source: TVA 2012.

Figure S–6 Sequoyah Nuclear Plant Location

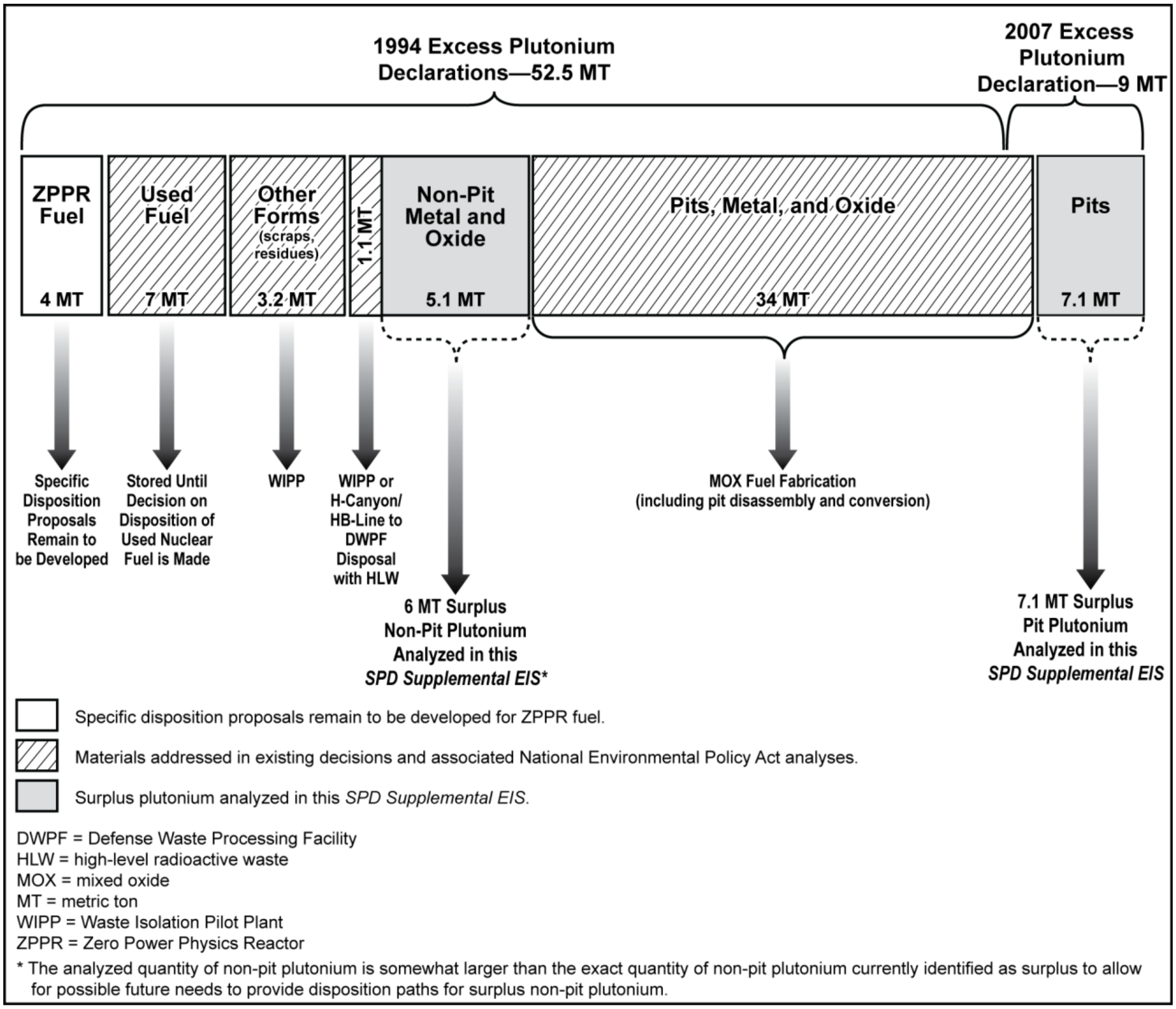


Figure S–7 Disposition Paths for Surplus Plutonium

Plutonium with No Identified Disposition Path

Figure S–7 also shows the DOE inventory of surplus plutonium, including those quantities for which a disposition path is not assigned. Of this material, DOE previously set aside for programmatic use 4 metric tons (4.4 tons) of surplus plutonium in the form of Zero Power Physics Reactor (ZPPR) fuel at its Idaho National Laboratory. DOE no longer has that particular programmatic use for this material. DOE is considering using a portion (about 0.4 metric tons [0.44 tons]) of the material for a different programmatic use. While the bulk of the ZPPR fuel currently stored at Idaho National Laboratory has been declared excess, specific disposition proposals remain to be developed. Therefore, DOE currently proposes to evaluate the disposition of 13.1 metric tons (14.4 tons) of surplus plutonium (i.e., 7.1 metric tons [7.8 tons] of pit plutonium[6] and 6 metric tons [6.6 tons] of non-pit plutonium[7]). The 6 metric tons (6.6 tons) of non-pit plutonium includes a limited quantity of additional plutonium

[6] *The 34 metric tons (37.5 tons) previously identified for MOX fuel fabrication included an allowance of 1.9 metric tons (2.1 tons) for future declarations. DOE later determined, as shown in Figure S–7, that 1.9 metric tons (2.1 tons) from the 9 metric tons (9.9 tons) of pit plutonium in the 2007 declaration qualified for inclusion within the 34 metric tons (37.5 tons) identified for MOX fuel fabrication, leaving 7.1 metric tons (7.8 tons) of pit plutonium to be dispositioned.*

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

(0.9 metric tons [1.0 ton]), to allow for the possibility that DOE may, in the future, identify additional quantities of surplus plutonium that could be processed for disposition through the facilities and capabilities analyzed in this *SPD Supplemental EIS*. For example, future sources of additional surplus plutonium could include plutonium quantities recovered from foreign locations through NNSA's Global Threat Reduction Initiative[8] or future quantities of plutonium declared excess to U.S. defense needs.

S.5 Public Involvement

The NEPA process for this *SPD Supplemental EIS* included opportunities for public involvement during the scoping period and the public comment period on the *Draft SPD Supplemental EIS*. Section S.5.1 summarizes the scoping process and Section S.5.2 summarizes the public comment period on the *Draft SPD Supplemental EIS*. Although scoping is optional for a supplemental EIS under DOE's NEPA implementing procedures in Title 10 of the *Code of Federal Regulations* (CFR) (10 CFR 1021.314(d)), DOE invited public participation during three distinct scoping periods for the preparation of this *SPD Supplemental EIS*. A public comment period on a draft supplemental EIS is required by 40 CFR 1503.1 and 10 CFR 1021.314(d).

S.5.1 Scoping Process

DOE first opened the scoping process for the *Draft SPD Supplemental EIS* in 2007 (72 FR 14543). Between 2007 and 2012, DOE provided three specific scoping periods, during which DOE held public scoping meetings and actively solicited scoping comments from Federal agencies, state and local governmental entities, American Indian tribal governments, and members of the public (2007 [72 FR 14543]; 2010 [75 FR 41850]; and 2012 [77 FR 1920]). The public scoping periods extended from March 28 through May 29, 2007; July 19 through September 17, 2010; and January 12 through March 12, 2012. The dates and locations of the scoping meetings are listed below.

Date	*Scoping Meeting Location*
April 17, 2007	Aiken, South Carolina
April 19, 2007	Columbia, South Carolina
August 3, 2010	Tanner, Alabama
August 5, 2010	Chattanooga, Tennessee
August 17, 2010	North Augusta, South Carolina
August 24, 2010	Carlsbad, New Mexico
August 26, 2010	Santa Fe, New Mexico
February 2, 2012	Pojoaque, New Mexico

Commentors were encouraged to submit scoping comments via the U.S. mail, email, a toll-free telephone number, and a toll-free fax line. All scoping comments received by DOE were considered in preparing the *Draft SPD Supplemental EIS*. A summary of the comments received during the public scoping periods is presented in Appendix L.

S.5.2 Public Comment Period on the *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

On July 27, 2012, the U.S. Environmental Protection Agency (EPA) and DOE published notices in the *Federal Register* announcing the availability of the *Draft SPD Supplemental EIS* (77 FR 44234 and 77 FR 44222, respectively). A 60-day comment period, from July 27 to September 25, 2012, was announced to provide time for interested parties to review and comment on the *Draft SPD Supplemental EIS*. In response to public requests, DOE extended the public comment period by 15 days through October 10, 2012, and held an additional public hearing (77 FR 54908). During the

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

public comment period, DOE held seven public hearings to provide interested members of the public with opportunities to learn more about the content of the *Draft SPD Supplemental EIS* from exhibits, factsheets, and other materials; to hear DOE representatives present the results of the *Draft SPD Supplemental EIS* analyses; to ask questions; and to provide oral or written comments. TVA representatives attended the public hearings in Chattanooga, Tennessee, and Tanner, Alabama. The dates and locations of the public hearings are listed below.

Date	***Public Hearing Location***
August 21, 2012	Los Alamos, New Mexico
August 23, 2012	Santa Fe, New Mexico
August 28, 2012	Carlsbad, New Mexico
September 4, 2012	North Augusta, South Carolina
September 11, 2012	Chattanooga, Tennessee
September 13, 2012	Tanner, Alabama
September 18, 2012	Española, New Mexico

In addition, Federal agencies, state and local governmental entities, American Indian tribal governments, and members of the public were encouraged to submit comments via the U.S. mail, email, a toll-free telephone number, and a toll-free fax line. All comments received by DOE, including late comments, were considered in preparing this *Final SPD Supplemental EIS*.

DOE received 432 comment documents containing about 1,050 comments during the public comment period for the *Draft SPD Supplemental EIS*. Comments that DOE determined to be outside the scope of the *SPD Supplemental EIS* are acknowledged as such in the Comment Response Document (CRD) (Volume 3 of this *Final SPD Supplemental EIS*). The remaining comments were reviewed by policy experts, subject matter experts, and NEPA specialists, as appropriate. In addition to responding to these comments, this *Final SPD Supplemental EIS* was modified as appropriate to address these comments. The CRD presents the comment letters, including the campaign letters,[9] as well as the public hearing transcripts and DOE's responses to the comments. The CRD is organized as follows:

- Section 1 describes the public comment process for the *Draft SPD Supplemental EIS*; the format used in the public hearings on the *Draft SPD Supplemental EIS*; the organization of the CRD and how to use the document; and the changes made by DOE to this *Final SPD Supplemental EIS* in response to the public comments.
- Section 2 presents topics of interest from the public comments received on the *Draft SPD Supplemental EIS* and DOE's response to each topic of interest.
- Section 3 presents a side-by-side display of all comments received by DOE on the *Draft SPD Supplemental EIS* and DOE's response to each comment.

DOE's review of the public input received during the public comment period on the *Draft SPD Supplemental EIS* indicates the main topics of interest:

[9] *A letter was considered to be part of a campaign if a significant number of letters were received with the same text in the body of the letter.*

National Environmental Policy Act Process

Topic A: Commentors stated that, rather than completing this *SPD Supplemental EIS*, DOE must supplement or prepare a new *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement (Storage and Disposition PEIS)* (DOE 1996) and/or prepare a new *SPD EIS* (DOE 1999) to include consideration of LANL and WIPP.

Discussion: The decision to prepare this *SPD Supplemental EIS* was made in accordance with Council on Environmental Quality (CEQ) and DOE NEPA regulations. This *SPD Supplemental EIS* supplements the *SPD EIS* (DOE 1999), which in turn is tiered from the *Storage and Disposition PEIS* (DOE 1996). DOE's purpose and need, as stated in the *Storage and Disposition PEIS,* was to "implement the…Nonproliferation and Export Control Policy in a safe, reliable, cost-effective, and timely manner." DOE's need to store and disposition surplus plutonium in this manner has not changed since the *Storage and Disposition PEIS* was prepared. DOE, however, needs to disposition 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned, and to provide the appropriate capability to disassemble surplus pits and convert surplus plutonium to a form suitable for disposition. Pursuant to CEQ and DOE NEPA regulations and guidance, this can appropriately be done in a supplement to the *SPD EIS*, which is the path DOE has elected to take with this *SPD Supplemental EIS*.

DOE has pursued a program for safe storage and disposition of surplus weapons-usable plutonium since the mid-1990s. The *Storage and Disposition PEIS* (DOE 1996) evaluated programmatic alternatives for storage and disposition of plutonium surplus to the Nation's defense needs. The *Storage and Disposition PEIS* considered a comprehensive range of 35 alternatives and subalternatives for surplus plutonium disposition, including irradiation in nuclear reactors, immobilization, and deep geologic emplacement. At the conclusion of the *Storage and Disposition PEIS*, DOE decided to pursue a disposition approach utilizing immobilization of surplus plutonium in glass or ceramic material for disposal in a geologic repository and fabrication of surplus plutonium into MOX fuel for irradiation in existing domestic commercial nuclear reactors, as well as relying on "existing and new buildings and facilities, and technology variations" (62 FR 3014). The specifics for implementing any aspects of this approach were intended to be analyzed and compared in follow-on environmental analyses that tiered from the *Storage and Disposition PEIS*.

In November 1999, DOE issued one such tiered document, the *SPD EIS* (DOE 1999), which evaluated the impacts of constructing and operating facilities to disposition up to 50 metric tons (55 tons) of surplus weapons-usable plutonium in accordance with the disposition approaches established in the ROD that followed the *Storage and Disposition PEIS* (DOE 1996). After considering the analysis in the *SPD EIS* and other factors, DOE decided to "implement a program to provide for the safe and secure disposition of up to 50 metric tons (55 tons) of surplus plutonium" that would include construction and operation of a Pit Disassembly and Conversion Facility (PDCF), an immobilization facility, and an MFFF at SRS (65 FR 1608). In April 2002, DOE amended the RODs for the *Storage and Disposition PEIS* and *SPD EIS* to, among other things, cancel the immobilization portion of the disposition strategies due to cost considerations, while continuing to proceed with the remaining disposition strategies DOE had decided to pursue in furtherance of the *Storage and Disposition PEIS* (67 FR 19432).

This *SPD Supplemental EIS* continues DOE's tiered evaluation of site-specific impacts for implementing DOE's programmatic approach to storage and disposition of surplus plutonium. This *SPD Supplemental EIS* updates and supplements DOE's previous plutonium disposition analysis to incorporate new proposals for utilizing existing facilities for pit disassembly and conversion and to analyze the potential environmental impacts of several alternatives – including immobilization and MOX, but also extending to other alternatives that would advance the programmatic goal of environmentally safe and timely plutonium disposition – for approximately 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned. This *SPD Supplemental EIS* also analyzes the potential environmental impacts associated with the use of MOX fuel in domestic commercial nuclear power reactors, including five reactors at two TVA facilities.

Topic B: Commentors stated that the cost of the MOX Fuel Alternative and the relative costs of the MOX and immobilization pathways should be included in this *SPD Supplemental EIS*.

Discussion: Cost, schedule, technical viability, worker and public safety, potential environmental impacts, security, and the ability to carry out international agreements are among the factors that the decisionmaker may consider when selecting an alternative for implementation. This *SPD Supplemental EIS* provides the decisionmaker with information on the potential environmental impacts of each alternative and will inform the decisionmaker's selection of an alternative for implementation. Cost information on DOE programs is made public in the President's annual budget submission and the congressional budget process.

Alternatives

Topic A: Commentors asked DOE to reconsider its previous decision to fabricate 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at the MFFF and consider immobilization of the entire inventory, because immobilization would be safer, quicker, and less costly.

Discussion: In previous RODs (65 FR 1608 and 68 FR 20134), DOE announced its decision to fabricate 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at MFFF, which is currently under construction at SRS, and to use the MOX fuel in domestic commercial nuclear power reactors to generate electricity, thereby rendering the plutonium into a used (spent) fuel form that is not readily usable in nuclear weapons. DOE's prior decisions with respect to the disposition path for the 34 metric tons (37.5 tons) (68 FR 20134) of surplus plutonium are not addressed in this *SPD Supplemental EIS*.

In April 2014, DOE's Plutonium Disposition Working Group issued its report, *Analysis of Surplus Weapon-Grade Plutonium Disposition Options* (DOE 2014), which assesses options that could potentially provide a more cost-effective approach for disposition of surplus U.S. weapons-grade plutonium and provides the foundation for further analysis and independent validation. The primary options assessed were irradiation as MOX fuel in light water reactors (i.e., domestic commercial nuclear power reactors), irradiation in fast reactors, immobilization with high-level radioactive waste (HLW), downblending and disposal, and deep borehole disposal. Variations on the assessed options were also considered. For each option, the Working Group assessed costs; compliance with international agreements; the time required to disposition 34 metric tons (37.5 tons) of surplus plutonium; technical viability; and legal, regulatory, and other issues. Completion of this *Final SPD Supplemental EIS* is independent of DOE's ongoing assessment of potential plutonium disposition strategies identified by the Plutonium Disposition Working Group.

This *SPD Supplemental EIS* evaluates alternatives for 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned. The alternatives for this surplus plutonium being considered and analyzed in this *Final SPD Supplemental EIS* include immobilization at SRS (Immobilization to DWPF Alternative), fabrication into MOX fuel at SRS with subsequent irradiation in one or more domestic commercial nuclear power reactors (MOX Fuel Alternative), vitrification with HLW at SRS (H-Canyon/HB-Line to DWPF Alternative), and potential disposal as contact-handled transuranic (CH-TRU)[10] waste at WIPP (WIPP Alternative) (see Chapter 2, Section 2.3, of this *SPD Supplemental EIS*).

Currently, surplus pit plutonium is not in a form suitable for disposition and must be disassembled and converted to an oxide. Pit disassembly and conversion options analyzed in this *Final SPD Supplemental EIS* are: (1) a stand-alone PDCF at F-Area at SRS; (2) a Pit Disassembly and Conversion Project (PDC) at K-Area at SRS; (3) a pit disassembly and conversion capability in PF-4 in TA-55 at LANL and metal oxidation in MFFF at SRS; and (4) a pit disassembly and conversion capability in PF-4 at LANL with the potential for pit disassembly in the K-Area Complex, conversion in H-Canyon/HB-Line, and metal oxidation in MFFF at SRS (see Chapter 2, Section 2.1, of this *Final SPD Supplemental EIS*).

[10] *DOE has revised this* SPD Supplemental EIS *to indicate that only CH-TRU and mixed CH-TRU waste would be generated by surplus plutonium disposition activities.*

Analyses presented in this *SPD Supplemental EIS* show that impacts to the public in the vicinity of SRS and LANL would be minor as a result of any of the proposed alternatives. DOE expects no latent cancer fatalities (LCFs)[11] would result from normal operations of the surplus plutonium disposition facilities, and there would be little offsite impact on the public from these operations in terms of air and water pollution or from the transportation of radiological materials and wastes. The waste generated as a result of the alternatives would not require modifications to existing waste management facilities at SRS, and, if required, only minor modifications to existing and planned waste management facilities at LANL. DOE would be able to dispose of radioactive waste generated at SRS and LANL in onsite facilities, or at offsite federal and commercial disposal sites. Consistent with current practices, hazardous waste would continue to be transported to offsite treatment, storage and disposal facilities. Solid nonhazardous waste from SRS and LANL would continue to be disposed of at onsite and offsite landfills, consistent with current practices. Further, operation of the surplus plutonium disposition facilities would contribute little to cumulative impacts, including health effects among the offsite population (see Chapter 2, Section 2.6, and Chapter 4, Section 4.5.3.3).

DOE evaluated accidents initiated by natural phenomena such as earthquakes, as well as other events such as criticalities and fires at SRS and LANL. The analyses presented in this *SPD Supplemental EIS* indicate that no LCFs would be expected among the offsite population should a design-basis accident occur (see Chapter 2, Table 2–3; Chapter 4, Section 4.1.2.2; and Appendix D).

Under both normal operating and postulated accident conditions, the impacts of operating reactors using a partial MOX fuel core are not expected to change appreciably from those associated with using a full low-enriched uranium (LEU) fuel core (see Chapter 4, Section 4.1.2, and Appendices I and J of this *SPD Supplemental EIS*).

As described in Appendix B, Table B–2, of this *SPD Supplemental EIS*, the duration of the Immobilization to DWPF Alternative is expected to be similar to the durations of the other alternatives. Cost, schedule, technical viability, worker and public safety, environmental impacts, security, and the ability to carry out international agreements are among the factors the decisionmaker may consider when selecting an alternative for implementation.

Topic B: Commentors questioned whether disposal of surplus plutonium at WIPP as TRU waste would exceed WIPP's regulatory limit pursuant to the WIPP Land Withdrawal Act and whether the waste would meet the acceptance criteria.

Discussion: DOE annually re-evaluates available disposal capacity against projected inventories of all TRU waste that is expected to be disposed at WIPP. Based on estimates in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012c), approximately 24,700 cubic meters (872,000 cubic feet) of unsubscribed[12] CH-TRU waste capacity could support the actions analyzed in this *SPD Supplemental EIS*. Depending on the alternative chosen by DOE, CH-TRU waste generated at SRS and LANL as a result of surplus plutonium disposition activities could use between 24 percent (under the No Action Alternative) and 108 percent (under the WIPP Alternative using pipe overpack containers [POCs]) of the unsubscribed WIPP disposal capacity. If Fast Flux Test Facility (FFTF) fuel can be disposed directly and criticality control overpacks (CCOs)[13] are assumed to be used, CH-TRU waste generated at SRS and LANL under the WIPP Alternative would use 65 percent of the unsubscribed WIPP disposal capacity instead of 108

[11] *An LCF is a death from cancer resulting from, and occurring sometime after, exposure to ionizing radiation or other carcinogens. For each individual or population group considered, an estimate of the potential LCFs was made using the risk estimator of 0.0006 latent fatal cancers per rem or person-rem (or 600 latent fatal cancers per 1 million rem or person-rem) (DOE 2003b) (see Appendix C, Section C.1.3, of this* SPD Supplemental EIS*). For acute doses to individuals equal to or greater than 20 rem, the factor is doubled (NCRP 1993).*

[12] *The term "unsubscribed" refers to that portion of the total WIPP capacity that is not being used or needed for the disposal of DOE's currently estimated inventory of transuranic waste.*

[13] *A CCO is a transportation package that would allow the transport of more plutonium material in a package (analyzed in this* SPD Supplemental EIS *at 350 plutonium fissile gram equivalents per container) than in a POC. A CCO has components that address possible criticality concerns inherent in transporting a larger quantity of plutonium in a container.*

percent. Disposal of CH-TRU waste under all alternatives evaluated in this *SPD Supplemental EIS* would be in accordance with the WIPP waste acceptance criteria and, with the exception of a scenario that would use only POCs for disposal of 13.1 metric tons (14.4 tons) of surplus plutonium under the WIPP Alternative, would remain within WIPP's disposal capacity (see Chapter 2, Section 2.6.2; Chapter 4, Section 4.5.3.6.3; and Appendix B, Sections B.1.3 and B.3).

Pit Disassembly and Conversion

Topic A: Commentors were opposed to expanding pit disassembly and conversion activities at LANL because of concerns about public health and safety.

Discussion: LANL is currently performing pit disassembly and conversion operations for 2 metric tons (2.2 tons) of plutonium in support of the Surplus Plutonium Disposition Program, in accordance with the *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (*LANL SWEIS)* (DOE 2008b) and associated ROD (73 FR 55833). In addition to the analysis in the *LANL SWEIS*, these operations are analyzed in this *SPD Supplemental EIS* under the No Action Alternative. This *SPD Supplemental EIS* also evaluates the impacts of expanding these existing operations under all of the action alternatives. Expansion of pit disassembly and conversion activities at PF-4 at LANL is expected to have minimal environmental impacts (see Chapter 4, Section 4.1, and Appendix F of this *SPD Supplemental EIS*). In addition, expansion of pit disassembly and conversion activities at PF-4 would contribute little to cumulative impacts at LANL (see Chapter 4, Section 4.5.3). For further discussion of the impacts of the alternatives for surplus plutonium disposition, refer to Section 2.2, Alternatives, of the CRD.

Topic B: Commentors were concerned about the proximity of faults to PF-4 at LANL, Defense Nuclear Facilities Safety Board (DNFSB) findings on PF-4 seismic performance, and the ability of the facility to withstand an earthquake.

Discussion: DOE has ongoing programs to better understand the geology and seismology of the LANL region in order to predict the likelihood of severe earthquakes. DOE recognizes that LANL is in the vicinity of active faults and continues to take appropriate actions to further improve the safety basis that documents the hazards and controls in place at LANL to ensure safety and to implement facility modification and upgrades as necessary.

DOE has an ongoing program to ensure that PF-4 can meet DOE safety goals under a wide range of severe accident conditions, including severe earthquakes. DOE is working with DNFSB to ensure these goals are met. Both physical and administrative changes have been made to reach the goals by limiting plutonium inventory and material forms in the building at any one time. Structural changes made as part of the seismic upgrade program have improved the overall response of the facility and equipment to limit the release of radioactive materials in severe earthquakes. Safety analyses have also been improved to more realistically examine and model the material at risk, the damage it might sustain in a variety of accident scenarios, and the fraction of material at risk that might become airborne and be released from the building. This *Final SPD Supplemental EIS* includes updated information in Appendix D, Section D.1.5.2.11, to summarize DNFSB's concerns regarding PF-4 seismic performance that have been communicated since the *Draft SPD Supplemental EIS* was prepared, and DOE's response to those concerns.

This *SPD Supplemental EIS* evaluates several accident scenarios for varying levels of damage caused by earthquakes (see Chapter 4, Section 4.1.2.2, and Appendix D, Sections D.1.5.2.11 and D.2.9) and describes concerns identified by DNFSB through August 2014. The accident scenario with the highest impacts takes into account a major fire occurring as a result of a severe earthquake that causes major structural damage to PF-4. Until ongoing seismic upgrades to the PF-4 structures are completed (scheduled for early 2016), a design-basis earthquake with a return interval of about 1 in 8,300 years might initiate structural damage to the facility. Although the earthquake by itself is not a beyond-design-basis event, the level of damage (building collapse), spills, impacts, and fires postulated for this scenario is estimated to decrease the probability of releases of the magnitude considered by a factor of 10 to 100;

hence, the overall event is extremely unlikely. DOE estimates that up to 3 LCFs could occur in the offsite population at LANL as a result of radiation exposure from the damaged PF-4; the annual frequency of this accident is estimated to range from 1 chance in 100,000 to 1 chance in 10,000,000.

Topic C: Commentors stated that DOE should focus on cleanup and remediation efforts at LANL instead of an increased pit disassembly and conversion mission.

Discussion: Decisions related to cleanup and remediation of existing contamination are outside the scope of this *SPD Supplemental EIS*. LANL performs a variety of activities directed by Congress and the President, including cleanup and remediation, maintaining a safe and secure nuclear weapons stockpile, and plutonium disposition and nonproliferation. DOE will continue to conduct the environmental restoration programs at LANL in parallel with its other missions.

MOX Fuel Program

Topic A: Commentors expressed general opposition to nuclear weapons and nuclear power; they also stated that the MOX fuel program is not a viable approach to meet the mission need and could not be completed within a reasonable period of time due to the time required for testing of MOX fuel assemblies and reactor license modifications. A frequent comment was that the program did not have any utilities currently committed to using MOX fuel.

Discussion: Policies related to nuclear weapons and use of nuclear energy are not within the scope of this *SPD Supplemental EIS*.

This *SPD Supplemental EIS* analyzes the potential environmental impacts associated with the various disposition alternatives under consideration for the 13.1 metric tons (14.4 tons) of surplus plutonium that are the subject of this analysis. The lack of current customers for the use of MOX fuel does not indicate a deficiency in the environmental analysis presented in this *SPD Supplemental EIS*. This *SPD Supplemental EIS* includes analysis specific to TVA's Browns Ferry and Sequoyah Nuclear Plants because TVA and DOE have signed an interagency agreement to study the use of MOX fuel at these plants.

MOX fuel technology is a viable approach to achieving disposition of a portion of this surplus plutonium. Several national regulatory agencies, including the U.S. Nuclear Regulatory Commission (NRC), have evaluated the use of MOX fuel in nuclear power reactors and found that it can be used safely. MOX fuel has been used in commercial nuclear power reactors worldwide for more than 40 years and continues to be used. This experience base includes the use of MOX fuel in both pressurized water reactors (PWRs) and boiling water reactors (BWRs), including tests using plutonium ranging from reactor-grade to weapons-grade. Roughly 2,000 metric tons (2,200 tons) of MOX fuel has already been fabricated and loaded into power reactors. Currently, about 40 reactors in Belgium, Switzerland, Germany, and France are licensed to use MOX fuel, and more than 30 are presently doing so. These reactors generally use MOX fuel in about one-third of their core, although some are licensed to use MOX fuel in as much as half of their core.

As summarized in Appendix J, Section J.2, of this *SPD Supplemental EIS*, tests performed by Duke Energy demonstrated that MOX fuel containing weapons-grade plutonium performed as expected in a commercial nuclear power plant. Between 2005 and 2008, Duke Energy irradiated four lead test assemblies (LTAs) containing weapons-grade MOX fuel at the Catawba Nuclear Station. The LTAs were examined at the reactor following each irradiation cycle. After the second cycle, a representative sample of fuel rods was removed for further examination in an offsite hot cell. Most examination results were within predictive calculations and experience. The measured maximum fuel assembly axial growth in three of the four assemblies, however, exceeded predicted values by about the thickness of a dime, but remained within a range that did not impact safety. The axial growth was due to a change in the length of the control rod guide tubes and was not related to the presence of MOX fuel rods in the fuel assembly. Such larger-than-predicted fuel assembly axial growth had previously been observed in other reactors using LEU fuel in similar fuel assembly designs. Because the axial growth of three of the four LTAs exceeded the conservative pre-established criterion for reinsertion for a third cycle of irradiation, the LTAs were discharged after the second cycle. In summary, extensive nondestructive examinations and post-irradiation examination of the MOX LTAs showed close agreement with computer code predictions and other MOX fuel experience for most performance parameters. No issues that would affect the safe operation of the core were found, although higher-than-predicted axial fuel assembly growth in three LTAs prevented a third cycle of irradiation.

To operate, MFFF must be licensed by NRC. The NRC staff has concluded that MFFF operations would not pose an undue risk to worker and public health and safety (NRC 2010). NRC will determine whether any additional LTA tests are required, in conjunction with future license amendments that may be submitted by nuclear power reactor operators that express an interest in using MOX fuel.

Nuclear Reactor Safety

Topic A: Commentors were concerned about ongoing safety issues at the Browns Ferry and Sequoyah Nuclear Plants. Commentors were specifically concerned about the GE Mark-I containment, fire safety, and used fuel pool safety at the Browns Ferry Nuclear Plant.

Discussion: TVA's highest priority is ensuring the continued safe operation of its nuclear plants. Working closely with NRC, TVA continuously evaluates operations at its nuclear plants, including the Browns Ferry and Sequoyah Nuclear Plants. It is the responsibility of the NRC to regulate the operation of nuclear power plants in the United States. As NRC or TVA identifies issues, the issues are investigated to determine their root causes and corrective actions are implemented to assure safety. As a courtesy to commentors, TVA provides the following discussion of safety issues at Browns Ferry.

With regard to concerns raised about the reactor containment structures at Browns Ferry, NRC reviewed the Browns Ferry operating history as part of its safety evaluation of TVA's request to extend the Browns Ferry operating licenses and determined that the containment structures are sound and able to continue safe operation for another 20 years (see http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/lra-bfn.pdf for TVA's license renewal application). In 2006, NRC issued a license renewal safety evaluation report (NRC 2006a, 2006b) that documented an in-depth review of Browns Ferry and concluded that TVA be granted a 20-year operating license renewal for Browns Ferry, in accordance with 10 CFR Part 54. NRC approved the Browns Ferry license renewal request on May 4, 2006. Refer to Topic C below for further discussion of the Browns Ferry Nuclear Plant containment.

Over its 37 years of operation, the Browns Ferry Nuclear Plant has undergone numerous modifications, including those related to fire protection equipment and programs. TVA is in the process of again modifying Browns Ferry's fire protection program to meet the newest and most-comprehensive fire safety standards. For more information on Browns Ferry's fire protection system, see the Safety Evaluation Report prepared by NRC in conjunction with TVA's license renewal application. This document is available from NRC at http://pbadupws.nrc.gov/docs/ML0522/ML052210484.pdf.

With regard to concerns expressed over the used (spent) fuel pools at Browns Ferry, consistent with all other operators of light water reactors in the United States, TVA utilizes water-filled pools to safely store used nuclear fuel after it is initially discharged from the reactor. TVA has committed to placing the older used fuel into dry cask storage, which requires no electricity or water to cool the used fuel. The Sequoyah and Browns Ferry Independent Spent Fuel Storage Installations (ISFSIs) were granted NRC approval on July 13, 2004, and August 21, 2005, respectively, to use Holtec HI-Storm 100S dry storage casks (NRC 2012a). As of January 2013, 40 dry spent fuel storage casks, each containing 68 BWR fuel assemblies, have been filled and placed at the Browns Ferry ISFSI, and 32 dry spent fuel storage casks, each containing 32 PWR fuel assemblies, have been filled and placed at the Sequoyah ISFSI. Plans for future transfer of used fuel to ISFSI casks have been formulated for the operating lives of the Sequoyah and Browns Ferry Nuclear Plants, based on the anticipated need for storage beyond that available in the wet storage pools (TVA 2013a).

In addition, NRC is requiring nuclear plants, including Browns Ferry, to increase the instrumentation associated with their used fuel pools to allow for a more reliable display of the level of water remaining in these pools during beyond-design-basis accidents (NRC 2012b). In accordance with the NRC requirement, in February 2013, TVA submitted plans for providing reliable indication of key water levels in the spent fuel pools at Browns Ferry and Sequoyah Nuclear Plants (TVA 2013b, 2013c).

Topic B: Commentors were concerned about the safety of using MOX fuel versus LEU fuel in domestic commercial nuclear power reactors, including the Browns Ferry and Sequoyah Nuclear Plants. Commentors were concerned about safe storage of used MOX fuel, including decay heat production.

Discussion: DOE used current data to develop representative core inventories for both partial MOX and full LEU fuel cores for the accident analysis in this *SPD Supplemental EIS*. This *SPD Supplemental EIS* analyzes the risks associated with the use of a partial MOX fuel core under various accident scenarios, including failures that could lead to a core meltdown, and concludes that the risks are comparable to those associated with the use of a full LEU core (see Chapter 4, Section 4.1.2.4, and Appendix J, Section J.3.2). The risks to the maximally exposed individual (MEI)[14] and the offsite population of developing a fatal cancer as a result of one of these accidents, regardless of whether the reactors are using partial MOX or full LEU fuel cores, are small (see Appendix J, Section J.3).

The safe operation of these plants is regulated by the NRC, pursuant to licenses from the NRC. The use of MOX fuel in any domestic commercial nuclear power reactor must be in accordance with the applicable license (as it may be amended) and license conditions for the facility, and must comply with NRC regulations. If the NRC does not believe that a plant could operate safely with a partial MOX fuel core, NRC would not approve the plant operator's application for a license amendment (see Appendix J, Sections J.1 and J.2).

Initially, used MOX fuel would be discharged to the reactor's used fuel storage pool, where it would be stored with existing used LEU fuel. After about 5 years, the decay heat load from either fuel type would be low enough to allow the fuel to be transferred to dry storage casks. Although the amount of fissile material would be somewhat higher in used MOX fuel rods than in used LEU fuel rods, the number of fuel assemblies and their spacing in the used fuel pools and dry storage casks could be adjusted to maintain the necessary criticality and thermal safety margins so that MOX fuel could be stored just as safely as LEU fuel.

When initially removed from a reactor, used MOX fuel produces slightly less decay heat (about 4 percent) than an equivalent amount of LEU fuel. Due to isotopic differences in the used fuels, decay heat production in MOX fuel declines more slowly than it does in LEU fuel. Consequently, after a while, MOX fuel heat production exceeds that of LEU (by about 16 percent after 5 years) (ANS 2011). After about 30 years of cooling, the decay heat difference between the two fuel types would be equivalent to the heat produced by a few incandescent light bulbs. The differences in the decay heat rates of equivalently cooled used MOX fuel and used LEU fuel would not be an appreciable consideration for storage 30 years after fuel discharge. Thus, no major changes are expected in the plants' used fuel storage plans to accommodate the used MOX fuel.

Topic C: Commentors were concerned that using MOX fuel in domestic commercial nuclear power reactors could result in a Fukushima-like accident.

Discussion: The March 11, 2011, earthquake and subsequent tsunami in Japan caused substantial damage to reactors at the Fukushima Dai-ichi Nuclear Power Station. At the time of the accident, Unit 3 was operating with a partial MOX fuel core. However, at least one authority has determined that the accident involved failures unrelated to the use of MOX fuel. The United Kingdom's Office of Nuclear Regulation examined the Fukushima accident and stated, "[t]here is no evidence to suggest that the

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

presence of MOX fuel in Reactor Unit 3 significantly contributed to the health impact of the accident on or off the site." With respect to the use of MOX fuel in United Kingdom reactors, the statement is made that the information to date about Fukushima Dai-ichi does not add to knowledge about the safety of the use of MOX fuel (ONR 2011).

NRC is working to ensure that the lessons learned from the Fukushima accident are applied to the design, construction, and operation of U.S. nuclear power plants. Specific lessons learned include the need to protect the plant safety systems from extreme floods, including tsunamis, flooding and surges from severe weather, and upstream dam failures, as well as the need to ensure cooling of the reactor core and support systems for longer periods than previously planned (NRC 2011b). As discussed in Section J.3.3.3, NRC has issued policy guidance, orders, and requests for information and is developing additional regulatory requirements to implement recommendations stemming from the above lessons learned. These actions, along with those taken by the nuclear industry, are being implemented in the United States with the goal of reducing the chance that a severe natural or other event would result in an extended loss of power leading to a loss of cooling and an uncontrolled release of radioactivity to the environment. As a result of these efforts, TVA and the other domestic nuclear power plant operators are working with NRC to improve their plants' abilities to withstand such events without suffering the severe damage encountered at Fukushima.

The Browns Ferry Nuclear Plant has a GE Mark-I type containment. This containment is similar to that used at the Fukushima Dai-ichi Nuclear Power Station in Japan. In response to the March 11, 2011, accident at the Fukushima Dai-ichi Nuclear Power Station and as discussed in Appendix J, Section J.3.3.3, all nuclear plant operators, including TVA, are performing NRC-mandated evaluations of plant designs and operations to provide additional protection against beyond-design-basis events. TVA has already installed additional safety equipment (portable electric generators and pumps) and established procedures for mitigating an extended loss of electric power. From what is known about the Fukushima accident, the GE Mark-I type containment structure for the Fukushima reactors remained intact and undamaged following the earthquake and tsunami. Subsequent events developed that resulted in non-nuclear (hydrogen gas) explosions (see Appendix J, Section J.3.3.3). NRC and TVA are evaluating the designs of the Browns Ferry containments to determine changes that make them more effective in the unlikely event of a severe accident.

Environmental Justice

Topic A: Commentors stated that the environmental justice analysis did not adequately portray the potential impacts of the proposed alternatives on minority and low-income populations, including Native American pueblos near LANL. Commentors stated that the lifestyles of Native Americans may result in increased exposure to radionuclides.

Discussion: For this *Final SPD Supplemental EIS*, the results of a dose assessment similar to that for the MEI located at the LANL boundary were added to Chapter 4, Section 4.1.6, to show the potential impact on a hypothetical individual living at a pueblo boundary near LANL. The maximum annual dose for a person at the Pueblo de San Ildefonso boundary from normal operations of pit disassembly and conversion at PF-4 would be 0.044 millirem; 0.0046 millirem at the Santa Clara boundary. These values can be compared to the MEI dose from normal operations of pit disassembly and conversion at PF-4 of about 0.081 millirem per year and the average annual dose from natural background radiation of 469 millirem per year (see Chapter 3, Section 3.2.6.1).

Based on the analyses in this *Final SPD Supplemental EIS*, DOE concludes that none of the proposed alternatives would subject minority or low-income populations to disproportionately high and adverse impacts. Further, risks to the public, including nearby Native Americans, are expected to be minor as a result of proposed actions at LANL. No LCFs are expected among the offsite population, including nearby minority or low-income populations, as a result of normal operations of the proposed surplus plutonium disposition facilities.

As discussed in Chapter 4, Section 4.5.3.8.2, of this *SPD Supplemental EIS*, the additional dose from the proposed surplus plutonium disposition activities would be less than 0.01 millirem per year to the average Native American living as close as 5 miles (8 kilometers) from LANL, and this dose would not change the risks associated with the special pathways scenario discussed in the *LANL SWEIS* (DOE 2008b). These individuals would be exposed to a small increased annual risk of developing a latent fatal cancer of 3×10^{-6}, or approximately 1 chance in 330,000, from continued LANL operations.

Long-term Management of Used Nuclear Fuel and High-Level Radioactive Waste

Topic A: Commentors were concerned about long-term management of used nuclear fuel and HLW.

Discussion: Examining the potential environmental impacts of construction and operation of a future repository (or repositories) for used nuclear fuel and HLW is not within the scope of this *SPD Supplemental EIS*. As discussed in Appendix I, Sections 1.1.2.4 and I.2.2.4, of this *SPD Supplemental EIS*, used MOX fuel would be managed in a similar manner as used LEU fuel. In addition, as discussed in this *SPD Supplemental EIS*, DWPF canisters containing vitrified plutonium with HLW would be managed in the same manner as other DWPF canisters containing HLW.

DOE has terminated the program for a geologic repository for used nuclear fuel and HLW at Yucca Mountain, Nevada. Notwithstanding the decision to terminate the Yucca Mountain program, DOE remains committed to meeting its obligations to manage and ultimately dispose of used nuclear fuel and HLW. DOE established the Blue Ribbon Commission on America's Nuclear Future to conduct a comprehensive review and evaluate alternative approaches for meeting these obligations. The Commission report to the Secretary of Energy of January 26, 2012 (BRCANF 2012) provided a strong foundation for the Administration's January 2013 *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (DOE 2013f). This Strategy provides a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel and HLW from civilian nuclear power generation, defense, national security, and other activities. The link to the strategy is http://energy.gov/downloads/strategy-management-and-disposal-used-nuclear-fuel-and-high-level-radioactive-waste. Full implementation of this Strategy will require legislation.

S.6 Changes from the *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

In preparing this *Final SPD Supplemental EIS*, DOE made revisions to the *Draft SPD Supplemental EIS* in response to comments received from other Federal agencies, state and local government entities, American Indian tribes, and the public. DOE also changed this *Final SPD Supplemental EIS* to provide more environmental baseline information, including additional analyses, as well as to correct inaccuracies, make editorial corrections, and clarify text. In addition, DOE updated information due to events or notifications made in other documents since the *Draft SPD Supplemental EIS* was provided for public comment in July 2012. The following summarizes the more important changes made to this *Final SPD Supplemental EIS*.

Public Comment Period and Comments Received on the *Draft SPD Supplemental EIS*

A new Section 1.6.2 was added to Chapter 1, and a new Section S.5.2 was added to this Summary, to describe the public comment period on the *Draft SPD Supplemental EIS*. A CRD was added to this *Final SPD Supplemental EIS*. The CRD presents the comment letters, including the campaign letters, as well as public hearing transcripts and DOE's responses to the comments.

Changes Made for this *Final SPD Supplemental EIS*

A new Section 1.8 was added to Chapter 1, and a new Section S.6 was added to this Summary to list the changes made to the *Draft SPD Supplemental EIS* in preparing this *Final SPD Supplemental EIS*.

WIPP Alternative

In the *Draft SPD Supplemental EIS*, the WIPP Alternative evaluated disposition of 6 metric tons (6.6 tons) of surplus non-pit plutonium as CH-TRU waste at WIPP and disposition of 7.1 metric tons (7.8 tons) of surplus pit plutonium as MOX fuel. Based on public comments on the *Draft SPD Supplemental EIS*, updated estimates of unsubscribed CH-TRU waste capacity at WIPP (DOE 2012c), and the availability of a higher capacity disposal container (i.e., CCO), the WIPP Alternative was revised to include analysis of the potential disposal of all 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium as CH-TRU waste at WIPP. All of this surplus plutonium could be prepared at H-Canyon/HB-Line and the K-Area Complex at SRS for potential disposal at WIPP, or 7.1 metric tons (7.8 tons) of pit plutonium could be prepared at LANL for potential disposal at WIPP should higher levels of pit disassembly and conversion take place at LANL as proposed under the PF-4 and MFFF; and PF-4, H-Canyon/HB-Line, and MFFF pit disassembly and conversion options. Changes to the *Final SPD Supplemental EIS* include a description of the revised WIPP Alternative in Chapter 2 and the Summary, and analyses of the impacts of the revised alternative in Chapter 4 and Appendices E and G.

Alternatives Considered but Dismissed from Detailed Study

Section S.10 and Chapter 2, Section 2.4, of this *Final SPD Supplemental EIS* were revised to discuss additional options and alternatives, including some recommended by the public that were considered but dismissed from detailed study.

Preferred Alternative

Chapter 2, Section 2.5, was revised to change the Preferred Alternative. In the *Draft SPD Supplemental EIS*, the MOX Fuel Alternative was DOE's Preferred Alternative for surplus plutonium disposition. DOE's preferred option for disposition of surplus non-pit plutonium that is not suitable for MOX fuel fabrication was disposal at WIPP. DOE's preferred option for pit disassembly and conversion of surplus plutonium metal, regardless of its origins, was to use some combination of facilities at TA-55 at LANL and K-Area, H-Canyon/HB-Line, and MFFF at SRS, rather than to construct a new stand-alone facility.

In this *Final SPD Supplemental EIS*, DOE has no Preferred Alternative for the disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium that is the subject of this *SPD Supplemental EIS*. Also, DOE has no Preferred Alternative regarding the sites or facilities to be used to prepare surplus plutonium metal for disposition (i.e., pit disassembly and conversion capability). Consistent with the requirements of NEPA, once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a ROD no sooner than 30 days after its announcement of a Preferred Alternative.

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

Secure Transportation Asset Program

Chapter 2, Section 2.1, and Appendix E were revised to clarify transportation activities that would be conducted under NNSA's Secure Transportation Asset Program. Under this program, NNSA would transport plutonium material between DOE sites and MOX fuel from SRS to domestic commercial nuclear power reactors.

Incorporation of Updated Environmental Information

Chapter 3, Sections 3.1 and 3.2, were revised to reflect updated environmental data from the *Savannah River Site Environmental Report for 2011* (SRNS 2012) and the *Los Alamos National Laboratory Environmental Report 2011* (LANL 2012a).

Transuranic Waste

Chapter 4, Section 4.1.4, and Appendix E, Section E.5.1, were revised to clarify that all TRU waste generated under the alternatives for surplus plutonium disposition would be CH-TRU and mixed CH-TRU waste (analyzed collectively).

WIPP Unsubscribed Waste Quantity

Chapter 4, Sections 4.1.4 and 4.5.3.6.3, as well as this Summary, were updated to include revised CH-TRU waste projections for SRS and LANL and unsubscribed CH-TRU waste capacity data that were presented in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012c).

Environmental Justice

The environmental justice analysis in Chapter 4, Section 4.1.6, was revised to include a dose assessment similar to that for the MEI member of the public. Radiological impacts were calculated for hypothetical individuals living at the Pueblo de San Ildefonso and Santa Clara Pueblo boundaries who would be most affected by emissions from PF-4 at LANL. In addition, the discussion of impacts from a special pathways dose analysis (impacts on a subsistence consumer) that was performed for the *LANL SWEIS* (DOE 2008b) was expanded and moved to the cumulative impacts section of Chapter 4 (Section 4.5.3.8.2).

Climate Change in the Southwest

Chapter 4, Section 4.5.4.2, was revised to include a summary of the possible impacts of climate change in the southwestern United States.

Human Health Impact Measures and Assessment Methods

Appendix C, Section C.1, was revised to include a more detailed discussion of human health impact measurement and assessment methods. Additional information was provided regarding the basis for the risk factor of 0.0006 LCFs per person-rem (for the population) or rem (for an individual) and the scientific basis for its use.

Elimination of MFFF Accident

The ion exchange exotherm accident (explosion) was removed from the range of accidents evaluated for the MFFF. The accident was included in the *Draft SPD Supplemental EIS* as it had been in the original *SPD EIS*. It was deleted from this *Final SPD Supplemental EIS* because the design for MFFF, as evaluated in the EIS supporting licensing (NRC 2005) and as described in Chapter 2 and Appendix B, does not include an ion exchange column as was envisioned for this accident. The analysis in this *SPD Supplemental EIS* continues to include an explosion accident in a sintering furnace at the MFFF. This is considered the limiting design-basis accident[15] associated with this facility.

[15] *As used here, the limiting design-basis accident means the individual facility accident analyzed in this* SPD Supplemental EIS *that would have the largest potential impact on the surrounding population, with the exception of accidents involving earthquakes. Accidents involving earthquakes are addressed separately (see Appendix D).*

Seismic Safety Analysis of PF-4

Appendix D, Section D.1.5.2.11, was updated to discuss additional concerns regarding the seismic analysis of PF-4 at LANL raised by DNFSB after the *Draft SPD Supplemental EIS* was completed in the summer of 2012. The letters from DNFSB and DOE's responses through the end of August 2014 are discussed in this *Final SPD Supplemental EIS*. The analyses in this *Final SPD Supplemental EIS* were also revised to include scenarios consistent with the 2013 addendum to the documented safety analysis for PF-4 (LANL 2013) and the *SPD Supplemental EIS* scenarios that take credit for factors that would normally help lessen the impacts of such accidents should they occur (see Appendix D for further information on these scenarios).

Emergency Response Actions in the Event of a Transportation Accident

Section E.4 was added to Appendix E to describe the emergency response actions that would occur in the event of a transportation accident. First responders and/or state and Federal responders would initiate actions in accordance with the U.S. Department of Transportation *Emergency Response Guidebook* (DOT 2012a) to isolate the incident and perform any actions necessary to protect human health and the environment (e.g., evacuations, sheltering, or other measures to reduce or prevent impacts to the public).

Dunnage as a Contributor to Uncertainty in Determining Waste Shipments to WIPP

Appendix E, Section E.14.2, was revised to include dunnage (secured space not occupied by waste or waste containers) as a contributor to uncertainty when determining the number of waste shipments to WIPP. Dunnage is only used to complete a payload assembly (e.g., a 7-pack of 55-gallon drums, a second standard waste box) when a limit is reached (e.g., fissile gram equivalent, weight, wattage). There is no "typical" dunnage usage for shipments to WIPP, even within a single waste stream.

U.S. MOX Fuel Use Experience and Testing

Appendix J, Section J.2, was revised to provide additional information on U.S. MOX fuel use and testing in PWRs and BWRs.

S.7 Scope of this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

In this *SPD Supplemental EIS*, DOE considers four action alternatives for the disposition of 13.1 metric tons (14.4 tons) of surplus plutonium and four options for pit disassembly and conversion of 34.6 metric tons (38.1 tons) (rounded to 35 metric tons [38.6 tons]).[16] These alternatives involve DOE facilities at LANL, SRS, and WIPP. DOE also analyzes the potential environmental impacts of using MOX fuel in TVA's Browns Ferry and Sequoyah Nuclear Plants, as well as in one or more generic reactors. **Figure S–8** shows the locations of major facilities that could be affected by activities analyzed in this *SPD Supplemental EIS*.[17]

Potential impacts from transporting surplus plutonium to WIPP are addressed in this *SPD Supplemental EIS*. The impacts from TRU waste disposal at WIPP are analyzed in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997) and are briefly described in Appendix A, Section A.2, of this *SPD Supplemental EIS*.

[16] *As described earlier, in two RODs for the* SPD EIS *(65 FR 1608 and 68 FR 20134), DOE decided to fabricate 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at MFFF, which is being constructed at SRS. DOE's prior decisions with respect to the disposition path for the 34 metric tons (37.5 tons) of surplus plutonium are not addressed in this* SPD Supplemental EIS. *However, because DOE is revisiting its decision to construct and operate a PDCF at SRS, the pit disassembly and conversion options analyzed in this* SPD Supplemental EIS *will apply to the 27.5 metric tons (30.3 tons) of plutonium metal that DOE has decided to fabricate into MOX fuel, as well as the 7.1 metric tons (7.8 tons) of pit plutonium for which disposition is under consideration in this* SPD Supplemental EIS.

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

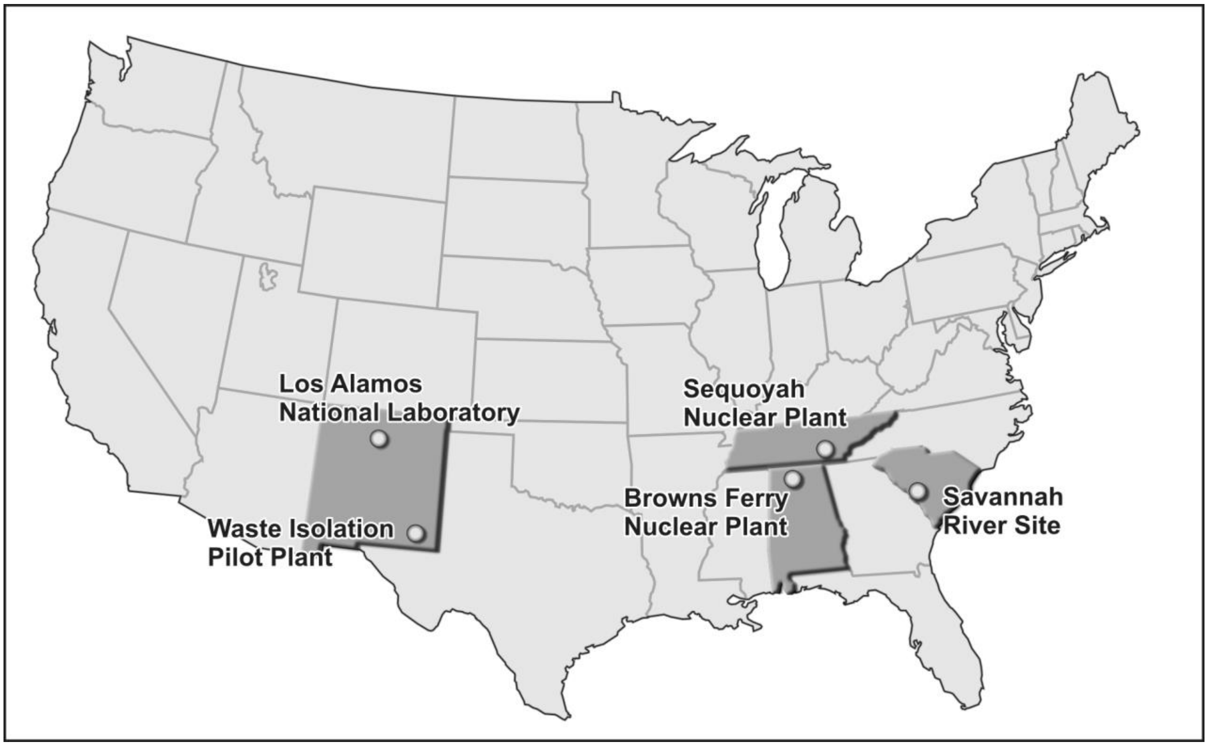


Figure S–8 Locations of Major Facilities Evaluated in this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

The 7.1 metric tons (7.8 tons) of surplus plutonium pits addressed in this *SPD Supplemental EIS* are currently stored at the Pantex Plant (Pantex) near Amarillo, Texas. Potential impacts from transporting pits from Pantex to SRS and LANL are addressed in this *SPD Supplemental EIS*. The impacts from continued storage of pits at Pantex are analyzed in the *Final Supplemental Analysis for the Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (DOE 2012d) and are briefly described in Appendix A, Section A.2, of this *SPD Supplemental EIS*.

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

S.8 Decisions to be Supported by the *Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

Consistent with the requirements of NEPA, DOE may issue a ROD announcing its decision no sooner than 30 days after its announcement of a Preferred Alternative in the *Federal Register*. DOE could decide, based on cost, schedule, technical viability, worker and public safety, potential environmental impacts, security, and the ability to carry out international agreements, which pit disassembly and conversion option to implement and which options to implement for disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium.

As stated in the 2010 amended NOI (75 FR 41850) and reaffirmed in the 2012 amended NOI (77 FR 1920), DOE and TVA are evaluating use of MOX fuel in up to five TVA reactors at the Browns Ferry and Sequoyah Nuclear Plants. TVA, as a cooperating agency, may adopt this *Final SPD Supplemental EIS* after independently reviewing the EIS and determining that its comments and suggestions have been satisfied (40 CFR 1506.3(c)).

S.9 Alternatives Analyzed in the *Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

This section describes the alternatives DOE has identified to disposition 13.1 metric tons (14.4 tons) of surplus plutonium: 7.1 metric tons (7.8 tons) of pit plutonium and 6 metric tons (6.6 tons) of non-pit plutonium. The alternatives addressed in this *SPD Supplemental EIS* are composed of a combination of pit disassembly and conversion options and plutonium disposition options,[18] as summarized below and explained in more detail in Sections S.9.1, S.9.2, and S.9.3 and Chapter 2, Sections 2.1, 2.2, and 2.3.

Pit Disassembly and Conversion Options. Currently, surplus pit plutonium is not in a form that is suitable for disposition. Plutonium, in metallic forms, must be converted to an oxide before it can be dispositioned. For plutonium in pits, this requires disassembly of the pits. In its ROD for the *SPD EIS* (65 FR 1608), DOE made a decision to construct, operate, and eventually decommission a stand-alone PDCF at SRS. DOE is reconsidering that decision and analyzing other pit disassembly and conversion options that would use existing facilities and a workforce experienced in these operations. As part of that reconsideration, DOE commissioned a study that examined, among other things, use of existing plutonium processing infrastructure at LANL and H-Canyon/HB-Line at SRS, as well as delivery of both plutonium metal and plutonium oxide to MFFF accompanied by installation of oxidation furnaces at MFFF (MPR 2012).

Based on the results of the study, DOE developed a range of pit disassembly and conversion options for analysis in this *SPD Supplemental EIS*: (1) a stand-alone PDCF at F-Area at SRS; (2) a PDC at K-Area at SRS; (3) a pit disassembly and conversion capability in PF-4 at LANL and metal oxidation in MFFF at SRS; and (4) a pit disassembly and conversion capability in PF-4 at LANL; and pit disassembly in the K-Area Complex, conversion at H-Canyon/HB-Line, and metal oxidation in MFFF at SRS. Pit disassembly and conversion options are described in Section S.9.1, and the potential impacts of each option are described in Appendix F of this *SPD Supplemental EIS*.

In the 2000 ROD (65 FR 1608) and 2003 amended ROD (68 FR 20134) for the *SPD EIS*, DOE decided to convert 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at MFFF, which is currently being constructed at SRS. DOE is revisiting its PDCF decision, and a total of 35 metric tons (38.6 tons) of surplus pit plutonium and plutonium metal is analyzed in this *SPD Supplemental EIS* for all pit disassembly and conversion options.[19] Regardless of the action alternative selected, pit disassembly and conversion would be necessary for 35 metric tons (38.6 tons) of surplus plutonium.

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

[19] *Under the No Action Alternative, 27.5 metric tons (30.3 tons) of surplus pit plutonium and plutonium metal are analyzed for processing at PDCF.*

Plutonium Disposition Options. In this *SPD Supplemental EIS*, DOE evaluates the potential impacts of four options for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium: (1) immobilization and vitrification at DWPF at SRS; (2) MOX fuel fabrication and use in domestic commercial nuclear power reactors;[20] (3) processing at H-Canyon/HB-Line and vitrification at DWPF; and (4) preparation for potential disposal as CH-TRU waste at WIPP in H-Canyon/HB-Line at SRS or in H-Canyon/HB-Line at SRS and facilities in TA-55 at LANL such as PF-4.[21] Plutonium disposition options are described in Section S.9.2, and the impacts of each option are described in Appendix G of this *SPD Supplemental EIS*.

Alternatives. DOE evaluates the potential impacts of four action alternatives, which are combinations of the pit disassembly and conversion options and disposition options, as well as a No Action Alternative. **Table S–1** summarizes the pit disassembly and conversion and disposition pathways for the 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium. Each disposition option could be combined with different pit disassembly and conversion options (see **Table S–2**). The action alternatives are: (1) Immobilization to DWPF Alternative – glass can-in-canister immobilization for both surplus non-pit and disassembled and converted pit plutonium and subsequent filling of the canister with HLW at DWPF; (2) MOX Fuel Alternative – fabrication of the disassembled and converted pit plutonium and much of the non-pit plutonium into MOX fuel at MFFF for use in domestic commercial nuclear power reactors to generate electricity, as well as potential disposition of the surplus non-pit plutonium that is not suitable for MFFF as CH-TRU waste at WIPP; (3) H-Canyon/HB-Line to DWPF Alternative – processing the surplus non-pit plutonium in H-Canyon/HB-Line and subsequent vitrification with HLW (in DWPF) and fabrication of the pit plutonium into MOX fuel at MFFF; and (4) WIPP Alternative – preparing for potential disposal as CH-TRU waste at WIPP the surplus non-pit and disassembled and converted pit plutonium in H-Canyon/HB-Line and the K-Area Complex at SRS, or preparing the surplus non-pit plutonium in H-Canyon/HB-Line and the K-Area Complex at SRS and preparing the surplus disassembled and converted pit plutonium in TA-55 facilities at LANL. Each alternative also reflects the MOX disposition path previously designated for 34 metric tons (37.5 tons) of surplus plutonium (65 FR 1608 and 68 FR 20134) (also reflected in Table S–2). The alternatives are described in Section S.9.3 and the impacts of each of the alternatives are described in Chapter 4 of this *SPD Supplemental EIS* and summarized in Section S.12 of this Summary.

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

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

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

[21] In addition to H-Canyon/HB-Line, the K-Area Complex at SRS may also be used to prepare plutonium for potential disposal as CH-TRU waste at WIPP. Plutonium would be prepared for potential WIPP disposal as CH-TRU waste using the same processes as those described for H-Canyon/HB-Line. Minor modifications to the K-Area Complex may be needed to provide this capability.

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

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

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

[a] Only surplus plutonium that would meet the MFFF feed specification would be dispositioned as MOX fuel.
[b] Only surplus plutonium meeting the WIPP waste acceptance criteria would be disposed of at WIPP.
[c] Pits would be disassembled at PF-4 at LANL or at the K-Area Complex at SRS, and plutonium would be converted to plutonium oxide at H-Canyon/HB-Line.
[d] Pits would be disassembled at PF-4 at LANL and plutonium would be converted to plutonium oxide at MFFF.
[e] Includes approximately 0.7 metric tons of unirradiated FFTF fuel.

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

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

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

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

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

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

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

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

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

[f] Pit disassembly could occur at PF-4 at LANL or the K-Area Complex at SRS. Metal from pits disassembled at PF-4 could be converted to plutonium oxide at PF-4 or could be sent to MFFF or HC/HBL at SRS for conversion. Metal from pits disassembled at the K-Area Complex would be converted to plutonium oxide at HC/HBL.

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

S.9.1 Additional Description of Pit Disassembly and Conversion Options

This section describes four options for converting plutonium pits and plutonium metal to a form that is suitable for use in the disposition options. Pit disassembly and conversion capabilities could be located at SRS and LANL. Pits would be transported by the DOE/NNSA Secure Transportation Asset Program[22] operated by NNSA's Office of Secure Transportation from Pantex to PF-4 at LANL, and possibly to K-Area storage at SRS as well, depending on where the capability was ultimately located.

Under all of the pit disassembly and conversion options, in accordance with previous decisions (65 FR 1608; 73 FR 55833), 2 metric tons (2.2 tons) of plutonium would be disassembled and converted to plutonium oxide at PF-4 at LANL and shipped to SRS for fabrication into MOX fuel at MFFF. The Advanced Recovery and Integrated Extraction System (ARIES) line at PF-4 at LANL has been operational since 1998 and production operations are ongoing to provide 2 metric tons (2.2 tons) of plutonium oxide feed for MFFF (DOE 1998, 2008b; LANL 2013).

S.9.1.1 PDCF at F-Area at SRS (PDCF)

Under this option, DOE would construct and operate a stand-alone PDCF at F-Area at SRS, as described in the *SPD EIS* (DOE 1999), to convert plutonium pits and metal to an oxide form that is suitable for feed to MFFF, immobilization, or disposal at WIPP.[23] PDCF would be a new facility constructed at F-Area near MFFF. Pits would be mechanically disassembled. As part of the metal preparation process, plutonium would be mechanically or chemically separated from other materials. The plutonium metal that was bonded with highly enriched uranium or other material would be size-reduced and separated from these materials via a hydride/dehydride process that converts plutonium metal to plutonium hydride, which can be easily removed from other materials. The plutonium hydride would then be converted to plutonium metal or plutonium oxide (DOE 1999). All mechanically or chemically separated plutonium metal would then be converted to plutonium oxide via an oxidation process. The plutonium oxide would be sealed in DOE-STD-3013 containers[24] for transfer to facilities for subsequent disposition.

S.9.1.2 PDC at K-Area at SRS (PDC)

Under this option, PDCF would not be constructed, and an equivalent-capacity PDC would be constructed at K-Area. PDC would be constructed largely within an existing building, with some support facilities outside the building, but within K-Area. Pit disassembly and conversion would take place as described in Section S.9.1.1.

S.9.1.3 PF-4 at LANL and MFFF at SRS (PF-4 and MFFF)

Under this option, a new stand-alone pit disassembly and conversion capability (i.e., PDCF or PDC) would not be constructed at SRS, and DOE would use PF-4 at LANL for pit disassembly and conversion. The existing ARIES capability in PF-4 would be supplemented with equipment to process additional material. Pits would be disassembled, and some plutonium would be converted to plutonium oxide and shipped to SRS by NNSA's Secure Transportation Asset Program. In addition, some of the plutonium could be shipped as metal to MFFF at SRS, where it would be converted to plutonium oxide. Plutonium oxidation furnaces and associated systems and equipment would be installed in MFFF to convert the metal received from LANL to oxide that is suitable for subsequent fabrication into MOX fuel.[25]

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[22] *See Appendix E, Section E.2.4, of this* SPD Supplemental EIS *for a description of some of the security features provided by NNSA's Secure Transportation Asset Program, as well as Section E.5.2, which discusses all of the materials that would be transported by this program.*

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

[24] *Containers that meet the specifications in DOE-STD-3013,* Stabilization, Packaging, and Storage of Plutonium-Bearing Materials *(DOE 2012b).*

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

S.9.1.4 PF-4 at LANL, and H-Canyon/HB-Line and MFFF at SRS (PF-4, H-Canyon/HB-Line, and MFFF)

Under this option, pit disassembly and conversion capabilities would be located at both LANL and SRS. Pit disassembly and conversion would take place in PF-4 at LANL, as described in Section S.9.1.3, and plutonium metal and plutonium oxide would be shipped to SRS for processing at MFFF or H-Canyon/HB-Line. Oxidation furnaces and associated systems and equipment would be installed in MFFF to convert the metal received from LANL to oxide suitable for subsequent disposition. Pit disassembly at SRS could also take place within a glovebox at the K-Area Complex, where pits would be disassembled, resized, packaged, and transported to H-Canyon/HB-Line for metal oxidation. At H-Canyon, pit metal from the K-Area Complex or LANL would be dissolved in existing dissolvers and sent to HB-Line for conversion to plutonium oxide for disposition.

S.9.2 Additional Description of Plutonium Disposition Options

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

S.9.2.1 Immobilization and DWPF

Under this option, plutonium would be immobilized using a can-in-canister immobilization capability to be constructed at K-Area. Non-pit plutonium would be brought to the immobilization capability from K-Area storage, while pit plutonium in metal or oxide form would be brought to the immobilization capability from PDCF or H-Canyon/HB-Line at SRS, or from PF-4 at LANL. Clean oxides not requiring conversion would be stored pending immobilization. Metals and alloys would be converted to oxide in one of two oxidation furnaces housed within gloveboxes. The cladding from the FFTF fuel from the Hanford Site would be removed, and the fuel pellets would be sorted according to fissile material content. Pellets containing plutonium or enriched uranium would be ground to an acceptable particle size for proper mixing. Plutonium oxide feed would be prepared to produce individual batches with the desired composition, and then milled to reduce the size of the oxide powder to achieve faster and more-uniform distribution during the subsequent melting process. The milled oxide would be blended with borosilicate glass frit (i.e., small glass particles) containing neutron absorbers (e.g., gadolinium, boron, hafnium). The mixture would be melted in a platinum/rhodium melter vessel and drained into stainless steel cans. The cans would be loaded into canisters and transferred to DWPF to be filled with an HLW[26]/glass mixture (DOE 1999, 2007b; SRS 2007a, 2007b, 2007c). Filled canisters would be transported to S-Area at SRS for storage pending offsite storage or disposal. Because the cans of immobilized plutonium would displace an equivalent volume of vitrified HLW, approximately 95 additional HLW canisters would be processed at DWPF, assuming 13.1 metric tons (14.4 tons) of plutonium were immobilized using this approach, and stored in S-Area. The immobilization capability and PDC (Section S.9.1.2) are mutually exclusive because there is insufficient space at the K-Area Complex to construct and operate both capabilities.

S.9.2.2 MOX Fuel

Under this option, plutonium would be fabricated into MOX fuel at MFFF, which is currently under construction at F-Area (DOE 2003a). Plutonium oxide from pit disassembly and conversion or from processing some of the non-pit plutonium could serve as feed for MFFF. DOE estimates that, after processing, approximately 4 metric tons (4.4 tons) of the 6 metric tons (6.6 tons) of non-pit plutonium would meet the feed specification for MOX fuel fabrication. This non-pit plutonium would be processed at H-Canyon/HB-Line. As described under the pit disassembly and conversion options in Section S.9.1, plutonium would be shipped from PDCF, PDC, or H-Canyon/HB-Line at SRS, or from PF-4 at LANL.

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

Some of the plutonium from PF-4 could be shipped as metal and converted to plutonium oxide in oxidation furnaces at MFFF or at H-Canyon/HB-Line.

The MOX fuel would be used in domestic commercial nuclear power reactors (65 FR 1608).[27] Appendix I, Section I.1, of this *SPD Supplemental EIS* includes an impact analysis of using MOX fuel in up to five reactors at TVA's Browns Ferry and Sequoyah Nuclear Plants. To support future DOE decisions involving domestic utilities that may be interested in using MOX fuel in one or more of their reactors, a generic reactor impact analysis has been included in Appendix I, Section I.2. Before MOX fuel could be used in any reactor in the United States, the utility operating the reactor would be required to obtain a license amendment from NRC in accordance with 10 CFR Parts 50 or 52.

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

S.9.2.3 H-Canyon/HB-Line and DWPF

Under this option, non-pit plutonium would be brought to H-Canyon/HB-Line from K-Area storage. Plutonium processing in H-Canyon/HB-Line would start with dissolution of the majority of the material that is in oxide form in HB-Line and dissolution of most of the metals in H-Canyon. Unirradiated FFTF fuel would be repackaged into carbon steel containers that are suitable for dissolution in H-Canyon. The dissolved solutions would then be transferred to the separations process. Any uranium present in the solutions would be recovered or discarded to the high-level waste system. The plutonium solutions would be transferred to the Liquid Radioactive Waste Tank Farm, to be combined with HLW, pending vitrification at DWPF. Canister-filling operations in DWPF for these solutions would be similar to the operations described in Section S.9.2.1.

S.9.2.4 WIPP Disposal

Under this option, plutonium would be prepared in facilities at SRS or LANL for potential WIPP disposal. If all 13.1 metric tons (14.4 tons) of surplus plutonium were prepared at SRS for potential disposal at WIPP, non-pit plutonium would be brought to H-Canyon/HB-Line from K-Area storage, while pit plutonium in oxide form would be brought to HB-Line from PDCF, PDC, or H-Canyon/HB-Line at SRS, or PF-4 at LANL. Plutonium metal or oxide in DOE-STD-3013 containers would be shipped to HB-Line, where the containers would be cut open in gloveboxes. Metals would be converted to oxide using an existing or new furnace. Oxide would be repackaged into suitable containers, mixed/blended with inert material, and loaded into POCs or CCOs. Inert material would be added to reduce the plutonium content to less than 10 percent by weight and inhibit plutonium recovery and could include dry mixtures of commercially available materials. The loaded POCs or CCOs would be transferred to E-Area, where WIPP waste characterization activities would be performed. Once the POCs or CCOs have successfully passed the characterization process and meet WIPP waste acceptance criteria, they would be shipped to WIPP in TRUPACT-II [Transuranic Package Transporter Model 2] or HalfPACT shipping containers.

The non-pit plutonium addressed in this *SPD Supplemental EIS* includes unirradiated FFTF fuel. If this FFTF fuel could not be disposed of by direct disposal at WIPP, it would be disassembled at SRS and packaged for disposal at WIPP. H-Canyon would be used to disassemble the fuel bundles, remove the pellets from the fuel pins, and package the pellets into suitable containers. HB-Line could be used to

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

prepare and mix/blend the fuel pellet material with inert material, then package it for shipment to WIPP. Some modifications to H-Canyon and HB-Line may be required (see Appendix B, Section B.1.3).

Surplus plutonium may also be prepared at the K-Area Complex at SRS for potential disposal as CH-TRU waste at WIPP. Plutonium would be prepared for potential WIPP disposal as CH-TRU waste using the same processes as previously described for H-Canyon/HB-Line. Minor modifications to existing equipment and the addition of equipment to handle the inert material at the K-Area Complex may be needed to provide this capability. PDC in K-Area would use much of the same equipment required for preparing plutonium for potential disposal as CH-TRU waste, but with a much larger throughput. Therefore, impacts of preparing surplus plutonium for potential WIPP disposal at the K-Area Complex would be enveloped by those for PDC (see Appendix F).

Under this option, if expanded pit disassembly and conversion were to take place at LANL, 7.1 metric tons (7.8 tons) of pit plutonium could be sent to SRS for additional processing as discussed above or some or all of this pit plutonium could be blended down and packaged at LANL for potential disposal at WIPP. If packaged at LANL, this would eliminate the need to ship this material to SRS for further processing and shorten the shipment route to WIPP once the material was in a form that met the WIPP waste acceptance criteria. After pit disassembly and conversion in PF-4, the resulting plutonium oxide would be blended with inert materials at LANL and packaged for shipment to WIPP using the same process as that discussed above for H-Canyon/HB-Line at SRS. DOE would add capacity to accommodate the increased TRU waste volume, throughput, and temporary storage capacity in TA-55 facilities (see Appendix G for further details). DOE could also use additional equipment or storage capacity at the TRU Waste Facility to be constructed at TA-63 (see Appendix H).

S.9.3 Alternatives

This section describes the No Action and four action alternatives, which are combinations of the pit disassembly and conversion options and plutonium disposition options described above. Each alternative reflects the MOX disposition path previously designated for 34 metric tons (37.5) tons of surplus plutonium (65 FR 1608 and 68 FR 20134), because that surplus plutonium is affected by any decisions made on a pit disassembly and conversion option. In accordance with previous decisions (65 FR 1608; 73 FR 55833), 2 metric tons (2.2 tons) of plutonium would be converted to plutonium oxide at the ARIES line at PF-4 at LANL and shipped to SRS for fabrication into MOX fuel at MFFF. Also, in an interim action determination, approved in June 2012 (DOE 2012a), DOE decided to prepare approximately 2.4 metric tons (2.6 tons) of plutonium metal and oxide as feed material for the MFFF using H-Canyon/HB-Line at SRS.

S.9.3.1 No Action Alternative

Under the No Action Alternative, the 13.1 metric tons (14.4 tons) of surplus plutonium analyzed in this *SPD Supplemental EIS* would be managed through the approaches illustrated in **Figure S–9**. Up to 6 metric tons (6.6 tons) of surplus non-pit plutonium would be stored at the K-Area Complex at SRS, consistent with the 2002 amended ROD for the *Storage and Disposition PEIS* (67 FR 19432); the *Supplement Analysis, Storage of Surplus Plutonium Materials at the Savannah River Site* (DOE/EIS-0229-SA-4) (DOE 2007a); and an amended ROD issued in 2007 (72 FR 51807). The 7.1 metric tons (7.8 tons) of the 9 metric tons (9.9 tons) of pit plutonium declared excess in 2007 (see Chapter 1, Figure 1–7) would remain in storage at Pantex, consistent with the 1997 ROD for the *Storage and Disposition PEIS* (62 FR 3014), the 1997 ROD for the *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (62 FR 3880), and the 2012 *Final Supplement Analysis for the Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (DOE 2012d).[28]

[28] *The remaining 1.9 metric tons (2.1 tons) of pit plutonium declared excess in 2007 are included in the 34 metric tons (37.5 tons) already designated for fabrication into MOX fuel at MFFF (see Section S.4).*

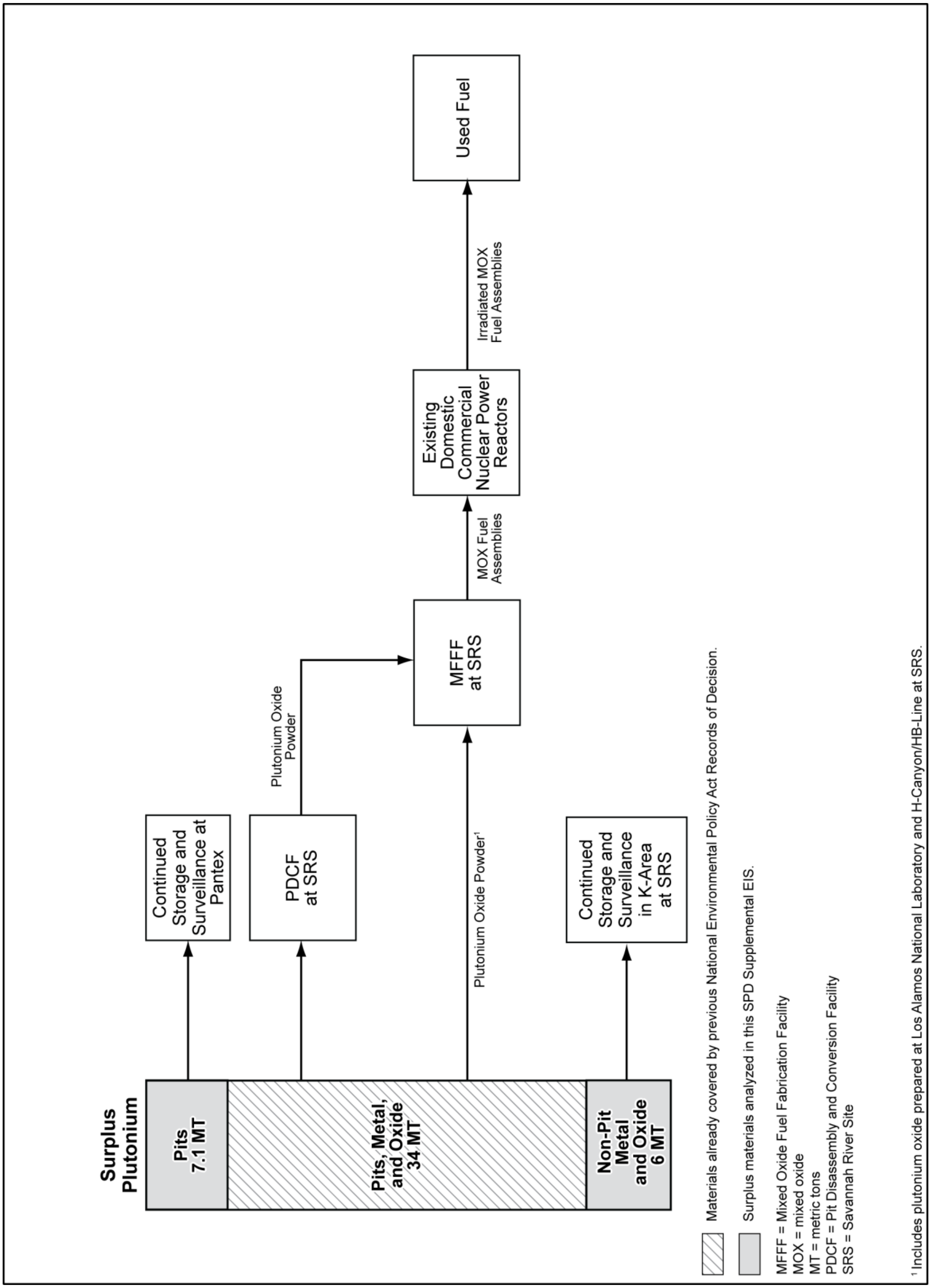


Figure S–9 No Action Alternative

In its 2000 ROD (65 FR 1608) and 2003 amended ROD (68 FR 20134) for the *SPD EIS*, DOE decided to disposition 34 metric tons (37.5 tons) of surplus plutonium as MOX fuel. Pits would be disassembled and the 27.5 metric tons (30.3 tons) of disassembled pits and other plutonium metal would be converted to plutonium oxide at PDCF, as described in Chapter 2, Section 2.1.1. The 34 metric tons (37.5 tons) of plutonium would be fabricated into MOX fuel at MFFF, as described in Chapter 2, Section 2.2.2, for use at domestic commercial nuclear power reactors.

Since the issuance of the *SPD EIS*, there have been changes in the MOX fuel program. The 1999 *SPD EIS* addressed the potential environmental impacts of using MOX fuel in Duke Energy and Virginia Power nuclear reactors. Neither company is part of the MOX fuel program at this time. Therefore, the No Action Alternative for this *SPD Supplemental EIS* only addresses the use of MOX fuel at generic reactor sites. Under the No Action Alternative, TVA would not receive MOX fuel from DOE.

S.9.3.2 Immobilization to DWPF Alternative

This alternative evaluates disposition of 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium by immobilization and vitrification with HLW, while, as under the No Action Alternative, 34 metric tons (37.5 tons) of surplus plutonium would be dispositioned as MOX fuel. Under the Immobilization to DWPF Alternative, the surplus plutonium addressed in this *SPD Supplemental EIS* would be dispositioned through the approaches illustrated in **Figure S–10**. The 7.1 metric tons (7.8 tons) of pit plutonium and 6 metric tons (6.6 tons) of non-pit plutonium would be immobilized, as described in Section S.9.2.1. The 34 metric tons (37.5 tons) addressed in previous decisions would be fabricated into MOX fuel and dispositioned, as discussed in Section S.9.2.2.

Plutonium immobilization would need to be completed consistent with DOE's program for HLW vitrification; this program has been developed in accordance with applicable permits and consent orders. DOE expects that there would be insufficient HLW with the characteristics needed to enable vitrification of more than approximately 6 metric tons (6.6 tons) of surplus plutonium. Under these conditions, it is possible that the remaining approximately 7.1 metric tons (7.8 tons) of plutonium could not be immobilized and vitrified under this alternative, but would need to be dispositioned by another method.

As noted in Section S.9.2.1, the immobilization capability and PDC (Section S.9.1.2) are mutually exclusive because there is insufficient space at the K-Area Complex to construct and operate both capabilities. Therefore, only three options for pit disassembly and conversion are possible under the Immobilization to DWPF Alternative: PDCF; PF-4 and MFFF; or PF-4, H-Canyon/HB-Line, and MFFF. These options are discussed in Section S.9.1.

S.9.3.3 MOX Fuel Alternative

The MOX Fuel Alternative would maximize the disposition of surplus plutonium as MOX fuel. Under this alternative, surplus plutonium would be dispositioned using the approaches illustrated in **Figure S–11**.

The 7.1 metric tons (7.8 tons) of surplus pit plutonium and 4 metric tons (4.4 tons) of surplus non-pit plutonium, along with the 34 metric tons (37.5 tons) of surplus plutonium addressed in previous decisions (for a total of 45.1 metric tons [49.7 tons]), would be fabricated into MOX fuel at MFFF, as described in Section S.9.2.2. The 2 metric tons (2.2 tons) of non-pit plutonium that could not meet the criteria for MOX feed would be prepared at H-Canyon/HB-Line and the K-Area Complex at SRS for potential disposal as CH-TRU waste at WIPP in accordance with the WIPP waste acceptance criteria, as described in Section S.9.2.4. The four options for pit disassembly and conversion under the MOX Fuel Alternative are discussed in Section S.9.1.

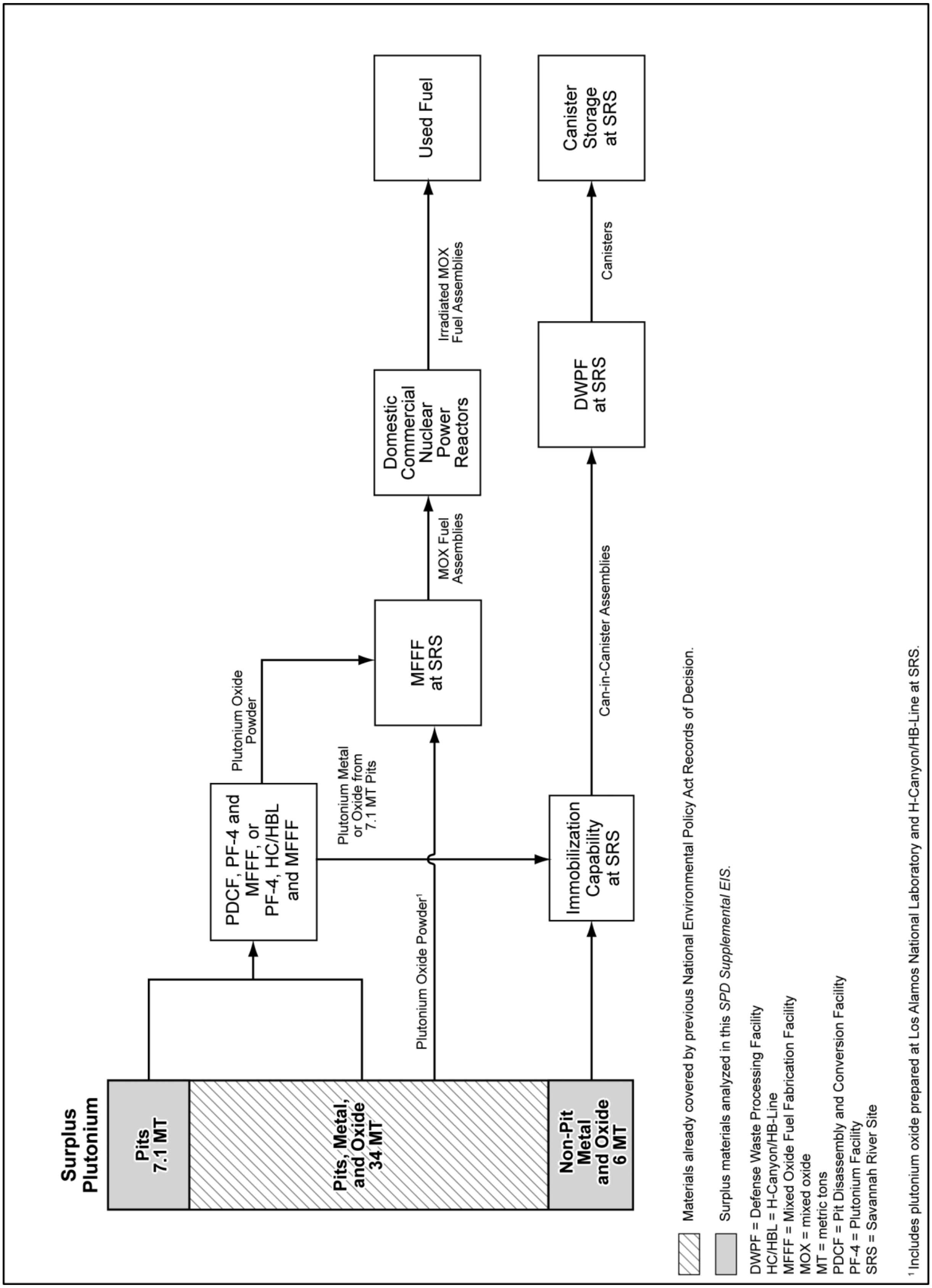


Figure S–10 Immobilization to DWPF Alternative

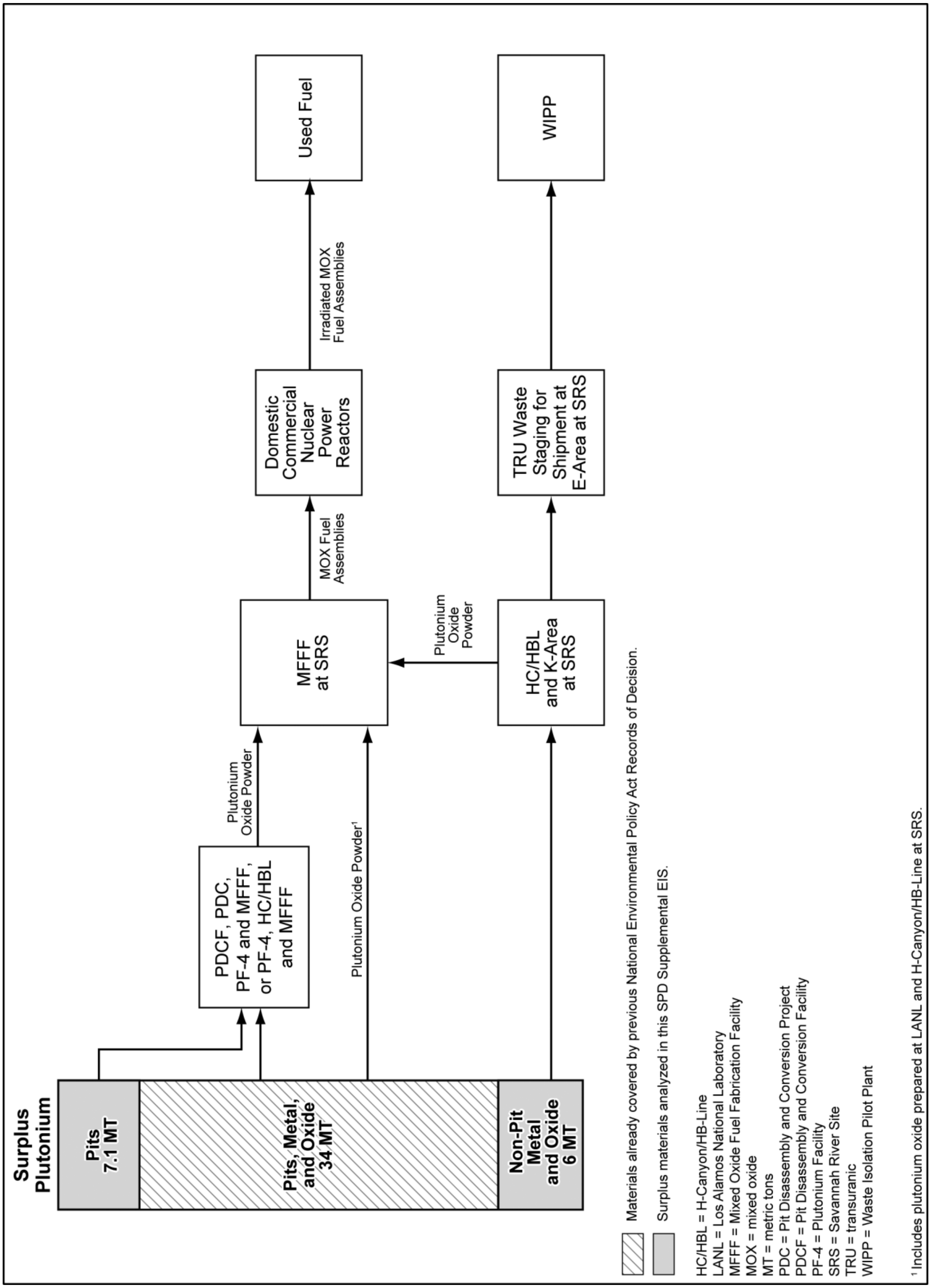


Figure S–11 MOX Fuel Alternative

S.9.3.4 H-Canyon/HB-Line to DWPF Alternative

The H-Canyon/HB-Line to DWPF Alternative evaluates disposition of 6 metric tons (6.6 tons) of surplus non-pit plutonium through H-Canyon/HB-Line and disposition of 7.1 metric tons (7.8 tons) of surplus pit plutonium as MOX fuel using the approaches illustrated in **Figure S–12**. The 6 metric tons (6.6 tons) of surplus non-pit plutonium would be processed in H-Canyon/HB-Line, with subsequent vitrification with HLW at DWPF, as described in Section S.9.2.3. Pit plutonium is not considered for dissolution and vitrification with HLW because there would be insufficient HLW with the characteristics needed to vitrify more than approximately 6 metric tons (6.6 tons) of surplus plutonium. The 7.1 metric tons (7.8 tons) of surplus pit plutonium, along with the 34 metric tons (37.5 tons) of surplus plutonium addressed in previous decisions (for a total of 41.1 metric tons [45.3 tons]), would be fabricated into MOX fuel at MFFF with subsequent irradiation in domestic commercial nuclear power reactors as described in Section S.9.2.2. The four options for pit disassembly and conversion under this alternative would be the same as those under the MOX Fuel Alternative.

S.9.3.5 WIPP Alternative

The WIPP Alternative evaluates potential disposition of 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium at WIPP using the approaches illustrated in **Figure S–13**. The 6 metric tons (6.6 tons) of non-pit plutonium would be prepared at H-Canyon/HB-Line and the K-Area Complex at SRS, and the 7.1 metric tons (7.8 tons) of surplus pit plutonium could be prepared at a combination of facilities using H-Canyon/HB-Line and the K-Area Complex at SRS and/or TA-55 facilities at LANL. The pit and non-pit plutonium would be prepared to meet the WIPP waste acceptance criteria and would potentially be disposed of at WIPP as CH-TRU waste, as described in Section S.9.2.4. The four options for pit disassembly and conversion under this alternative would be the same as those under the MOX Fuel Alternative.

S.10 Alternatives Considered but Dismissed from Detailed Study

DOE identified the following alternatives, which were considered for evaluation but ultimately dismissed from detailed study in this *SPD Supplemental EIS*, as discussed in Sections S.10.1 through S.10.3: (1) the ceramic can-in canister approach to immobilization for any of the 13.1 metric tons (14.4 tons) of surplus plutonium; (2) disposition of the entire 13.1 metric tons (14.4 tons) of surplus plutonium using the MOX fuel approach; and (3) disposition of the entire 13.1 metric tons (14.4 tons) of surplus plutonium using H-Canyon/HB-Line and DWPF.

In addition, public comments received in response to the proposed action and upon review of the *Draft SPD Supplemental EIS* provided suggestions for alternative methods to achieve DOE's purpose and need. Some of these alternatives appear to have called for analyses duplicated in previous NEPA documents that are also applicable to the proposed actions in this *SPD Supplemental EIS*, involved national security and international policy concerns, or were outside the scope of DOE's purpose and need.[29] DOE considered these other alternatives but dismissed them from detailed consideration, as discussed in Sections S.10.4 through S.10.9.

[29] *The Foreword refers to DOE's Plutonium Disposition Working Group options study which assesses options that could potentially provide a more cost-effective approach for the disposition of surplus U.S. weapons-grade plutonium. While the options paper included technologies dismissed in previous NEPA documents, the reasons for dismissal of these technologies remain valid for the disposition of 13.1 metric tons (14.4 tons) of surplus plutonium that is the subject of this* SPD Supplemental EIS.

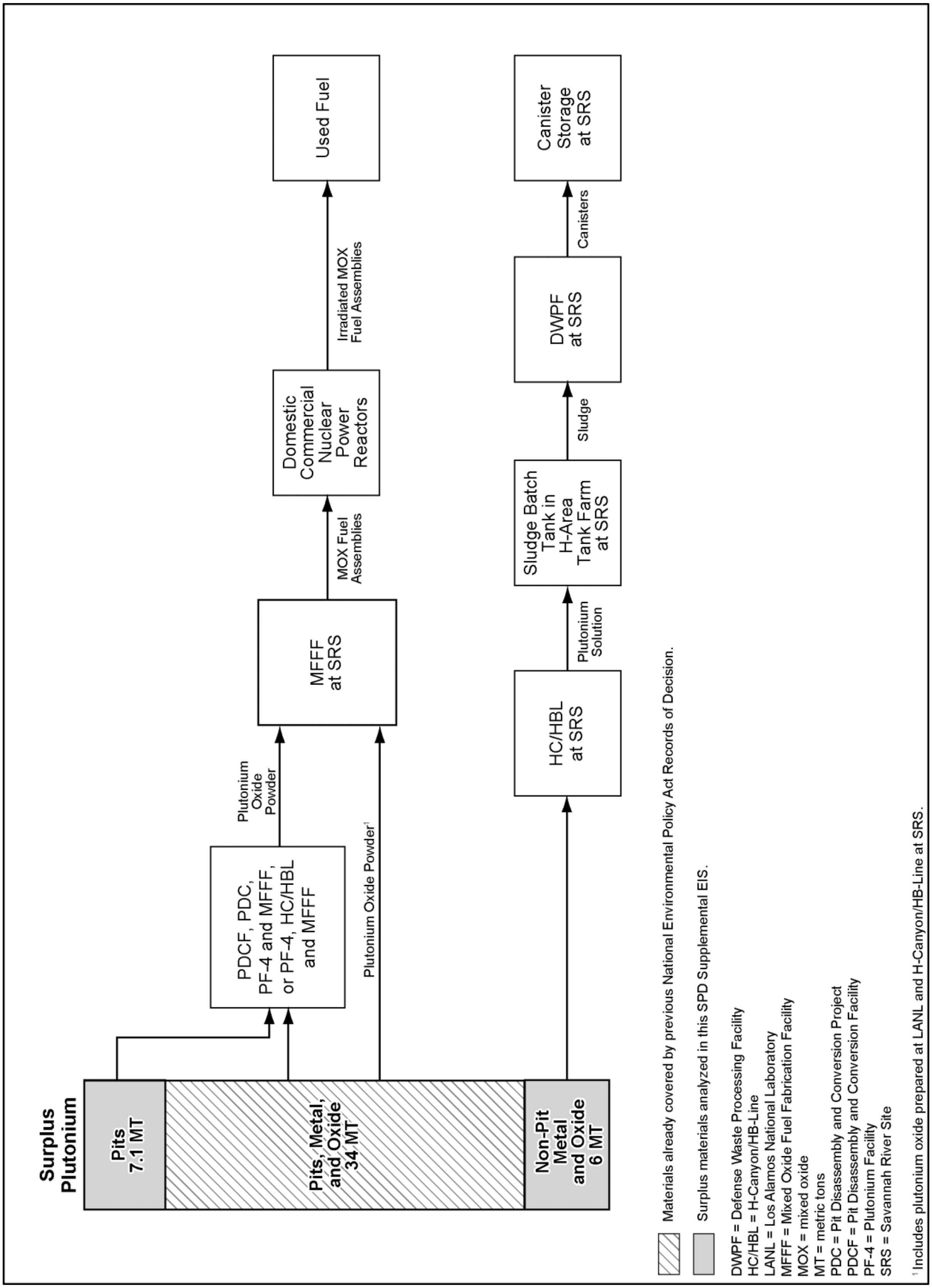
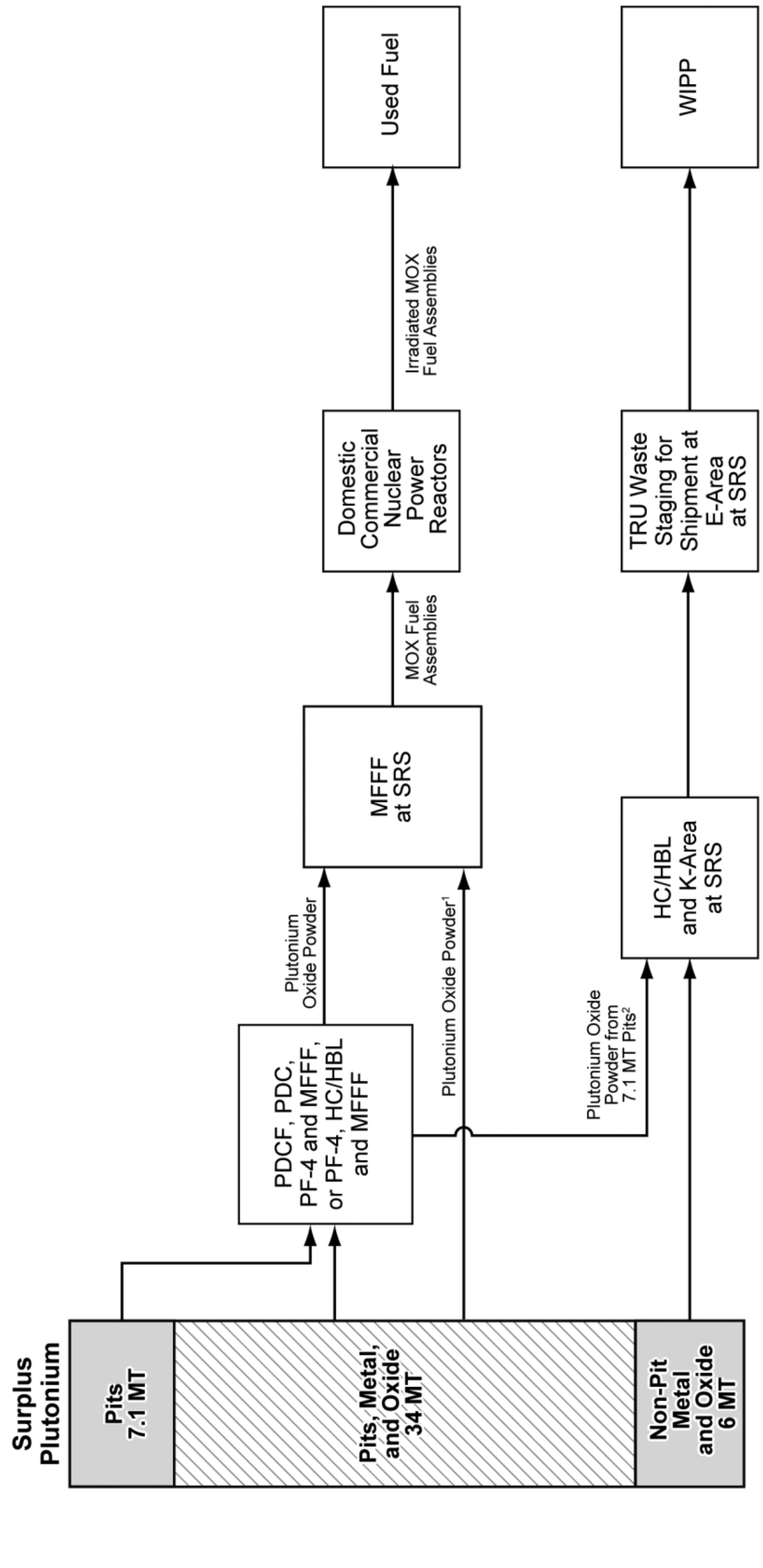


Figure S–12 H-Canyon/HB-Line to DWPF Alternative



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

Surplus materials analyzed in this SPD Supplemental EIS.

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

[1] Includes plutonium oxide prepared at LANL and H-Canyon/HB-Line at SRS.
[2] This material may be prepared at Technical Area 55 and staged at TRU waste management facilities at LANL for WIPP disposal.

Figure S–13 WIPP Alternative

S.10.1 Ceramic Can-in-Canister Approach

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

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

In contrast, DOE has maintained research, development, and production infrastructure capabilities for glass waste forms. In 2003, work began on qualifying the waste form for inclusion in the Yucca Mountain Geologic Repository license application pursuant to 10 CFR Part 63.[30] Understanding of the glass approach has also benefited from parallel work to develop or qualify similar processes for other applications, including the immobilization of HLW.

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

S.10.2 Disposition of 13.1 Metric Tons (14.4 tons) of Surplus Plutonium Using the MOX Fuel Approach

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

[30] *DOE has terminated the program for a geologic repository for used nuclear fuel and HLW at Yucca Mountain, Nevada. Notwithstanding the decision to terminate the Yucca Mountain program, DOE remains committed to meeting its obligations to manage and ultimately dispose of used nuclear fuel and HLW. DOE established the Blue Ribbon Commission on America's Nuclear Future to conduct a comprehensive review and evaluate alternative approaches for meeting these obligations. The Commission report to the Secretary of Energy of January 26, 2012* (BRCANF 2012) *provided a strong foundation for the Administration's January 2013* Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste (DOE 2013f). *This Strategy provides a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel and HLW from civilian nuclear power generation, defense, national security, and other activities. The link to the strategy is http://energy.gov/downloads/strategy-management-and-disposal-used-nuclear-fuel-and-high-level-radioactive-waste. Full implementation of this Strategy will require legislation.*

2 metric tons (2.2 tons) of the surplus non-pit plutonium is not considered to be viable for processing at MFFF and, therefore, an alternative that considers disposal of the entire 13.1 metric tons (14.4 tons) of surplus plutonium using the MOX fuel approach was not evaluated.

S.10.3 Disposition of 13.1 Metric Tons (14.4 tons) of Surplus Plutonium Using H-Canyon/HB-Line and DWPF

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

S.10.4 Direct Deep Borehole Disposal of Surplus Plutonium

Commentors suggested that DOE consider direct disposal of surplus plutonium. Direct disposal of surplus plutonium in a deep borehole was evaluated in the *Storage and Disposition PEIS* (DOE 1996). This approach is not considered in detail in this *Final SPD Supplemental EIS* for the reasons given in the Record of Decision for the *Storage and Disposition PEIS* (62 FR 3014).

S.10.5 Disposal of 13.1 Metric Tons of Surplus Plutonium at a Second Repository Similar to the Waste Isolation Pilot Plant

This *Final SPD Supplemental EIS* considers disposal at WIPP of 13.1 metric tons (14.4 tons) of plutonium as a reasonable alternative because disposal of this amount could potentially be accomplished within WIPP's unsubscribed capacity,[31] which is based on estimates contained in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012c). Commentors on the *Draft SPD Supplemental EIS* suggested that DOE consider disposal of the surplus plutonium in a new repository that would be similar to WIPP. A second repository similar to WIPP would not be needed to dispose of the surplus plutonium that is the subject of this *SPD Supplemental EIS*. Based on estimates in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012c), WIPP has sufficient capacity to accommodate disposition of all 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned. The WIPP Alternative (see Section S.9.3.5) has been revised since the *Draft SPD Supplemental EIS* was issued to include this possibility (see Section S.6).

S.10.6 Pit Disassembly and Conversion at the Pantex Plant

Commentors suggested that DOE consider locating all pit disassembly and conversion activities at Pantex, the location where the pits are stored. Pit disassembly and conversion at Pantex was evaluated in the *SPD EIS* (DOE 1999). In the *SPD EIS* ROD (65 FR 1608), DOE selected construction of a PDCF at SRS over Pantex because Pantex possesses neither the experience nor the infrastructure needed to support plutonium processing. Although DOE is reconsidering the decision to build a PDCF at SRS and is looking at other options, including using PF-4 at LANL, DOE is not reconsidering pit disassembly and conversion at Pantex for the reasons set forth in the *SPD EIS* ROD.

[31] *If POCs were used to dispose of all 13.1 metric tons (14.4 tons) of surplus plutonium at WIPP, the cumulative CH-TRU waste volume would exceed the unsubscribed WIPP disposal capacity by approximately 8 percent. However, direct disposal of FFTF fuel and the use of CCOs would result in approximately 65 percent of the unsubscribed WIPP disposal capacity being used.*

S.10.7 Modification of the MOX Fuel Fabrication Facility to Incorporate Pit Disassembly and Conversion

A commentor suggested that DOE consider modifying MFFF to perform pit disassembly and conversion activities. This *SPD Supplemental EIS* includes options that would allow plutonium conversion to take place in a modified MFFF (see Sections S.9.1.3 and S.9.1.4); plutonium metal would be received in an unclassified form and converted to oxide. DOE did not evaluate an option that would allow pit disassembly to take place in a modified MFFF due to security, design, and licensing considerations.

S.10.8 Outsourcing Surplus Plutonium Disposition Activities to Foreign Entities Already Involved in Similar Activities

A commentor suggested that DOE consider outsourcing surplus plutonium disposition activities to other countries, such as France or Russia, that already fabricate or are planning to fabricate MOX fuel. DOE did not consider sending pits to a foreign country for disassembly and conversion for a number of reasons; sending U.S. pits or plutonium from pits to a foreign country would involve nonproliferation and national security concerns among others.

S.10.9 Surplus Plutonium Disposition Using the Liquid Fluoride Thorium Reactor Technology

A commentor suggested that DOE consider using a liquid fluoride thorium reactor to disposition the 13.1 metric tons (14.4 tons) of surplus plutonium under consideration in this document. The *Storage and Disposition PEIS* (DOE 1996) considered the use of molten salt reactors, such as a liquid fluoride thorium reactor, for plutonium disposition and concluded that the technology was immature. Despite the length of time since the *Storage and Disposition PEIS* was issued, this technology is still immature. There would be a long and costly development and demonstration effort associated with any attempt to establish these reactors as viable options for plutonium disposition. If this reactor technology is developed and successfully operated, it may be considered in future NEPA analyses.

S.11 Preferred Alternative

DOE has no Preferred Alternative at this time for the disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium that is the subject of this *SPD Supplemental EIS*. Also, DOE has no Preferred Alternative regarding the sites or facilities to be used to prepare surplus plutonium metal for disposition (i.e., pit disassembly and conversion capability). Consistent with the requirements of NEPA, once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a ROD no sooner than 30 days after its announcement of a Preferred Alternative.

This *SPD Supplemental EIS* evaluates disposition alternatives that include irradiation of MOX fuel in TVA reactors, subject to appropriate amendments to the applicable licenses from the NRC. TVA is a cooperating agency for this *SPD Supplemental EIS* and, as such, is not required to declare a preferred alternative. TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.

S.12 Summary of Environmental Consequences

This section summarizes the impact analyses for the alternatives evaluated in this *SPD Supplemental EIS*. Section S.12.1 summarizes the potential consequences of each alternative by resource area at SRS and LANL, as well as potential domestic commercial nuclear power reactor sites. Section S.12.2 is a summary of the cumulative impacts analysis that considers the consequences of the proposed alternatives in the context of other past, present, and reasonably foreseeable future actions. See Chapter 2, Section 2.6, of this *SPD Supplemental EIS*, for more information.

S.12.1 Comparison of Potential Consequences of Alternatives

Table S–3 at the end of this section summarizes the potential impacts of the alternatives evaluated in this *SPD Supplemental EIS* at SRS and LANL. Under the WIPP Alternative, the impacts in Table S–3 reflect preparation at SRS of 13.1 metric tons (14.4 tons) of surplus plutonium for potential WIPP disposal, including 7.1 metric tons (7.8 tons) of pit plutonium. Some or all of this pit plutonium could instead be prepared at TA-55 facilities at LANL. DOE has included a qualitative evaluation of the impacts of preparing pit plutonium at LANL for potential disposal at WIPP in Chapter 4 and Appendix G; these impacts are not included in Table S–3. Use of LANL facilities to prepare pit plutonium for potential disposal at WIPP may require additional NEPA analysis. In addition, under the MOX Fuel and WIPP Alternatives, the impacts in Table S-3 reflect the assumption that preparation of plutonium at SRS for potential WIPP disposal would occur at H-Canyon/HB-Line. This activity could also occur at the K-Area Complex with impacts enveloped by those assessed in Appendix F for construction and operation of the PDC at K-Area.

Impacts on key resource areas at these DOE sites (i.e., air quality, human health, socioeconomics, waste management, transportation, and environmental justice) are discussed in the following paragraphs. The remaining resource areas (i.e., land resources, geology and soils, water resources, noise, ecological resources, cultural resources, and infrastructure) are likely to experience minimal or no impacts regardless of the alternative being considered and, therefore, are analyzed in less detail.

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

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

Greenhouse gases emitted by operations of the proposed surplus plutonium disposition facilities at SRS and LANL would add a relatively small increment to emissions of these gases in the United States and the world. Overall greenhouse gas emissions in the United States during 2010 totaled about 6.8 billion metric tons (7.5 billion tons) of carbon dioxide equivalent[32] (EPA 2012). By way of comparison, increases in annual operational emissions of greenhouse gases from the proposed surplus plutonium disposition facilities at SRS and LANL (up to 180,000 metric tons [200,000 tons]) would equal about 0.003 percent of the United States' total emissions in 2010. However, emissions from the proposed

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

surplus plutonium disposition facilities at SRS and LANL would contribute incrementally to climate change impacts. At present, there is no methodology that would allow DOE to estimate the specific impacts that this increment of climate change would produce in the vicinity of these facilities or elsewhere.

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

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

The annual collective worker dose during operations of all required capabilities at LANL and SRS under each alternative is estimated to range from approximately 310 person-rem under the H-Canyon/HB-Line to DWPF Alternative with the PF-4 and MFFF Option for pit disassembly and conversion to approximately 680 person-rem under the Immobilization to DWPF Alternative with the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion. Based on exposures over the operating life of the plutonium disposition facilities required under each alternative, 3 LCFs (under the No Action, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives with the PDCF or PDC Option for pit disassembly and conversion) to 7 LCFs (under the Immobilization to DWPF Alternative with the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion) could occur among the facilities' radiation workers. Worker doses would be monitored and controlled to ensure that individual doses do not exceed 2,000 millirem per year and are kept as low as reasonably achievable (ALARA) to limit the potential health effects of these worker doses, thereby reducing the likelihood of any LCFs resulting from the proposed activities.

Latent Cancer Fatalities

The most significant effects of radiation exposure are induced cancer fatalities, called latent cancer fatalities (LCFs) because the onset of cancer generally occurs many years after the radiation dose is received. In this *SPD Supplemental EIS*, LCFs are used to measure the estimated risk due to radiation exposure and compare impacts among the alternatives. A factor of 0.0006 LCFs per rem or person-rem is used to calculate the risk associated with individual radiation dosesless than 20 rem; for acute individual doses above 20 rem, the risk factor is doubled (NCRP 1993). Other effects of exposure to low doses of radiation include mutagenic effects that can be passed to subsequent generations; the estimated risk from effects that can be inherited are about 3 to 4 percent of the nominal fatal cancer risk (Valentin 2007).

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

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

The annual dose to the population[33] surrounding SRS from operation of the proposed plutonium disposition activities would range from 0.45 to 0.97 person-rem across the alternatives, resulting in no LCFs. The annual dose to the offsite MEI from SRS operations of the proposed plutonium disposition activities would range from 0.0052 to 0.010 millirem across the alternatives, resulting in an annual risk of a latent fatal cancer ranging from 1 chance in 170 million to 1 chance in 330 million.

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

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

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

Defense Nuclear Facilities Safety Board (DNFSB) Concerns

In response to DNFSB concerns, the U.S. Department of Energy (DOE) provided a report on its assessment of the current state of public and worker protection for Plutonium Facility (PF 4) seismic accident scenarios and the risk reduction measures to be applied to mitigate near-term seismic risks (DOE 2013a). Consistent with DOE's requirements, a re-evaluation of seismic data, assumptions, and modeling was performed. This re-evaluation determined that PF 4 could undergo a collapse in a severe earthquake (one with peak ground motion that could occur on the order of once in ten thousand years).

Actions taken to date have both reduced the potential for collapse of PF 4 and reduced the magnitude of release that may occur. Currently, the analysis shows that the building provides its intended confinement safety function for an earthquake of an annual probability of exceedance of 1.2×10^{-4}. This is within the DOE Standard 1020 allowance provided for existing facilities (i.e., 2×10^{-4}).

DOE is taking the following near-term measures to further reduce risk at PF-4: 1) Reduce the first floor plutonium inventory limit; 2) Reduce the vault plutonium inventory limit; 3) Implement a new safety-class container for heat source plutonium, which is predominantly plutonium-238; and 4) Remove one kilogram of heat-source plutonium from the PF-4 first floor. Additionally, conceptual designs have been developed for two structural modifications that will further reduce the probability of collapse and will be installed during the next 2 to 3 years.

Based on current seismic analysis showing that PF 4 can provide its confinement safety function and on near-term risk reduction measures that reduce potential consequences, DOE determined that PF 4 can continue to operate safely while longer-term structural modifications are completed (DOE 2013a). Responding to DNFSB concerns with the current seismic analysis, an alternate analysis is being performed. DOE believes this alternate analysis will be helpful in understanding further the seismic integrity of the PF-4 facility and providing assurance that all of its structural elements that require updating are identified (DOE 2013e).

In response to DNFSB concerns regarding criticality safety at Los Alamos National Laboratory (LANL) (DNFSB 2013, 2014), DOE responded with information on corrective actions, commitments to complete causal analysis and needed improvements to the criticality safety program; as a precautionary measure, the LANL Director paused PF-4 programmatic operations (DOE 2013d, 2013g). Subsequent LANL actions included revision of program management plans to improve performance in Conduct of Operations and Nuclear Criticality Safety. DOE is taking a deliberate approach to resuming operations, requiring high-risk operations to undergo a Federal readiness assessment. These assessments validate that criticality safety controls are identified and implemented to ensure safety in operations.

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

Based on information presented in this *SPD Supplemental EIS* and the *SPD EIS* (DOE 1999), normal operation of reactors using partial MOX cores as opposed to LEU cores is not expected to result in any greater doses to the general population surrounding the reactor[34] or the MEI. Doses from normal operation of the TVA reactors are very low and are not expected to result in any additional LCFs among the public.

Human Health – Accidents. The risks to the MEI and the general population from accidents at SRS and LANL are very small, taking into account the probabilities and consequences of the accidents. The most severe consequences of design-basis accidents and beyond-design-basis accidents are for accidents in the extremely unlikely (probability of 1 in 10,000 to 1 in 1 million per year) or beyond extremely unlikely (probability of less than 1 in 1 million per year) frequency categories. These postulated accidents are not expected to occur over the life of a facility.

Under the No Action Alternative, the limiting design-basis accident at SRS would be an overpressurization of a plutonium oxide storage can at PDCF under the PDCF Option for pit disassembly and conversion. This accident would result in no LCFs in the general population, should it occur. If the accident were to occur, the probability of the MEI dose (0.52 rem) resulting in a latent fatal cancer would be about 1 chance in 3,300; the probability of the noninvolved worker dose (4.5 rem) resulting in a latent fatal cancer would be about 1 chance in 330.

Under the Immobilization to DWPF Alternative, the limiting design-basis operational accident at SRS would be an explosion in a K-Area metal oxidation furnace during immobilization activities. This accident would result in no LCFs in the general population, should it occur. It the accident were to occur, the probability of the MEI dose (2.1 rem) resulting in a latent fatal cancer would be about 1 chance in 1,000; the probability of the noninvolved worker dose (27 rem) resulting in a latent fatal cancer would be about 1 chance in 33.

Under the MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives, the limiting design-basis operational accident for the population at SRS would be a level-wide fire in HB-Line. This accident would result in no LCFs in the general population, should it occur. The limiting design-basis operational accident for the MEI would be overpressurization of a plutonium oxide storage can at PDCF; if the accident were to occur, the probability of the dose (0.52 rem) resulting in a latent fatal cancer would be about 1 chance in 3,300. The limiting design-basis operational accident for the noninvolved worker would be an overpressurization of a plutonium oxide storage can at the K-Area Complex or PDCF; if the accident were to occur, the probability of the noninvolved worker dose (4.5 rem) resulting in a latent fatal cancer would be about 1 chance in 330.

Under all alternatives, the limiting design-basis operational accident at LANL for the general public, the MEI, and the noninvolved worker would be from a hydrogen deflagration incident resulting from dissolution of plutonium metal. This accident, should it occur, would result in no LCFs in the general population. The probability of the MEI dose (0.11 rem) resulting in a latent fatal cancer would be about 1 chance in 14,000; the probability of the noninvolved worker dose (3.7 rem) resulting in a latent fatal cancer would be about 1 chance in 500.

Under all alternatives, the maximum design-basis, natural-phenomenon-initiated accident at SRS would be a design-basis earthquake with fire. This accident is considered unlikely to beyond extremely unlikely. Such an accident could affect multiple facilities supporting the disposition of surplus plutonium. Under all alternatives, this accident would result in no LCFs in the general population, should it occur. The MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives would have the largest impacts; should a design-basis earthquake with fire occur at SRS under any of these alternatives, the probability of a latent fatal cancer to the MEI would be about 1 chance in 3,300. Should this accident occur under the

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

Immobilization to DWPF Alternative with the PF-4 and MFFF Option for pit disassembly and conversion, it would result in the lowest risk to the MEI at SRS. The increased risk of a latent fatal cancer, should the accident occur, would be about 1 chance in 50,000. The risks of a latent fatal cancer to the MEI at SRS under the other alternative and pit disassembly and conversion option combinations range from about 1 chance in 3,300 to 1 chance in 10,000. If this accident were to occur, the probability of the noninvolved worker at SRS developing a fatal cancer would range from about 1 chance in 1,000 to 1 chance in 3,300.

Under any of the alternatives, the maximum design-basis, natural-phenomenon-initiated accident at LANL would be a design-basis earthquake with spill plus fire. This accident is considered extremely unlikely and would likely result in no LCFs in the general population, should it occur. Under the pit disassembly and conversion options involving processing 2 metric tons (2.2 tons) of plutonium at LANL (the PDCF and PDC Options for pit disassembly and conversion), if this accident were to occur, the probability of the MEI developing a latent fatal cancer would be about 1 chance in 10,000; the probability of a noninvolved worker at LANL developing a latent fatal cancer would be about 1 chance in 250. For the PF-4 and MFFF and the PF-4, H-Canyon/HB-Line, and MFFF Options for pit disassembly and conversion, which involve a higher level of pit disassembly and conversion in PF-4, if this accident were to occur, the probability of the MEI developing a latent fatal cancer would be about 1 chance in 5,000; the probability of a noninvolved worker developing a latent fatal cancer would be about 1 chance in 170.

The maximum evaluated beyond-design-basis accident at SRS or LANL under all alternatives would be an earthquake that could result in severe damage to the facilities followed by fires. This accident is considered extremely unlikely to beyond extremely unlikely. This accident would result in 3 to 16 LCFs among the general population surrounding SRS from radiation exposure and uptake of radionuclides, should it occur. A similar accident at LANL involving pit disassembly and conversion activities would result in 2 to 3 LCFs among the general population surrounding LANL from radiation exposure and uptake of radionuclides, should it occur.

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

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

Socioeconomics. Peak construction direct employment at SRS would range from 275 under the Immobilization to DWPF, MOX Fuel, or H-Canyon/HB-Line to DWPF Alternatives with the PF-4 and MFFF Option for pit disassembly and conversion, to a maximum of 943 under the Immobilization to DWPF Alternative with the PDCF Option for pit disassembly and conversion. These construction efforts are expected to result in indirect employment in the area surrounding SRS ranging from 173 to 595 jobs. Peak construction direct employment at LANL would range from 0 to 46, with the higher value related to modification of pit disassembly and conversion activities in PF-4 to support a higher level of pit disassembly and conversion in PF-4. These construction efforts are expected to result in indirect employment in the area surrounding LANL ranging from 0 to 26 jobs. The total change in employment related to construction would represent less than 1 percent of the region of influence (ROI) labor force under all alternatives for both SRS and LANL.

Under all alternatives, the additional workers required for operations at SRS would help offset recent reductions in other activities at the site. Peak operations direct employment would range from 1,202 under the H-Canyon/HB-Line to DWPF Alternative with the PF-4 and MFFF Option for pit disassembly and conversion, to 2,111 under the Immobilization to DWPF Alternative with the PDCF Option for pit disassembly and conversion. These operations-related jobs are expected to result in indirect employment in the area surrounding SRS ranging from 1,430 to 2,511 jobs. The total change in employment related to operations would represent 1.0 to 1.6 percent of the SRS ROI labor force under all alternatives. When considered in conjunction with planned reductions in the workforce at SRS, it is expected that the local housing market would be able to absorb any in-migration of workers resulting from implementation of any of the alternatives. Likewise, the flow of traffic on main transportation corridors to and from the site would remain largely unchanged.

LANL peak operations direct employment would range from 149 under all of the alternatives that include the PDCF or PDC Option for pit disassembly and conversion to 493 under all of the action alternatives that include increased pit disassembly and conversion activities at LANL (i.e., either the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Option). These operations-related jobs are expected to result in indirect employment in the area surrounding LANL ranging from 151 to 499 jobs. The total change in employment related to operations would represent less than 1 percent of the LANL ROI labor force under all alternatives. It is expected that the local housing market would be able to absorb any in-migration of workers resulting from implementation of any of the alternatives. Likewise, the flow of traffic on main transportation corridors to and from the site would remain largely unchanged.

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

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

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

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

- CH-TRU waste – up to 27,000 cubic meters (950,000 cubic feet) under the WIPP Alternative with pit disassembly and conversion accomplished under the PF-4, H-Canyon/HB-Line, and MFFF Option
- MLLW – up to 1,000 cubic meters (35,000 cubic feet) under the Immobilization to DWPF Alternative if all 13.1 metric tons (14.4 tons) of plutonium were immobilized and pit disassembly and conversion was accomplished under either the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Option
- LLW – up to 34,000 cubic meters (1.2 million cubic feet) under the MOX Fuel Alternative with pit disassembly and conversion accomplished under the PDC Option

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

All alternatives would also generate CH-TRU waste. The total WIPP capacity for TRU waste disposal is currently set at 175,600 cubic meters (6.2 million cubic feet) by the WIPP Land Withdrawal Act. Based on agreements between DOE and the State of New Mexico limiting the remote-handled transuranic waste volume to 7,080 cubic meters (250,000 cubic feet), a design limit of 168,485 cubic meters (5.95 million cubic feet) of CH-TRU waste was set (DOE 2008d:16). Based on estimates in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012c), approximately 24,700 cubic meters (872,000 cubic feet) of unsubscribed[35] CH-TRU waste capacity could support the actions analyzed in this *SPD Supplemental EIS*.[36] CH-TRU waste generation for the activities being considered under the *SPD Supplemental EIS* alternatives would represent 24 to 108 percent of this unsubscribed disposal capacity.[37] Less CH-TRU waste would be generated, representing a smaller percentage of the unsubscribed WIPP disposal capacity (down to 65 percent compared to 108 percent), if a decision were made to ship the FFTF portion of non-pit plutonium inventory as CH-TRU waste directly to WIPP and CCOs were used as packaging for some materials rather than the assumed POCs.

[35] *The term "unsubscribed" refers to that portion of the total WIPP capacity that is not being used or needed for the disposal of DOE's currently estimated inventory of transuranic waste.*

[36] *Calculations performed based on data in the* Annual Transuranic Waste Inventory Report – 2012 *estimates that approximately 147,340 cubic meters (5.2 million cubic feet) of CH-TRU waste would be disposed of at WIPP (emplaced and anticipated volumes) (DOE 2011c, 2012c:11). This includes approximately 3,560 cubic meters (126,000 cubic feet) of CH-TRU waste from MFFF and the Waste Solidification Building (DOE 2012c). Subtracting the 3,560 cubic meters (126,000 cubic feet) of CH-TRU waste associated with MFFF and Waste Solidification Building operations from the 2012 estimates (because these are already included in the* SPD Supplemental EIS *analysis) results in approximately 143,780 cubic meters (5.1 million cubic feet) of CH-TRU waste that could be disposed of at WIPP. Subtracting this figure from the total available WIPP CH-TRU waste capacity (i.e., 168,485 cubic meters [5.95 million cubic feet]) shows that approximately 24,700 cubic meters (872,000 cubic feet) of unsubscribed CH-TRU waste capacity remains available to support the* SPD Supplemental EIS *alternatives.*

[37] *Under all alternatives, including the No Action Alternative, approximately 6,000 cubic meters (210,000 cubic feet) of CH-TRU waste would be generated by the fabrication of 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel, in accordance with previous decisions. Under the No Action Alternative, the 13.1 metric tons (14.4 tons) of surplus plutonium remain in storage, and do not contribute to TRU waste generation and disposal at WIPP. See Chapter 4, Tables 4–20, 4–21, and 4–47 for more information.*

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

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

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

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

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

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

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

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

Environmental Justice. As discussed in Chapter 4, Section 4.1.6, of this *Final SPD Supplemental EIS*, the potential environmental impacts and risks associated with the proposed surplus plutonium disposition activities are essentially the same or lower for minority and low-income populations residing near SRS or LANL as they are for nonminority and non-low-income populations. Section 4.1.6 includes an estimate of the potential impacts on hypothetical individuals who live at the boundaries of pueblos near LANL; these individuals are assumed to be exposed to radiological emissions from PF-4 in the same manner as the MEI. Because of the distances and directions to the pueblo boundary receptor locations and meteorological conditions (e.g., dominant wind direction), the radiological impacts on these individuals would be about half or less than those on the MEI.

In addition, a special pathways scenario[38] for populations near LANL was analyzed in the *LANL SWEIS* (DOE 2008b); it showed that the risks to individuals exposed via these pathways were low. Air emissions from proposed surplus plutonium disposition activities would be the only source of radiation exposure in addition to those previously analyzed in the *LANL SWEIS*. These air emissions would result in a dose that is a fraction of the dose that would result from other LANL activities and the special pathways. The additional risk to these individuals from the proposed surplus plutonium disposition activities included in this *SPD Supplemental EIS* would not substantially increase the risks associated with the special pathways scenario analyzed in the *LANL SWEIS* (see Chapter 4, Section 4.5.3.8.2). Including the maximum dose contribution from the proposed surplus plutonium disposition activities at LANL, persons practicing such a lifestyle would be exposed to a small increased annual risk of developing a latent fatal cancer of 3×10^{-6}, or approximately 1 chance in 330,000, as a result of LANL activities. Therefore, no disproportionately high and adverse impacts on minority or low-income populations residing near SRS or LANL would result from implementing any alternative.

[38] *Under the special pathways scenario, a person was assumed to derive all of his or her food locally, consume increased amounts of fish, deer, and elk from the areas surrounding LANL, and drink surface water and cota (a tea made from local plants). The special pathways receptor also would be exposed to additional amounts of contaminated soils and sediments from performing outdoor activities on or near LANL.*

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

Resource Area	*Alternative*				
	No Action	***Immobilization to DWPF***	***MOX Fuel*** [a]	***H-Canyon/HB-Line to DWPF***	***WIPP*** [a]
Air Quality	***Construction***				
	- Particulate matter would be emitted from land-disturbing activities associated with construction of PDCF in F-Area at SRS. Pollutants would be emitted from diesel construction equipment, operation of a concrete batch plant, and vehicle emissions. - Concentrations at the site boundary would not exceed air quality standards.	- Impacts would be approximately the same as under the No Action Alternative. - Activities at LANL, if undertaken, would not exceed air quality standards.	- Impacts would be approximately the same as under the No Action Alternative from construction of PDCF or reduced impacts from construction of PDC or modification of existing facilities at SRS. - Activities at LANL would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Operations				
	Concentrations at the SRS and LANL site boundaries would not exceed air quality standards.	Same as under the No Action Alternative for SRS. Expanded activities at LANL, if undertaken, would not exceed air quality standards.	Approximately the same as under the Immobilization to DWPF Alternative.	Approximately the same as under the Immobilization to DWPF Alternative.	Approximately the same as under the Immobilization to DWPF Alternative.
Human Health – Normal Operations, Workers	***Construction***				
	No additional worker doses or risks are expected at SRS or LANL.	- Total worker dose at SRS – up to 13 person-rem - SRS total LCFs – 0 (up to 0.008) - Total worker dose at LANL – up to 140 person-rem - LANL total LCFs – 0 (up to 0.08)	- Total worker dose at SRS – up to 6.0 person-rem - SRS total LCFs – 0 (up to 0.004) - Total worker dose and LCFs at LANL would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	- Total worker dose at SRS – up to 7.2 person-rem - SRS total LCFs – 0 (up to 0.004) - Total worker dose and LCFs at LANL would be the same as under the Immobilization to DWPF Alternative.
	Operations				
	- Annual total worker dose at SRS – 300 person-rem - SRS annual LCFs – 0 (0.2) - SRS total LCFs – 3 - Annual total worker dose at LANL – 29 person-rem - LANL annual LCFs – 0 (0.02) - LANL total LCFs – 0 (0.1)	- Annual total worker dose at SRS – 430 to 620 person-rem - SRS annual LCFs – 0 (0.3 to 0.4) - SRS total LCFs – 3 to 5 - Annual total worker dose at LANL – 29 to 190 person-rem - LANL annual LCFs – 0 (0.02 to 0.1) - LANL total LCFs – 0 (0.1) to 3	- Annual total worker dose at SRS – 130 to 320 person-rem - SRS annual LCFs – 0 (0.08 to 0.2) - SRS total LCFs – 1 to 3 - Worker impacts at LANL would be the same as under the Immobilization to DWPF Alternative.	- Annual total worker dose at SRS – 120 to 310 person-rem - SRS annual LCFs – 0 (0.07 to 0.2) - SRS total LCFs – 1 to 3 - Worker impacts at LANL would be the same as under the Immobilization to DWPF Alternative.	- Annual total worker dose at SRS – 170 to 360 person-rem - SRS annual LCFs – 0 (0.1 to 0.2) - SRS total LCFs – 2 to 3 - Worker impacts at LANL would be the same as under the Immobilization to DWPF Alternative.

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

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

Resource Area	***Alternative***				
	No Action	***Immobilization to DWPF***	***MOX Fuel*** [a]	***H-Canyon/HB-Line to DWPF***	***WIPP*** [a]
Socioeconomics (impacts in peak year)	***Construction***				
	- SRS direct employment, peak – 722 - SRS indirect employment, peak – 455 - Value added to local economy near SRS, peak – $67 million No new construction would be required at LANL. Impacts on housing and traffic would be small.	- SRS direct employment, peak – 275 to 943 - SRS indirect employment, peak – 173 to 595 - Value added to local economy near SRS, peak – $25 million to $87 million - LANL direct employment, peak – 0 to 46 - LANL indirect employment, peak – 0 to 26 - Value added to local economy near LANL, peak – $0 to $3.8 million Impacts on housing and traffic would be small.	- SRS direct employment, peak – 275 to 741 - SRS indirect employment, peak – 173 to 467 - Value added to local economy near SRS, peak – $25 million to $68 million - LANL impacts would be the same as under the Immobilization to DWPF Alternative. Impacts on housing and traffic would be small.	- SRS direct employment, peak – 275 to 741 - SRS indirect employment, peak – 173 to 467 - Value added to local economy near SRS, peak – $25 million to $68 million - LANL impacts would be the same as under the Immobilization to DWPF Alternative. Impacts on housing and traffic would be small.	- SRS direct employment, peak – 285 to 741 - SRS indirect employment, peak – 180 to 467 - Value added to local economy near SRS, peak – $26 million to $68 million - LANL impacts would be the same as under the Immobilization to DWPF Alternative. Impacts on housing and traffic would be small.
	Operations				
	- Direct employment at SRS, peak – 1,677 - Indirect employment at SRS, peak – 1,995 - Value added to local economy near SRS, peak – $250 million - Total worker-years (includes construction) – 36,200 - Direct employment at LANL, peak – 149 - Indirect employment at LANL, peak – 151 - Value added to local economy at LANL, peak – $19 million - Total worker-years – 1,040 Impacts on housing and traffic would be small.	- Direct employment at SRS, peak – 1,596 to 2,111 - Indirect employment at SRS, peak – 1,898 to 2,511 - Value added to local economy at SRS, peak – $240 million to $320 million - Total worker-years (includes construction) – up to 41,000 - Direct employment at LANL, peak – 149 to 493 - Indirect employment at LANL, peak – 151 to 499 - Value added to local economy at LANL, peak – $19 million to $63 million - Total worker-years (includes construction) – 1,040 to 8,400 Impacts on housing and traffic would be small.	- Direct employment at SRS, peak – 1,357 to 1,716 - Indirect employment at SRS, peak – 1,614 to 2,041 - Value added to local economy at SRS, peak – $200 million to $260 million - Total worker-years (includes construction) – Up to 40,900 LANL impacts would be the same as under the Immobilization to DWPF Alternative. Impacts on housing and traffic would be small.	- Direct employment at SRS, peak – 1,202 to 1,676 - Indirect employment at SRS, peak – 1,430 to 1,993 - Value added to local economy at SRS, peak – $180 million to $250 million - Total worker-years (includes construction) – Up to 38,600 LANL impacts would be the same as under the Immobilization to DWPF Alternative. Impacts on housing and traffic would be small.	- Direct employment at SRS, peak – 1,257 to 1,766 - Indirect employment at SRS, peak – 1,495 to 2,100 - Value added to local economy at SRS, peak – $190 million to $270 million - Total worker-years (includes construction) – Up to 39,000 LANL impacts would be the same as under the Immobilization to DWPF Alternative. Impacts on housing and traffic would be small.

Resource Area	*No Action*	*Immobilization to DWPF*	*MOX Fuel* [a]	*H-Canyon/HB-Line to DWPF*	*WIPP* [a]
Waste Management (cubic meters over life of the project)	***SRS Construction***				
	CH-TRU waste – 0 MLLW – 0 LLW – 0 Hazardous – 56 Nonhazardous (solid) – 1,300 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	CH-TRU waste – 0 to 23 MLLW – 100 LLW – 2,500 Hazardous – 100 to 160 Nonhazardous (solid) – 2,500 to 3,800 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	CH-TRU waste – 10 to 33 MLLW – 0 to 210 LLW – 0 to 12,000 Hazardous – 0 to 7,000 Nonhazardous (solid) – 0 to 6,800 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	CH-TRU waste – 0 to 23 Remainder same as under the MOX Fuel Alternative. Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	Same as under the MOX Fuel Alternative. Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.
	SRS Operations				
	CH-TRU waste – 5,900 MLLW – 0 LLW – 16,000 Hazardous – 10 Nonhazardous (solid) – 29,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	CH-TRU waste – 10,000 to 12,000 MLLW – 800 LLW – 12,000 to 22,000 Hazardous – 810 Nonhazardous (solid) – 16,000 to 36,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	CH-TRU waste – 9,800 to 11,000 MLLW – 0 LLW – 12,000 to 22,000 Hazardous – 7 to 8 Nonhazardous (solid) – 17,000 to 38,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	CH-TRU waste – 5,400 to 7,000 MLLW – 0 LLW – 11,000 to 20,000 Hazardous – 7 to 8 Nonhazardous (solid) – 15,000 to 36,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	CH-TRU waste – 24,000 to 25,000 [b] MLLW – 0 LLW – 9,700 to 19,000 Hazardous – 5 to 6 Nonhazardous (solid) – 13,000 to 32,000 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.
	LANL Construction				
	Not applicable.	CH-TRU waste – 0 to 19 MLLW – 0 to 56 LLW – 0 to 37 Hazardous – 0 Nonhazardous (solid) – 0 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.
	LANL Operations				
	CH-TRU waste – 120 MLLW – 2 LLW – 200 Hazardous – 0 Nonhazardous (solid) – 0 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	CH-TRU waste –120 to 2,400 MLLW – 2 to 31 LLW – 200 to 4,000 Hazardous – 0 to 4 Nonhazardous (solid) – 0 Waste treatment, storage, and disposal capacities are sufficient to manage these waste streams.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative.	Same as under the Immobilization to DWPF Alternative with the possible exception of TRU waste. [b]

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

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

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

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

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

Resource Area	Alternative				
	No Action	***Immobilization to DWPF***	***MOX Fuel*** [a]	***H-Canyon/HB-Line to DWPF***	***WIPP*** [a]
Infrastructure (per year)	***Construction***				
	- SRS Electricity (megawatt-hours) – 15,000 - SRS Fuel (gallons) – 390,000 - SRS Water (gallons) – 2.6 million Utility usage would remain well within SRS's available capacities.	- SRS Electricity (megawatt-hours) – 9,000 to 24,000 - SRS Fuel (gallons) – 5,000 to 400,000 - SRS Water (gallons) – 2,000 to 2.6 million Utility usage would remain well within SRS's available capacities. - LANL Electricity (megawatt-hours) – 0 to 80 - LANL Fuel (gallons) – 0 to 2,800 - LANL Water (gallons) – 0 to 340,000 Utility usage would remain within LANL's available capacities.	- SRS Electricity (megawatt-hours) – minimal to 16,000 - SRS Fuel (gallons) – minimal to 390,000 - SRS Water (gallons) – minimal to 2.6 million Utility usage would remain well within SRS's available capacities. LANL infrastructure requirements would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.
	Operations				
	- SRS Electricity (megawatt-hours) – 270,000 - SRS Fuel (gallons) – 320,000 - SRS Water (gallons) – 41 million Utility usage would remain well within SRS's available capacities. - LANL Electricity (megawatt-hours – 960 - LANL Fuel (gallons) – No additional - LANL Water (gallons) – 820,000 Utility usage would remain well within LANL's available capacities.	- SRS Electricity (megawatt-hours) – 220,000 to 310,000 - SRS Fuel (gallons) – 300,000 to 340,000 - SRS Water (gallons) – 41 million to 57 million Utility usage would remain well within SRS's available capacities. - LANL Electricity (megawatt-hours) – 960 to 1,900 - LANL Fuel (gallons) – No additional - LANL Water (gallons) –820,000 to 2,700,000 Utility usage would remain well within LANL's available capacities.	- SRS Electricity (megawatt-hours) – 170,000 to 270,000 - SRS Fuel (gallons) – 280,000 to 460,000 - SRS Water (gallons) – 25 million to 41 million Utility usage would remain well within SRS's available capacities. LANL infrastructure requirements would be the same as under the Immobilization to DWPF Alternative.	Same as under the MOX Fuel Alternative.	Same as under the MOX Fuel Alternative.

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

[a] Under the WIPP Alternative, the impacts reflect preparation at SRS of 13.1 metric tons (14.4 tons) of surplus plutonium for potential WIPP disposal, including 7.1 metric tons (7.8 tons) of pit plutonium. Some or all of this pit plutonium could instead be prepared at TA-55 facilities at LANL. DOE has included a qualitative evaluation of the impacts of preparing pit plutonium at LANL for potential disposal at WIPP in Chapter 4 and Appendix G; these impacts are not included in Table S–3. Use of LANL facilities to prepare pit plutonium for potential disposal at WIPP may require additional NEPA analysis. In addition, under the MOX Fuel and WIPP Alternatives, the impacts in Table S–3 reflect the assumption that preparation of plutonium at SRS for potential WIPP disposal would occur at H-Canyon/HB-Line. This activity could also occur at the K-Area Complex with impacts enveloped by those assessed in Appendix F for construction and operation of the PDC at K-Area.

[b] Under the WIPP Alternative, if the decision were made to process 7.1 metric tons (7.8 tons) of pit plutonium at LANL and to dispose of this material at WIPP, there would be an increase in the amount of CH-TRU waste packaged at LANL for disposal at WIPP and a corresponding decrease in the amount of CH-TRU waste packaged at SRS for disposal at WIPP. The total amount of CH-TRU waste under this alternative would remain approximately the same.

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

S.12.2 Summary of Cumulative Impacts

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

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

The use of partial MOX fuel cores, as opposed to LEU fuel cores, would not result in any substantial changes to the environmental impacts of commercial nuclear power plant operation (see Chapter 4, Section 4.1, and Appendix I of this *SPD Supplemental EIS*). Thus, the use of MOX fuel would not change the cumulative impacts in the vicinity of the nuclear power reactors.

Land Use. Cumulative land use at SRS could occupy 10,575 to 10,625 acres (4,280 to 4,300 hectares). Cumulative land use would be generally compatible with existing land use plans and allowable uses of the site and would involve up to 5.4 percent of the 198,344 acres (80,268 hectares) encompassing SRS. Activities analyzed in the *SPD Supplemental EIS* would disturb a maximum of 52 acres (21 hectares) of land, or approximately 0.03 percent of available SRS land, and would not contribute substantially to cumulative impacts. Existing activities currently occupy approximately 9,900 acres (4,000 hectares) of SRS land.

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

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

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

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

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

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

The maximum cumulative dose to the SRS MEI is estimated to be 0.43 millirem per year, well below applicable DOE limits (i.e., 10 millirem per year from the air pathway, 4 millirem per year from the liquid pathway, and 100 millirem per year for all pathways).[39] This MEI dose does not include contributions from the Vogtle Electric Generating Plant because the distance between the two sites precludes the same receptor receiving both doses.

The maximum cumulative annual SRS worker dose could total 540 to 860 person-rem, resulting in 0 to 1 LCFs. Activities analyzed in the *SPD Supplemental EIS* could produce annual worker doses of 300 to 620 person-rem, resulting in no LCFs. However, as discussed in Section S.12.1, ALARA principles would be implemented to limit the potential health effects of these worker doses; thereby reducing the likelihood of any LCFs resulting from the proposed activities.

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

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

The maximum cumulative annual LANL worker dose could total 570 to 740 person-rem; no LCFs are expected as a result of these doses. Activities analyzed in the *SPD Supplemental EIS* could produce annual worker doses of 29 to 190 person-rem, resulting in no LCFs. As discussed above, ALARA principles would be implemented to limit the potential health effects of these worker doses.

Socioeconomics. Cumulative employment at SRS could reach 9,000 to 9,900 persons under the alternatives being considered in this *SPD Supplemental EIS*. These values are conservative estimates of short-term future employment at SRS. Some of the employment would occur at different times and the numbers may not be additive. Future employment due to surplus plutonium disposition activities could reduce the adverse socioeconomic effects of a recent SRS workforce reduction of approximately 1,240 workers (Pavey 2011). Activities analyzed in the *SPD Supplemental EIS* could produce direct employment of about 1,200 (under the H-Canyon/HB-Line to DWPF Alternative with the PF-4 and MFFF Option for pit disassembly and conversion) to about 2,100 (under the Immobilization to DWPF Alternative with the PDCF Option for pit disassembly and conversion). By comparison, approximately 215,000 people are employed in the ROI. In addition to direct jobs, an estimated 2,500 indirect jobs could be created in the ROI. Anticipated fluctuations in ROI employment from activities at SRS are unlikely to greatly stress housing and community services in the ROI.

[39] *As derived from DOE Order 458.1, Change 3,* Radiation Protection of the Public and the Environment.

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

If higher levels of pit disassembly and conversion were performed at PF-4 under any of the action alternatives, there would be an increase of approximately 493 LANL employees. This additional employment would result in no change in the cumulative socioeconomic conditions of the LANL ROI, but would help offset workforce reductions currently being pursued at LANL. The number of LANL employees supporting pit disassembly operations at PF-4 would represent a small fraction of the LANL workforce (approximately 13,500 in 2010) and an even smaller fraction of the regional workforce (approximately 163,000 in 2011). However, future employment due to surplus plutonium disposition activities at LANL could reduce the adverse socioeconomic effects of an expected workforce reduction (LANL 2012b). In the LANL ROI, in addition to direct jobs, an estimated 499 indirect jobs could be created if higher levels of pit disassembly and conversion were performed in PF-4. Any fluctuations in ROI employment are unlikely to greatly stress housing and community services in the ROI.

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

Including activities proposed in this *SPD Supplemental EIS*, projected LANL and Los Alamos County activities would annually require approximately 880,000 megawatt-hours of electricity and 1.67 billion gallons (6.32 billion liters) of water. LANL would remain within its capacity to deliver electricity and water.

Waste Management. CH-TRU waste, LLW, MLLW, hazardous waste, and solid nonhazardous waste are expected to see increased generation rates under all alternatives. No additional HLW would be generated under any of the alternatives. Under the H-Canyon/HB-Line to DWPF Alternative, however, some surplus plutonium materials would be dissolved at H-Canyon/HB-Line, mixed with HLW, and vitrified at DWPF. Because the dissolved plutonium would displace some of the HLW feed to DWPF, implementation of the H-Canyon/HB-Line to DWPF Alternative could result in generation of up to 48 additional canisters containing vitrified HLW. Under the Immobilization to DWPF Alternative, approximately 95 additional canisters containing vitrified HLW could be produced at DWPF. DOE would store canisters of vitrified HLW at S-Area pending their offsite disposition.

Because CH-TRU waste from both SRS and LANL would be shipped to WIPP, the range of CH-TRU waste volume generation needs to be evaluated considering both SRS and LANL inclusively under the different alternatives, while avoiding double counting waste generation from the performance of the same functions at SRS and LANL. **Table S–4** lists the ranges of cumulative CH-TRU waste generation under all *SPD Supplemental EIS* alternatives and the impact this volume of CH-TRU waste would have on unsubscribed WIPP capacity, which is based on estimates contained in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012c).

Table S–4 Cumulative Contact-Handled Transuranic Waste Generation at the Savannah River Site and Los Alamos National Laboratory (cubic meters)

Activity	*Alternatives*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Subtotal baseline plus other actions at SRS	7,350 [a]				
Subtotal baseline plus other actions at LANL	9,880 [a]				
SPD Supplemental EIS alternatives	6,000	12,000 – 13,000	12,000 – 13,000	7,100 – 8,200	26,000 – 27,000
Percent of unsubscribed WIPP capacity [b]	24	47 – 52	47 – 52	29 – 33	104 – 108 (65) [c]

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

[a] Baseline CH-TRU waste volumes at SRS and LANL are already included in the subscribed CH-TRU waste projected in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012c:Table 3–1); therefore, these quantities are not included in the percent of unsubscribed WIPP capacity calculations.

[b] WIPP unsubscribed capacity for CH-TRU waste is approximately 24,700 cubic meters.

[c] The greatest impact on the WIPP unsubscribed capacity (about 108 percent) occurs under the WIPP Alternative assuming generation of approximately 24,300 cubic meters of CH-TRU waste at SRS and 2,400 cubic meters of CH-TRU waste at LANL. The cumulative CH-TRU waste volume under the WIPP Alternative would drop to 65 percent if CCOs were used for packaging surplus plutonium for WIPP disposal as opposed to POCs, and FFTF fuel was shipped as waste directly to WIPP.

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

The total WIPP capacity for TRU waste disposal is set at 175,600 cubic meters (6.2 million cubic feet) pursuant to the WIPP Land Withdrawal Act, including up to 168,485 cubic meters (5.95 million cubic feet) of CH-TRU waste (DOE 2008d:16). Based on estimates in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012c), approximately 24,700 cubic meters (872,000 cubic feet) of unsubscribed CH-TRU waste capacity could support the activities analyzed in this *SPD Supplemental EIS* (see Chapter 4, Section 4.1.4). Depending on the alternative for surplus plutonium disposition, the volume of CH-TRU waste that could be generated would represent 24 to 108 percent of this unsubscribed WIPP disposal capacity. Under the MOX Fuel and WIPP Alternatives, less CH-TRU waste would be generated, representing a smaller percentage of the unsubscribed WIPP disposal capacity, if the portion of non-pit plutonium inventory that is unirradiated FFTF fuel was shipped as waste directly to WIPP, and if CCOs were used for packaging surplus plutonium for WIPP disposal rather than the assumed POCs.[40]

As part of the cumulative impacts evaluations in this *SPD Supplemental EIS* for alternatives involving WIPP, DOE identified proposed actions, including actions that could potentially burden unsubscribed capacity at WIPP and, cumulatively, exceed unsubscribed capacity. These actions are currently under consideration in the *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (DOE 2011e), the *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE 2012e), and the *Final Long-Term Management and Storage of Elemental Mercury Supplemental Environmental Impact Statement* (DOE 2013b), and are described in Chapter 4, Section 4.5.3.6.3, of this *SPD Supplemental EIS*. Future decisions about the disposal of TRU waste would be made in the context of the needs of the entire DOE complex.

[40] *If both options were implemented, the cumulative CH-TRU waste volume under the MOX Fuel Alternative would drop from a maximum of 52 percent of the unsubscribed WIPP disposal capacity (assuming 2 metric tons [2.2 tons] of surplus plutonium are disposed of at WIPP) to approximately 44 percent. The cumulative CH-TRU waste volume under the WIPP Alternative would drop from 108 percent of the unsubscribed WIPP disposal capacity to approximately 65 percent.*

DOE would be able to dispose of radioactive waste generated at SRS and LANL in onsite facilities, or at offsite federal and commercial disposal sites. Consistent with current practices, hazardous waste would continue to be transported to offsite treatment, storage and disposal facilities. Solid nonhazardous waste from SRS and LANL would continue to be disposed of at onsite and offsite landfills, consistent with current practices.

Transportation. The impacts from transportation in this *SPD Supplemental EIS* are quite small compared with overall cumulative transportation impacts. The collective worker dose from all types of shipments (including those under the alternatives in this *SPD Supplemental EIS*, historical shipments, reasonably foreseeable actions, and general transportation) was estimated to be about 421,000 person-rem (resulting in 252 LCFs) for the period from 1943 through 2073 (131 years). The general population collective dose was estimated to be about 436,000 person-rem (resulting in 262 LCFs). Worker doses under the *SPD Supplemental EIS* alternatives would be about 230 to 650 person-rem, resulting in no (0.1 to 0.4) LCFs. General population doses under the *SPD Supplemental EIS* alternatives would be about 150 to 580 person-rem, resulting in no (0.1 to 0.3) LCFs. To place these numbers in perspective, the National Center for Health Statistics indicates that the annual average number of cancer deaths in the United States from 2004 through 2008 was about 560,000, with less than a 1 percent fluctuation in the number of deaths in any given year (CDC 2011). The total number of LCFs (among the workers and general population) estimated to result from radioactive material transportation over the period between 1943 and 2073 is 515, or an average of about 4 LCFs per year. The transportation-related LCFs would represent about 0.0009 percent of the overall annual number of cancer deaths. The majority of the cumulative risks to workers and the general population would be due to the general transportation of radioactive material unrelated to activities evaluated in this *SPD Supplemental EIS*.

Up to one traffic fatality would be expected over the duration of the activities (which exceeds 20 years for all the alternatives) evaluated in this *SPD Supplemental EIS*. For comparison, in the United States in 2010, there were over 3,900 fatalities due to crashes involving large trucks (DOT 2012b) and over 32,000 traffic fatalities due to all vehicular crashes (DOT 2012c). The incremental increase in risk to the general population from shipments associated with the Surplus Plutonium Disposition Program would therefore be very small and would not substantially contribute to cumulative impacts.

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

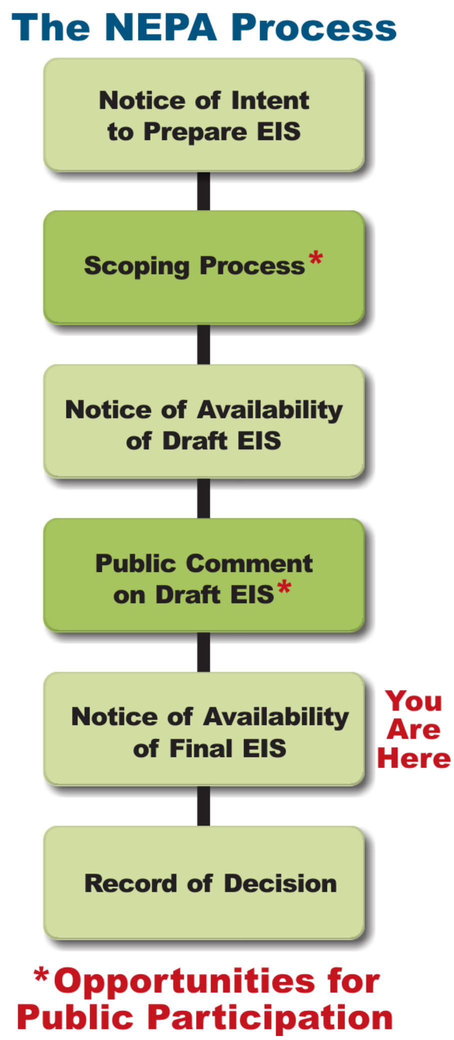
S.13 Organization of this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

This *SPD Supplemental EIS* consists of Chapters 1 through 10 and Appendices A through L. Chapter 1 describes the purpose and need for agency action; introduces the proposed action; summarizes the scoping process; describes the amounts of plutonium addressed; provides a description of related NEPA documents; and describes decisions to be made. Surplus plutonium disposition alternatives, as well as the materials, processes, and facilities that would be used to implement the alternatives, are described in Chapter 2. Chapter 2 also includes a comparison of potential impacts under each of the alternatives. In Chapter 3, the environments at SRS, LANL, and the TVA reactors are described in terms of resource areas or disciplines that establish the baselines for the impact analyses. Chapter 4 describes the potential impacts of the alternatives on the resource areas or disciplines. Chapter 4 also includes discussions of deactivation, decontamination, and decommissioning; cumulative impacts; irreversible and irretrievable commitments of resources; the relationship between short-term uses of the environment and long-term productivity; and mitigation. Chapter 5 describes the environmental and health and safety compliance requirements governing implementation of the alternatives, including permits and consultations. Chapters 6, 7, 8, 9, and 10 are the glossary of terms, the list of references, the list of preparers, the distribution list, and the index, respectively. Appendices A through L are the list of applicable *Federal Register* notices; a facilities description; a human health risk analysis for normal operations; a facility accident analysis; a transportation analysis; impacts of pit disassembly and conversion options; impacts of plutonium disposition options; impacts of principal support facilities; impacts of MOX fuel use in domestic commercial nuclear power reactors; evaluation of select reactor accidents with MOX fuel use; the Contractor Disclosure Statement; and a scoping comment summary, respectively.

S.14 Next Steps

The availability of this *Final SPD Supplemental EIS* was announced in the *Federal Register*, on the project website at http://nnsa.energy.gov/nepa/spdsupplementaleis, and on the DOE NEPA website at www.energy.gov/nepa. In addition, members of the public who are on the DOE mailing list for this *Final SPD Supplemental EIS* were notified by U.S. mail.

This Summary, as well as the full *Final SPD Supplemental EIS*, was provided to those who requested it in compact disc or print formats. This *Final SPD Supplemental EIS* and the cited references may be viewed on the project website listed above and at any of the reading rooms and libraries listed below.



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Based on this *Final SPD Supplemental EIS* and consistent with the requirements of NEPA, DOE may announce a decision regarding future actions in a ROD to be issued no sooner than 30 days after its announcement of a Preferred Alternative in the *Federal Register*. The ROD will describe the alternative selected for implementation and explain how environmental impacts will be avoided, minimized, or mitigated. TVA, as a cooperating agency, may adopt this *SPD Supplemental EIS* after independently reviewing the EIS and determining its comments and suggestions have been satisfied (40 CFR 1506.3(c)).

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Further information on DOE's NEPA program is available on the DOE NEPA website at http://energy.gov/nepa. Information on TVA's NEPA program is available at http://www.tva.gov/environment/reports/nepa.htm.

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DOE/EIS-0283-S2
April 2015

Final

Surplus Plutonium Disposition Supplemental Environmental Impact Statement

Volume 1
(Chapters 1 through 10)

U.S. Department of Energy
Office of Material Management and Minimization
and
Office of Environmental Management
Washington, DC

AVAILABILITY OF THE
FINAL SURPLUS PLUTONIUM DISPOSITION
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
(SPD Supplemental EIS)

For further information on this *SPD Supplemental EIS,* or to request a copy, please contact:

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Printed with soy ink on recycled paper

COVER SHEET[1]

Lead Agency: U.S. Department of Energy (DOE) / National Nuclear Security Administration (NNSA)

Cooperating Agency: Tennessee Valley Authority (TVA)

Title: *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* (DOE/EIS-0283-S2)

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

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

In this *SPD Supplemental EIS*, DOE describes the environmental impacts of alternatives for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned, including 7.1 metric tons (7.8 tons) of plutonium from pits that were declared excess to national defense needs after publication of the 2007 NOI, and 6 metric tons (6.6 tons) of surplus non-pit plutonium. The analyses also encompass potential use of MOX fuel in reactors at the Sequoyah and Browns Ferry Nuclear Plants of TVA, and at generic reactors.

In this *SPD Supplemental EIS,* DOE evaluates the No Action Alternative and four action alternatives for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium: (1) Immobilization to DWPF Alternative –

[1] *Vertical change bars in the margins of this Final Summary indicate revisions and new information added since the Draft Summary was issued in July 2012. Editorial changes are not marked.*

glass can-in-canister immobilization for both surplus non-pit and disassembled and converted pit plutonium and subsequent filling of the canister with high-level radioactive waste (HLW) at DWPF; (2) MOX Fuel Alternative – fabrication of the disassembled and converted pit plutonium and much of the non-pit plutonium into MOX fuel at MFFF for use in domestic commercial nuclear power reactors to generate electricity, as well as potential disposition of the surplus non-pit plutonium that is not suitable for MFFF as contact-handled transuranic (CH-TRU) waste at the Waste Isolation Pilot Plant (WIPP); (3) H-Canyon/HB-Line to DWPF Alternative – processing the surplus non-pit plutonium in H-Canyon/HB-Line and subsequent vitrification with HLW (in DWPF) and fabrication of the pit plutonium into MOX fuel at MFFF; and (4) WIPP Alternative – preparing for potential disposal as CH-TRU waste at WIPP the surplus non-pit and disassembled and converted pit plutonium in H-Canyon/HB-Line and the K-Area Complex at SRS, or preparing the surplus non-pit plutonium in H-Canyon/HB-Line and the K-Area Complex at SRS and preparing the surplus disassembled and converted pit plutonium in Technical Area 55 (TA-55) facilities at Los Alamos National Laboratory (LANL). Under all alternatives, DOE would also disposition as MOX fuel 34 metric tons (37.5 tons) of surplus plutonium in accordance with previous decisions. The 34 metric tons (37.5 tons) of plutonium would be fabricated into MOX fuel at MFFF for use at domestic commercial nuclear power reactors. Within each action alternative, DOE also evaluates options for pit disassembly and conversion of plutonium metal to an oxide form for disposition. Under three of the options, DOE would not build a stand-alone Pit Disassembly and Conversion Facility at F-Area at SRS, which DOE had previously decided to construct (65 FR 1608).

Preferred Alternative: DOE has no Preferred Alternative at this time for the disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium that is the subject of this *SPD Supplemental EIS*. Also, DOE has no Preferred Alternative regarding the sites or facilities to be used to prepare surplus plutonium metal for disposition (i.e., pit disassembly and conversion capability). Consistent with the requirements of NEPA, once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a preference.

This *SPD Supplemental EIS* evaluates disposition alternatives that include irradiation of MOX fuel in TVA reactors, subject to appropriate amendments to the applicable licenses from the U.S. Nuclear Regulatory Commission. TVA is a cooperating agency for this *SPD Supplemental EIS* and, as such, is not required to declare a preferred alternative. TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.

Public Comments: In preparing this *Final SPD Supplemental EIS*, DOE considered comments received during the three scoping periods (2007, 2010, 2012), during the public comment period on the *Draft SPD Supplemental EIS* (July 27 through October 10, 2012), and late comments received after the close of the public comment period. Public hearings on the *Draft SPD Supplemental EIS* were held in Tanner, Alabama; Chattanooga, Tennessee; North Augusta, South Carolina; and Carlsbad, Española, Los Alamos, and Santa Fe, New Mexico. DOE considered every comment received at the public hearings and by U.S. mail, email, and toll-free phone and fax lines during preparation of this *Final SPD Supplemental EIS*.

This *Final SPD Supplemental EIS* contains revisions and new information based in part on comments received on the *Draft SPD Supplemental EIS*. Volume 3 contains the comments received on the *Draft SPD Supplemental EIS* and DOE's responses to the comments. DOE will use the analysis presented in this *SPD Supplemental EIS*, as well as other information, in preparing a Record of Decision regarding the Surplus Plutonium Disposition Program. Consistent with the requirements of NEPA, once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a preference. TVA, as a cooperating agency, may adopt this *Final SPD Supplemental EIS* after independently reviewing the environmental impact statement and determining that its comments and suggestions have been satisfied.

Note: A Foreword was added to the *Final SPD Supplemental EIS*. The Foreword describes two ongoing activities that may affect the implementation of the proposed action in this *SPD Supplemental EIS*. These activities are: (1) DOE's reassessment of surplus plutonium disposition strategies; and (2) DOE's recovery effort at WIPP following two February 2014 incidents at the facility.

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FOREWORD

This *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* has been prepared to evaluate the potential environmental impacts from disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition pathway is not yet assigned. This *SPD Supplemental EIS* is being issued in parallel with two ongoing U.S. Department of Energy (DOE) activities that may affect the implementation of the proposed action in this *SPD Supplemental EIS*. These activities are: (1) DOE's reassessment of surplus plutonium disposition strategies; and (2) DOE's recovery effort at the DOE Waste Isolation Pilot Plant (WIPP) following two February 2014 incidents at the facility near Carlsbad, New Mexico. DOE issued the *Draft SPD Supplemental EIS* in July 2012; issuing the *Final SPD Supplemental EIS* at this time enables DOE to complete the evaluation of the environmental impacts of the disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium while neither prejudging nor impacting a separate ongoing DOE analysis of potential plutonium disposition strategies (see below).

Evolution of DOE's National Environmental Policy Act Decisions for Surplus Plutonium Disposition. DOE has pursued a program for safe storage and disposition of surplus weapons-grade plutonium since the mid-1990s. In 1996, DOE issued the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition PEIS)* (DOE 1996), which considered a comprehensive range of 37 programmatic alternatives and subalternatives for disposition of plutonium surplus to the Nation's defense needs. DOE decided to pursue a combination of disposition approaches, including fabrication of surplus plutonium into mixed oxide (MOX) fuel for irradiation in domestic commercial nuclear reactors (62 *Federal Register* [FR] 3014). Tiering from the *Storage and Disposition PEIS*, DOE issued the *Surplus Plutonium Disposition Environmental Impact Statement (SPD EIS)* in 1999 (DOE 1999). Subsequent to the analyses in the *SPD EIS* and other documents, DOE decided to disposition 34 metric tons (37.5 tons) of surplus plutonium by fabricating it into MOX fuel in a MOX Fuel Fabrication Facility (MFFF) to be constructed at the Savannah River Site (SRS), followed by use of the MOX fuel in domestic commercial nuclear power reactors. DOE also decided to construct and operate a stand-alone Pit Disassembly and Conversion Facility (PDCF) at SRS to prepare surplus plutonium for the MFFF (65 FR 1608 and 68 FR 20134). DOE began construction of MFFF in August 2007. In addition, the *Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated As No Longer Required for Defense Purposes and Related Cooperation* (PMDA) that entered into force in 2011 calls for the United States and the Russian Federation to each dispose of at least 34 metric tons (37.5 tons) of weapons-grade plutonium, by fabricating it into MOX fuel or any other method as may be agreed to by the Parties in writing.

The purpose of this *SPD Supplemental EIS* is to evaluate the environmental impacts from alternatives for safe and timely disposition of approximately 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition pathway is not yet assigned, not to reconsider DOE's previous decisions about pursuing the MOX fuel approach for 34 metric tons (37.5 tons) of weapons-grade plutonium. The alternatives addressed in this *SPD Supplemental EIS* for the 13.1 metric tons (14.4 tons) of surplus plutonium are the No Action Alternative and action alternatives that entail combinations of one or more of the following disposition technologies: glass can-in-canister immobilization and subsequent filling of the canister with high-level radioactive waste (HLW) at the Defense Waste Processing Facility (DWPF), fabrication into MOX fuel followed by irradiation in domestic commercial nuclear power reactors, combination with HLW and subsequent vitrification at DWPF, and preparation as contact-handled transuranic waste for potential disposal at WIPP. In this *SPD Supplemental EIS*, DOE also evaluates options for pit disassembly and conversion in addition to a new stand-alone PDCF.

Evaluation of Alternative Surplus Plutonium Disposition Strategies. In April 2014, DOE's Plutonium Disposition Working Group issued its report, *Analysis of Surplus Weapon-Grade Plutonium Disposition Options* (DOE 2014), which assesses options that could potentially provide a more cost-effective approach for disposition of surplus U.S. weapons-grade plutonium and provides the foundation for further analysis and independent validation. The primary options assessed were irradiation as MOX fuel in light water reactors (i.e., domestic commercial nuclear power reactors), irradiation in fast reactors, immobilization with HLW, downblending and disposal, and deep borehole disposal. Variations on the assessed options were also considered. For each option, the Working Group assessed costs; compliance with international agreements; the time required to disposition 34 metric tons (37.5 tons) of surplus plutonium; technical viability; and legal, regulatory, and other issues. Completion of this *Final SPD Supplemental EIS* is independent of DOE's ongoing assessment of potential plutonium disposition strategies identified by the Plutonium Disposition Working Group.

February 2014 Incidents at WIPP. DOE has suspended operations at WIPP following two events that occurred in February 2014. On February 5, an underground salt haul truck caught fire, leading to the evacuation of all underground workers. Several workers were treated for smoke inhalation, but no other injuries were sustained as a result of this incident. The fire was extinguished and the underground operations at WIPP were suspended. On February 14, the WIPP facility experienced a second event unrelated to the fire, when a continuous air monitor (CAM) within the mine alarmed, indicating the presence of airborne radioactive material.

DOE has suspended waste disposal operations at WIPP and has implemented a recovery plan comprising several steps and processes to be completed before WIPP returns to operations. Detailed information on the status of recovery activities can be found at http://www.wipp.energy.gov/wipprecovery/recovery.html. Pending the return of WIPP to operations, transuranic waste generated by DOE activities is being safely stored at DOE or commercial sites.

Potential Decisions Supported by this *SPD Supplemental EIS*. In light of the circumstances described above, DOE is not in a position to make decisions on the issues presented in this *SPD Supplemental EIS* in the short term. On the other hand, DOE wishes to be able to move forward as rapidly as possible once issues concerning the availability of WIPP and the future of the MFFF are clarified. By completing this *SPD Supplemental EIS*, DOE will be in the best position to take actions to remove surplus plutonium from the State of South Carolina, and to disposition 13.1 metric tons (14.4 tons) of weapon-usable plutonium. For example, after the path for resumption of operations at WIPP is clarified, it would be possible for DOE to issue a Record of Decision for potential disposal at WIPP of certain surplus plutonium currently at SRS because the environmental implications of taking this step have already been analyzed in this *SPD Supplemental EIS*.

DOE has no Preferred Alternative at this time. Consistent with the requirements of the National Environmental Policy Act (NEPA), once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a Preferred Alternative.

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ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

AADT	annual average daily traffic
ACS	American Community Survey
ALARA	as low as reasonably achievable
ARIES	Advanced Recovery and Integrated Extraction System
ATSDR	Agency for Toxic Substances and Disease Registry
BFN	Browns Ferry Nuclear Plant
BJWSA	Beaufort-Jasper Water and Sewer Authority
BLM	U.S. Bureau of Land Management
BMP	best management practice
C&D	construction and demolition
CCO	criticality control overpack
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CH-TRU	contact-handled transuranic
CMR	chemistry and metallurgy research
CMRR	Chemistry and Metallurgy Research Replacement
CMRR-NF	Chemistry and Metallurgy Research Replacement Nuclear Facility
CRD	Comment Response Document
CSWTF	Central Sanitary Wastewater Treatment Facility
DARHT	Dual-Axis Radiographic Hydrodynamic Test
dBA	decibels A-weighted
D&D	decontamination and decommissioning
DD&D	decontamination, decommissioning, and demolition
DHS	U.S. Department of Homeland Security
DNFSB	Defense Nuclear Facilities Safety Board
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DSA	Documented Safety Analysis
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FFTF	Fast Flux Test Facility
FGE	fissile gram equivalents
FR	*Federal Register*
FY	fiscal year
g	acceleration of gravity
GENII 2	GENII Environmental Dosimetry system, Version 2
GTCC	Greater-Than-Class C
GWSB	Glass Waste Storage Building
Hanford	Hanford Site

HC/HBL	H-Canyon/HB-Line
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HLW	high-level radioactive waste
HUC	Hydrologic Unit Code
HUFP	Hanford Unirradiated Fuel Package
IPCC	Intergovernmental Panel on Climate Change
ISLOCA	interfacing systems loss-of-coolant accident
ISO	International Organization for Standardization
KIS	K-Area Interim Surveillance capability
LAHDRA	Los Alamos Historical Document Retrieval and Assessment
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LCF	latent cancer fatality
LEED	Leadership in Energy and Environmental Design
LEU	low-enriched uranium
LLW	low-level radioactive waste
LOCA	loss-of-coolant accident
LOS	level of service
MACCS2	Melcor Accident Consequence Code System-2
MDA	material disposal areas
MEI	maximally exposed individual
MFFF	Mixed Oxide Fuel Fabrication Facility
MLLW	mixed low-level radioactive waste
MOX	mixed oxide
MSA	Material Storage Area
MSGP	Multi-Sector General Permit
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutant
NMAC	*New Mexico Administrative Code*
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
ODS	ozone-depleting substances
Pantex	Pantex Plant
PCB	polychlorinated biphenyl
PDC	Pit Disassembly and Conversion Project
PDCF	Pit Disassembly and Conversion Facility
PEIS	programmatic environmental impact statement
PF-4	Plutonium Facility
PGA	peak (horizontal) ground acceleration

PM_n	particulate matter less than or equal to *n* microns in aerodynamic diameter
PMDA	Plutonium Management and Disposition Agreement
POC	pipe overpack container
PSD	prevention of significant deterioration
RADTRAN	Radioactive Material Transportation Risk Assessment computer code
RCRA	Resource Conservation and Recovery Act
RDX	Research Department Explosive
RH-TRU	remote-handled transuranic
RIMS II	Regional Input-Output Modeling System
RISKIND	Risks and Consequences of Radioactive Material Transport computer code
RLUOB	Radiological Laboratory/Utility/Office Building
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROI	region of influence
SCDHEC	South Carolina Department of Health and Environmental Control
SEIS	supplemental environmental impact statement
SERF	Sanitary Effluent Reclamation Facility
SHPO	State Historic Preservation Office
SPD	surplus plutonium disposition
SQN	Sequoyah Nuclear Plant
SRARP	Savannah River Archaeological Research Program
SR	State Route
SRS	Savannah River Site
STA	Secure Transportation Asset
SWPPP	Storm Water Pollution Prevention Plan
SWEIS	site-wide environmental impact statement
SWWS	Sanitary Wastewater Systems
TA	technical area
TRAGIS	Transportation Routing Analysis Geographic Information System computer code
TRU	transuranic waste
TRUPACT-II	Transuranic Package Transporter Model 2
TSS	Transportation Safeguards System
TVA	Tennessee Valley Authority
U.S.C.	United States Code
VRM	Visual Resource Management
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
WSB	Waste Solidification Building
Y-12	Y-12 National Security Complex
ZPPR	Zero Power Physics Reactor
°C	degrees Celsius
°F	degrees Fahrenheit

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,018.5	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Radiation					
Sieverts	100	Rem	Rem	0.01	Sieverts
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.7854	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

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

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

4.1.2.5 Intentional Destructive Acts

DOE's National Nuclear Security Administration (NNSA) has prepared a classified analysis of the potential impacts of intentional destructive acts as part of this *SPD Supplemental EIS*. Substantive details of intentional destructive act scenarios, security countermeasures, and potential impacts are not released to the public because disclosure of this information could be exploited by enemies to plan attacks.

NNSA's strategy for the mitigation of environmental impacts resulting from extreme events, including intentional destructive acts, has three distinct components: (1) prevent or deter successful attacks; (2) plan and provide timely and adequate response to emergency situations; and (3) progress to recovery through long-term response in the form of monitoring, remediation, and support for affected communities and their environments.

Depending on the intentional destructive act, impacts could be similar to or exceed the impacts of accidents analyzed in this *SPD Supplemental EIS*. Classified analyses of intentional destructive acts related to plutonium operations at LANL and storage of plutonium pits at Pantex were prepared for the 2008 *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (LANL SWEIS)* (DOE 2008f) and the *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* (DOE 2008j), respectively. Information from those analyses and analyses specific to the proposed facilities at SRS is included in the classified appendix of this *SPD Supplemental EIS*. These analyses provide NNSA with information on which to base, in part, decisions regarding surplus plutonium. The classified appendix evaluates several scenarios involving intentional destructive acts, and calculates consequences for the noninvolved worker, MEI, and population in terms of physical injuries, radiation doses, and LCFs. Although the results of the analyses cannot be disclosed, the following general conclusions can be drawn: the potential consequences of intentional destructive acts are highly dependent upon the distance to the site boundary and the size and distribution of the surrounding population. That is, the closer and higher density of the surrounding population, the higher the consequences. In addition, it is generally easier and more cost-effective to protect newer than older facilities, because new security features can be incorporated into their design. In other words, protective forces needed to defend new facilities may be smaller than those needed in older facilities due to the inherent security features of newer facilities. Newer facilities can, as a result of design features, better prevent attacks and reduce the impacts of attacks.

4.1.3 Socioeconomics

Socioeconomic impacts that could result from implementation of the alternatives addressed in this *SPD Supplemental EIS* include impacts on the regional economic characteristics, population and housing, and traffic within the region of influence (ROI). The socioeconomic ROI for SRS is defined as the four-county area of Columbia and Richmond Counties in Georgia, and Aiken and Barnwell Counties in South Carolina. The socioeconomic ROI for LANL is defined as the four-county area of Los Alamos, Rio Arriba, Sandoval, and Santa Fe Counties in New Mexico. **Tables 4–10** and **4–11** provide summaries of construction and operations impacts, respectively, by alternative.

As described in Appendix I, the use of a 40 percent MOX fuel core in domestic commercial nuclear power reactors is not expected to change the socioeconomic impacts that currently occur due to the use of a 100 percent LEU fuel core. Therefore, the impacts from irradiating MOX fuel at domestic commercial nuclear power reactors are not discussed further in this section.

4.1.5 Transportation

For transportation, both radiological and nonradiological impacts would result from shipment of radioactive materials and waste. Only nonradiological impacts would result from shipment of nonradioactive wastes and construction materials. Radiological impacts are those associated with the effects from low levels of radiation emitted during incident-free transportation and from the accidental release of radioactive materials, and are expressed as additional LCFs. Nonradiological impacts are independent of the nature of the cargo being transported, and are expressed as traffic accident fatalities resulting only from the physical forces that accidents could impart to humans.

Appendix E contains a more detailed description of the transportation analysis and results. Increases in nonradiological pollutants from traffic emissions are discussed in Section 4.1.1, Air Quality.

Onsite shipment of radioactive materials and wastes at SRS would not affect members of the public because roads between SRS processing areas are closed to the public; therefore, shipments would only affect onsite workers. Shipment of TRU waste, LLW, and MLLW to E-Area is currently conducted as part of site operations with no discernible impacts on noninvolved workers. The transport of radioactive materials and wastes under the alternatives is not expected to significantly increase the risk to these workers. As shown in this section, the risks from incident-free transport of radioactive waste and materials off site over long distances (hundreds to thousands of kilometers) are very small; therefore, the risks from transporting radioactive waste and materials on site, where distances would be less than 20 kilometers (12 miles) and sometimes less than 5 kilometers (3 miles), would be even smaller. For NNSA Secure Transportation Asset (STA) shipments, onsite roads would be closed during transport, further limiting the risk of noninvolved worker exposure. All involved workers (i.e., drivers and escorts) would be monitored and the maximum annual dose to a transportation worker would be administratively limited to 2 rem (10 CFR Part 835). The potential for a trained radiation worker to develop a fatal latent cancer from the maximum annual exposure is 0.0012 LCFs; therefore, an individual transportation worker is not expected to develop a lifetime latent fatal cancer from exposure during these activities. Impacts associated with accidents during onsite transport of radioactive materials and wastes would be less than the impacts assessed for the bounding accident analyses for the plutonium facilities (see Section 4.1.2.2), and less than the impacts for offsite transports because of the much shorter distance traveled on site and because of onsite security measures and lower vehicle speeds. Because of these reasons, impacts from onsite transport of radioactive materials and wastes are not analyzed further in this *SPD Supplemental EIS*.

Methodology and Assumptions

Transportation packages containing radioactive materials emit low levels of radiation; the amount of transportation radiation depends on the kind and amount of transported materials. DOT regulations require that transportation packages containing radioactive materials have sufficient radiation shielding to limit the radiation dose rate to 10 millirem per hour at a distance of 2 meters (6.6 feet) from the transporter. For incident-free transportation, the potential human health impacts of the radiation field surrounding the transportation packages were estimated for transportation workers and the general population along the route (termed off-traffic or off-link), as well as for people sharing the route (termed in-traffic or on-link), at rest areas, and at other stops along the route. The RADTRAN 6 [Radioactive Material Transportation Risk Assessment] computer code (SNL 2009) was used to estimate the impacts on transportation workers and population along the route, as well as the impacts on an MEI (e.g., a person stuck in traffic, a gas station attendant, an inspector).

Transportation accidents involving radioactive materials present both nonradiological and radiological risks to workers and the public. Nonradiological impacts of transportation accidents include traffic accident fatalities. Radioactive material would be released during transportation accidents only when the transport package carrying the material is subjected to forces that exceed its design standard. Only a severe fire and/or a powerful collision, both events of extremely low probability, could lead to a transportation package of the type used to transport highly radioactive material being damaged to the extent that there could be a significant release of radioactive material to the environment.

The radiological impact of a specific accident is expressed in terms of probabilistic risk (i.e., dose-risk), which is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences (i.e., dose). The overall radiological risk is obtained by summing the individual radiological risks from all reasonably conceivable accidents. The analysis of accident risks takes into account a spectrum of accident severities ranging from high-probability accidents of low severity (e.g., a fender bender) to hypothetical high-severity accidents having low probabilities of occurrence.

In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive materials and wastes, this *SPD Supplemental EIS* assesses the highest consequences of a maximum reasonably foreseeable accident having a radioactive release frequency greater than 1×10^{-7} (1 chance in 10 million) per year in an urban or suburban population area along the route. This latter analysis used the RISKIND [Risks and Consequences of Radioactive Material Transport] computer code, Version 2.0, to estimate doses to individuals and populations (Yuan et al. 1995). The results of this analysis are presented in Appendix E, Section E.8.

Incident-free radiological health impacts are expressed in terms of additional LCFs. Radiological health impacts from accidents are also expressed as additional LCFs, and nonradiological accident risk as additional immediate (traffic) fatalities. LCFs associated with radiological exposure were estimated by multiplying the occupational (worker) and public dose by a dose conversion factor of 0.0006 LCFs per rem or person-rem of exposure (DOE 2003a). The health impacts associated with shipment of special nuclear material and unirradiated MOX fuel were calculated assuming that all transportation packages would be transported by escorted commercial truck or NNSA STA.

In determining transportation risks, per-shipment risk factors were calculated for incident-free and accident conditions using the RADTRAN 6 code (SNL 2009) in conjunction with the Transportation Routing Analysis Geographic Information System (TRAGIS) code (Johnson and Michelhaugh 2003), which was used to identify transportation routes in accordance with DOT regulations and other parameters. The TRAGIS program currently provides population density estimates along the routes based on the 2000 U.S. Census for determining population radiological risk factors. For incident-free operations, the affected population includes individuals living within 800 meters (0.5 miles) of each side of the road or rail line. For accident conditions, the affected population includes individuals living within 80 kilometers (50 miles) of the accident, and the MEI was assumed to be a receptor located 100 meters (330 feet) directly downwind from the accident. Additional details on the analytical approach and on modeling and parameter selections are provided in Appendix E. The estimated population for which dose is calculated was increased by comparing 2010 and 2000 census data and assuming the rate of population growth in this time period continues through the year 2020.

Accident and fatality rates for commercial truck transports are used for determining traffic accident fatalities (Saricks and Tompkins 1999). Statistics specific to STA shipments, which would be used for shipment of special nuclear material, are also used for escorted commercial truck shipments (see Appendix E, Section E.7.2). The methodology for obtaining and using accident and fatality rates is provided in Appendix E, Section E.7.2, Accident Rates.

For each alternative, transportation impacts were evaluated for the transport of the following (as applicable to each alternative):

- pits and assorted materials from Pantex near Amarillo, Texas, to SRS and LANL
- plutonium materials from LANL to SRS
- TRU waste from SRS and LANL to WIPP

- unirradiated MOX fuel from SRS to the Browns Ferry Nuclear Plant near Athens, Alabama; the Sequoyah Nuclear Plant near Soddy-Daisy, Tennessee; and one or more generic commercial nuclear power reactors assumed for analysis purposes to be located in the northwestern United States
- highly enriched uranium from SRS and LANL to the Y–12 National Security Complex at the Oak Ridge Reservation in Tennessee
- pieces and parts of pits from SRS to LANL
- LLW and MLLW from SRS and LANL to offsite Federal or commercial disposal facilities
- depleted uranium hexafluoride from the Portsmouth Gaseous Diffusion Plant at Piketon, Ohio, to AREVA at Richland, Washington
- depleted uranium oxide and depleted uranyl nitrate hexahydrate from AREVA at Richland, Washington, to SRS
- hazardous waste from SRS and LANL to an offsite treatment, storage, and disposal facility, which, for analysis purposes, would be located in Waynoka, Oklahoma (nonradiological impacts only)[11]

Route characteristics are determined for shipments to assess incident-free and transportation accident impacts related to radioactive material and waste shipments. The number of shipments associated with the transport of plutonium metal pits, highly enriched uranium, and pieces and parts of pits are determined by proportionally scaling the number of shipments analyzed in the *SPD EIS* based on the amount of material being transported for this *SPD Supplemental EIS*. The numbers of shipments associated with the transport of MOX fuel, depleted uranium, and wastes are determined using up-to-date information (as compared to the *SPD EIS*) regarding the types of transport packaging to be used and forecasted generation rates. The composition of transportation packages for different radioactive materials is estimated using unclassified information that provides a conservative estimate that would be reflective of the material or waste being transported. All shipments were assumed to be conducted by truck. Transport of plutonium materials and other classified materials was assumed to be conducted by STA (see Appendix E, Section E.2.4, for more information regarding STA vehicle requirements). Truck routes between specific origination and destination sites are analyzed, as shown in Appendix E, Figures E–2 and E–3. Tables E–6 through E–10 in Appendix E summarize the assumed destinations and estimated number of truck shipments for each type of radioactive waste or nuclear material.

Summary of Impacts

Table 4–22 summarizes transportation impacts under each alternative for shipments of radioactive materials and waste, not including shipments of unirradiated MOX fuel. The accident impacts presented in this table are those that could result from all reasonably conceivable impacts during transport of radioactive materials and waste. The impacts associated with transport of unirradiated MOX fuel to commercial nuclear power reactors are shown in **Table 4–23**. These impacts are also presented in Appendix E, Section E.8, and Appendix I, Sections I.1.2.5 and I.2.2.5, and are not expected to be substantially different from the impacts of shipping LEU fuel from the fuel supplier to the reactor sites. **Table 4–24** shows the impacts from transporting construction materials and hazardous wastes related to construction and operations (summarizing the information in Tables E–13 and E–14). The results in Tables 4–22 through 4–24 are discussed further in Sections 4.1.5.1 through 4.1.5.5. Route-specific impacts are presented in Tables E–6 through E–10.

[11] *Of the offsite treatment, storage, and disposal facilities used for management of SRS hazardous waste, this site would represent one of the longer waste transportation distances.*

Table 4–22 Risks of Transporting Radioactive Materials and Waste Under Each Alternative [a, b]

Pit Disassembly and Conversion Option	Number of Shipments	One-way Kilometers Traveled (million)	Incident-Free: Crew Dose (person-rem)	Incident-Free: Crew Risk [c]	Incident-Free: Population Dose (person-rem)	Incident-Free: Population Risk [c]	Accident: Radiological Risk [c]	Accident: Non-radiological Risk [c]
No Action Alternative								
PDCF	3,300	8.8	230	0.1	150	0.09	0.00007	0.4
Immobilization to DWPF Alternative								
PDCF	4,300	11	300	0.2	200	0.1	0.00007	0.5
PDC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF-4 and MFFF [d]	4,900	10	250	0.2	160	0.1	0.00009	0.5
PF-4, HC/HBL, and MFFF [e]	4,800	10	260	0.2	170	0.1	0.00008	0.5
MOX Fuel Alternative								
PDCF	4,400	11	320	0.2	210	0.1	0.00009	0.6
PDCF with packaging option [f]	4,200	11	290	0.2	190	0.1	0.00009	0.5
PDC	4,500	12	320	0.2	210	0.1	0.00009	0.6
PDC with packaging option [f]	4,200	11	290	0.2	200	0.1	0.00009	0.5
PF-4 and MFFF [d]	5,000	10	270	0.2	170	0.1	0.0001	0.5
PF-4 and MFFF with packaging option [d, f]	4,800	9.8	240	0.1	160	0.1	0.0001	0.5
PF-4, HC/HBL, and MFFF [e]	4,900	11	280	0.2	180	0.1	0.0001	0.5
PF-4, HC/HBL, and MFFF with packaging option [e, f]	4,600	9.9	250	0.1	160	0.1	0.0001	0.5
H-Canyon/HB-Line to DWPF Alternative								
PDCF	3,800	10	260	0.2	180	0.1	0.00008	0.5
PDC	3,900	10	260	0.2	180	0.1	0.00008	0.5
PF-4 and MFFF [d]	4,500	9.0	210	0.1	140	0.09	0.0001	0.4
PF-4, HC/HBL, and MFFF [e]	4,300	9.1	220	0.1	150	0.09	0.0001	0.4
WIPP Alternative								
PDCF	6,400	16	500	0.3	300	0.2	0.00007	0.9
PDCF with packaging option [f]	4,700	12	340	0.2	220	0.1	0.00007	0.6
PDC	6,400	16	500	0.3	300	0.2	0.00007	0.9
PDC with packaging option [f]	4,700	12	340	0.2	220	0.1	0.00007	0.6
PF-4 and MFFF [d]	7,000	15	460	0.3	260	0.2	0.00009	0.8
PF-4 and MFFF with packaging option [d, f]	5,300	11	290	0.2	180	0.1	0.00009	0.6
PF-4, HC/HBL, and MFFF [e]	6,900	15	460	0.3	270	0.2	0.00008	0.8
PF-4, HC/HBL, and MFFF with packaging option [e, f]	5,200	11	300	0.2	190	0.1	0.00008	0.6

DWPF = Defense Waste Processing Facility; HC/HBL= H-Canyon/HB-Line; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; WIPP = Waste Isolation Pilot Plant.

[a] The total impacts for each alternative include transportation due to construction and operations activities.

[b] Impacts in this table do not include impacts from transporting unirradiated MOX fuel to commercial nuclear power reactors. See Table 4–23 for these impacts.

[c] Risk is expressed in terms of LCFs, assuming a factor of 0.0006 LCFs per person-rem (DOE 2003a), except for nonradiological risk, where it refers to the number of traffic accident fatalities. Accident radiological dose-risk can be calculated by dividing the indicated risk values by 0.0006 (DOE 2003a). Radiological risk is representative of one-way travel, whereas nonradiological risk is representative of two-way travel.

[d] Under this option, pits would be disassembled at PF-4 at LANL. Pits disassembled at LANL would be converted to an oxide at LANL or at SRS using metal oxidation furnaces installed in MFFF.

[e] Under this option, pits would be disassembled at PF-4 at LANL or at the K-Area Complex at SRS. Pits disassembled at LANL would be converted to an oxide at PF-4 at LANL or at SRS using H-Canyon/HB-Line or metal oxidation furnaces installed in MFFF. Pits disassembled at the K-Area Complex would be converted to an oxide at H-Canyon/HB-Line at SRS.

[f] Under the packaging option, pit (WIPP Alternative only) and non-pit (MOX Fuel and WIPP Alternatives) plutonium would be packaged in CCOs rather than POCs for shipment to WIPP for disposal as CH-TRU waste, reducing the number of shipments, and Hanford Unirradiated Fuel Packages (HUFPs) would be used to transport unirradiated FFTF fuel to WIPP for disposal as CH-TRU waste, rather than repackaging the fuel in POCs.

Note: To convert kilometers to miles, multiply by 0.62137; metric tons to tons, multiply by 1.1023.

Table 4–23 Risks of Transporting Unirradiated Mixed Oxide Fuel Under Each Alternative

Unirradiated MOX Fuel Transport Option	*Number of Shipments*	*One-way Kilometers Traveled (million)*	*Incident-Free*				*Accident*	
			Crew		*Population*			
			Dose (person-rem)	*Risk* [a]	*Dose (person-rem)*	*Risk* [a]	*Radiological Risk* [c]	*Non-radiological Risk* [a]
No Action Alternative								
To TVA reactors	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
To generic reactors	3,400	15	150	0.09	280	0.2	0.000002	0.3
Immobilization to DWPF Alternative								
To TVA reactors	2,100	1.5	15	0.009	24	0.01	0.0000004	0.03
To generic reactors	3,400	15	150	0.09	280	0.2	0.000002	0.3
MOX Fuel Alternative								
To TVA reactors	2,900	2.0	20	0.01	32	0.02	0.0000005	0.04
To generic reactors	4,500	20	190	0.1	370	0.2	0.000002	0.4
H-Canyon/HB-Line to DWPF Alternative								
To TVA reactors	2,600	1.8	18	0.01	29	0.02	0.0000004	0.03
To generic reactors	4,100	18	180	0.1	340	0.2	0.000002	0.4
WIPP Alternative								
To TVA reactors	2,100	1.5	15	0.009	24	0.01	0.0000004	0.03
To generic reactors	3,400	15	150	0.09	280	0.2	0.000002	0.3

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; N/A = not applicable; TVA = Tennessee Valley Authority; WIPP = Waste Isolation Pilot Plant.

[a] Risk is expressed in terms of LCFs, assuming a factor of 0.0006 LCFs per person-rem (DOE 2003a), except for nonradiological risk, where it refers to the number of traffic accident fatalities. Accident radiological dose-risk can be calculated by dividing the indicated risk values by 0.0006 (DOE 2003a). Radiological risk is representative of one-way travel, whereas nonradiological risk is representative of two-way travel.

Note: To convert kilometers to miles, multiply by 0.62137; metric tons to tons, multiply by 1.1023.

Table 4–24 Estimated Impacts from Hazardous Waste and Construction Material Transport

Pit Disassembly and Conversion Option	*Number of Shipments*	*Total Distance Traveled (two-way kilometers)*	*Number of Accidents*	*Traffic Fatality Risk*
No Action Alternative				
PDCF	42,000	4,300,000	3.3	0.2
Immobilization to DWPF Alternative				
PDCF	43,000	4,600,000	3.5	0.2
PDC	N/A	N/A	N/A	N/A
PF-4 and MFFF [a]	1,300	370,000	0.23	0.01
PF-4, HC/HBL, and MFFF [b]	1,300	390,000	0.25	0.01
MOX Fuel Alternative				
PDCF	42,000	4,300,000	3.3	0.2
PDC	43,000	6,100,000	4.3	0.2
PF-4 and MFFF [a]	4	16,000	0.009	0.0004
PF-4, HC/HBL, and MFFF [b]	5	20,000	0.012	0.0005
H-Canyon/HB-Line to DWPF Alternative				
PDCF	42,000	4,300,000	3.3	0.2
PDC	43,000	6,100,000	4.3	0.2
PF-4 and MFFF [a]	4	16,000	0.009	0.0004
PF-4, HC/HBL, and MFFF [b]	5	20,000	0.012	0.0005

Pit Disassembly and Conversion Option	*Number of Shipments*	*Total Distance Traveled (two-way kilometers)*	*Number of Accidents*	*Traffic Fatality Risk*
WIPP Alternative				
PDCF	42,000	4,300,000	3.3	0.2
PDC	43,000	6,100,000	4.3	0.2
PF-4 and MFFF [a]	4	16,000	0.009	0.0004
PF-4, HC/HBL, and MFFF [b]	4	16,000	0.009	0.0004

DWPF = Defense Waste Processing Facility; HC/HBL = H-Canyon/HB-Line; MFFF = Mixed Oxide Fuel Fabrication Facility; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Under this option, pits would be disassembled at PF-4 at LANL. Pits disassembled at PF-4 would be converted to an oxide at PF-4 or at SRS using metal oxidation furnaces installed in MFFF.

[b] Under this option, pits could be disassembled at PF-4 at LANL or at the K-Area Complex at SRS. Pits disassembled at LANL would be converted to an oxide at PF-4 at LANL or at SRS using H-Canyon/HB-Line or metal oxidation furnaces installed in MFFF. Pits disassembled at the K-Area Complex would be converted to an oxide at H-Canyon/HB-Line at SRS.

Note: To convert kilometers to miles, multiply by 0.62137; metric tons to tons, multiply by 1.1023.

Transportation impacts are shown in Table 4–22 for: (1) an option whereby blended non-pit plutonium under the MOX Fuel and WIPP Alternatives and blended pit plutonium under the WIPP Alternative are transported in POCs; and (2) a packaging option whereby blended pit and non-pit plutonium (other than unirradiated FFTF fuel) is transported in CCOs rather than POCs, and unirradiated FFTF fuel is transported in Hanford Unirradiated Fuel Packages (HUFPs) rather than being first disassembled and repackaged. FFTF fuel is currently stored at SRS in HUFPs.

For all alternatives, transportation impacts were determined assuming that unirradiated MOX fuel would be transported using NNSA STA vehicles to TVA and generic commercial nuclear power plant sites, for which each shipment would consist of 2 MOX fuel assemblies transported in a Type B package. DOE is, however, considering shipment of up to 5 Type B packages per shipment containing pressurized-water reactor fuel assemblies or 7 Type B packages per shipment containing boiling-water reactor fuel assemblies, assuming use of escorted commercial trucks under NNSA's Secure Transportation Asset Program. If this MOX fuel shipment program is implemented, it is expected that radiological impacts on transport crew members would increase by a small amount, as addressed in detail in Appendix I, Sections I.1.2.5 and I.2.2.5, while incident-free radiological impacts on the population along the transport routes would decrease. Under either scenario, no LCFs would be expected among the transport crew and general population. The radiological risks to the population from all projected accidents would decrease if escorted commercial trucks were used because fewer shipments would be required, as would nonradiological traffic fatality risks. Possible impacts from a maximum reasonably foreseeable accident involving shipment of unirradiated MOX fuel would be unchanged.

4.1.5.1 No Action Alternative

Under this alternative, there would be about 3,300 truck shipments of radioactive materials and waste and 3,400 truck shipments of unirradiated MOX fuel to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the impacts of transporting radioactive materials and wastes would be less than those under the action alternatives because the 13.1 metric tons (14.4 tons) of surplus plutonium would remain in storage.

Crew – Transport of radioactive materials, waste, and unirradiated MOX fuel likely would not result in any LCFs among crew members.

Public – The cumulative dose to the general population likely would not result in any LCFs from transport of radioactive materials and waste, or from transport of unirradiated MOX fuel to generic commercial nuclear power reactors.

Impacts of Transportation Accidents

As described previously, two sets of analyses were performed for the evaluation of radiological transportation accident impacts: impacts of maximum reasonably foreseeable accidents (accidents having radioactive release probabilities greater than 1×10^{-7} [1 chance in 10 million] per year), and impacts of all conceivable accidents (total transportation accidents).

For maximum reasonably foreseeable transportation accidents probabilities were calculated for all route segments (i.e., rural, suburban, and urban), and maximum consequences were determined for those route shipments having a likelihood-of-release frequency exceeding 1 in 10 million per year. For radioactive materials and waste, the maximum reasonably foreseeable transportation accident having the highest consequence would involve truck transport of depleted uranium hexafluoride from the Portsmouth Gaseous Diffusion Plant at Piketon, Ohio, to AREVA at Richland, Washington, in 48G containers (see Appendix E, Table E–12). These shipments would occur over about 21 years.

The maximum reasonably foreseeable probability of a truck accident involving this material would be up to 2.1×10^{-7} per year in a suburban area, or about 1 chance in 4.8 million each year. The consequences of the truck transport accident in terms of population dose would be about 750 person-rem, resulting in no additional LCFs among the exposed population.

For unirradiated MOX fuel shipped to generic commercial nuclear power reactors, the maximum reasonably foreseeable probability of a truck accident involving this material would be up to 3.3×10^{-6} per year in a suburban area, or about 1 chance in 300,000 each year. The consequences of the truck transport accident in terms of population dose would be about 4.0 person-rem. If such an accident were to occur, the projected exposure likely would not result in an LCF (0.002) among the exposed population.

Estimates of total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of material or waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options likely would not result in any LCFs. Transport of radioactive materials and wastes and unirradiated MOX fuel could result in a nonradiological fatality due to a traffic accident.

Impacts of Construction Materials and Hazardous Waste Transport

Impacts from transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.5.2 Immobilization to DWPF Alternative

Under this alternative, there would be up to about 4,900 truck shipments of radioactive materials and waste (not including shipments of unirradiated MOX fuel). This is an increase over the total number of shipments under the No Action Alternative due to an increase in the amount of plutonium material to be transported to SRS for processing, and the resulting transport of additional products and wastes. For transport of unirradiated MOX fuel, there would be about 2,100 shipments to TVA reactors, or about 3,400 shipments to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the impacts of transporting radioactive materials and wastes would be slightly greater than those under the No Action Alternative.

Crew – Transport of radioactive materials and waste and unirradiated MOX fuel likely would not result in any LCFs among crew members.

Public – The cumulative dose to the general population likely would not result in LCFs from transport of radioactive materials and waste associated with any of the pit disassembly and conversion options, or from transport of unirradiated MOX fuel to TVA reactors or to generic commercial nuclear power reactors.

Impacts of Transportation Accidents

For radioactive materials and waste shipped under any of the pit disassembly and conversion options, or unirradiated MOX fuel shipped to TVA reactors or generic commercial nuclear power reactors, the maximum reasonably foreseeable offsite truck transportation accident having the highest consequence would involve the transport of plutonium oxide powder from LANL to SRS. The maximum reasonably foreseeable probability of a truck accident involving this material would be up to 2.0×10^{-7} per year in a suburban area, or 1 chance in 5 million each year. The consequences of the truck transport accident in terms of population dose would be about 6,300 person-rem, resulting in up to 4 LCFs (3.8) among the exposed population.

Estimates of total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of material and waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options, likely would not result in any LCFs. Transport activities under this alternative could result in a nonradiological fatality due to a traffic accident.

Impacts of Construction Materials and Hazardous Waste Transport

The impacts of transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.5.3 MOX Fuel Alternative

Under this alternative, there would be up to about 5,000 truck shipments of radioactive materials and waste. For transport of unirradiated MOX fuel, there would be about 2,900 shipments to TVA reactors, or about 4,500 shipments to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the radiation doses and resulting risks to crew members and to the public would be about the same as those under the Immobilization to DWPF Alternative (Section 4.1.5.2).

Crew – Transport of radioactive materials and waste and unirradiated MOX fuel likely would not result in any LCFs among crew members.

Transporting unirradiated FFTF fuel in HUFPs and transporting other surplus non-pit plutonium using CCOs to WIPP would not substantially change overall incident-free transportation risks to the crew for the alternative.

Public – The cumulative dose to the general population would not result in any LCFs from transport of radioactive materials and waste associated with the pit disassembly and conversion options, or from transport of unirradiated MOX fuel to TVA reactors or to generic commercial nuclear power reactors.

Transporting unirradiated FFTF fuel in HUFPs and transporting other surplus non-pit plutonium using CCOs to WIPP would not substantially change overall incident-free transportation risks to the public for the alternative.

Impacts of Transportation Accidents

For radioactive materials and waste shipped under any of the pit disassembly and conversion options, or unirradiated MOX fuel shipped to TVA reactors or generic commercial nuclear power reactors, the maximum reasonably foreseeable offsite truck transportation accident having the highest consequence would be the same as that under the Immobilization to DWPF Alternative (Section 4.1.5.2).

Estimates of total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of material or waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options would not result in any LCFs. Transport activities under this alternative could result in a nonradiological fatality due to a traffic accident. As indicated in Table 4–22, the overall accident risks for the alternative would not substantially change if FFTF fuel was transported in HUFPs and other surplus non-pit plutonium was transported in CCOs.

Impacts of Construction Materials and Hazardous Waste Transport

The impacts of transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.5.4 H-Canyon/HB-Line to DWPF Alternative

Under this alternative, there would be up to about 4,500 truck shipments of radioactive materials and waste. For transport of unirradiated MOX fuel, there would be about 2,600 shipments to TVA reactors, or about 4,100 shipments to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the radiation doses and resulting risks to crew members and to the public would be comparable to those under the Immobilization to DWPF Alternative (Section 4.1.5.2) and MOX Fuel Alternative (Section 4.1.5.3).

Crew – Transport of radioactive materials and waste and unirradiated MOX fuel likely would not result in any LCFs among crew members.

Public – The cumulative dose to the general population likely would not result in any LCFs from transport of radioactive materials and waste associated with the pit disassembly and conversion options, or from transport of unirradiated MOX fuel to TVA reactors or to generic commercial nuclear power reactors.

Impacts of Transportation Accidents

For radioactive materials and waste shipped under any of the pit disassembly and conversion options, or unirradiated MOX fuel shipped to TVA reactors or generic commercial nuclear power reactors, the maximum reasonably foreseeable offsite truck transportation accident having the highest consequence would be the same as that under the Immobilization to DWPF Alternative (Section 4.1.5.2).

Estimates of the total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of material or waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options, likely would not result in any LCFs. Transport activities under this alternative could result in a nonradiological fatality due to a traffic accident.

Impacts of Construction Materials and Hazardous Waste Transport

The impacts of transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

4.1.5.5 WIPP Alternative

Under this alternative, there would be up to about 7,000 truck shipments of radioactive materials and waste (not including shipments of unirradiated MOX fuel). This represents about a 60 percent increase over the H-Canyon/HB-Line to DWPF Alternative, primarily due to the shipment of 13.1 metric tons (14.4 tons) of surplus plutonium to WIPP for disposal as CH-TRU waste. For transport of unirradiated MOX fuel, there would be about 2,100 shipments to TVA reactors, and about 3,400 shipments to generic commercial nuclear power reactors.

Impacts of Incident-Free Transportation

Under this alternative, the radiation doses to crew members and the public would be higher than those under the Immobilization to DWPF, MOX Fuel, and H-Canyon/HB-Line to DWPF Alternatives (Sections 4.1.5.2, 4.1.5.3, and 4.1.5.4, respectively), but the relative risks would be about the same.

Crew – Transport of radioactive materials and waste and unirradiated MOX fuel likely would not result in any LCFs among crew members.

Transporting unirradiated FFTF fuel in HUFPs and transporting surplus pit and other non-pit plutonium using CCOs to WIPP would not substantially change overall incident-free transportation risks to the crew for the alternative.

Public – The cumulative dose to the general population would likely not result in LCFs from transport of radioactive materials and waste associated with the pit disassembly and conversion options, or from transport of unirradiated MOX fuel to generic commercial nuclear power reactors.

Transporting unirradiated FFTF fuel in HUFPs and transporting surplus pit and other non-pit plutonium using CCOs to WIPP would not substantially change overall incident-free transportation risks to the public for the alternative.

Impacts of Transportation Accidents

For radioactive materials and waste shipped under any of the pit disassembly and conversion options, or unirradiated MOX fuel shipped to TVA reactors or generic commercial nuclear power reactors, the maximum reasonably foreseeable offsite truck transportation accident having the highest consequence would be the same as that under the Immobilization to DWPF Alternative (Section 4.1.5.2).

Estimates of the total transportation accident dose-risks for all projected accidents involving all materials and waste shipments, regardless of materials or waste type, and unirradiated MOX fuel associated with the pit disassembly and conversion options, likely would not result in LCFs. Transport activities under this alternative could result in a nonradiological traffic fatality due to a traffic accident, with this risk being larger than that for the other alternatives because of the larger number of shipments. The overall accident risks for the alternative would not substantially change if FFTF fuel was transported in HUFPs and surplus pit and other non-pit plutonium was transported in CCOs.

Impacts of Construction Materials and Hazardous Waste Transport

The impacts of transporting construction materials to SRS and hazardous waste to an offsite disposal or recycle facility were also evaluated. No traffic fatalities are expected due to these activities.

Impacts of Transporting Pit Plutonium in POCs and CCOs from LANL to WIPP

The analysis in this section reflects the assumption that 7.1 metric tons (7.8 tons) of surplus pit plutonium would be prepared at SRS for potential WIPP disposal. Under the PF-4 and MFFF Option and the PF-4, H-Canyon, and MFFF Option, however, some or all of this pit plutonium could be prepared at LANL for potential WIPP disposal, and then shipped directly to WIPP, instead of being transported to SRS for processing with subsequent shipment to WIPP. In this event, there would be fewer shipments of pit plutonium from LANL to SRS, and fewer shipments of CH-TRU waste from SRS to WIPP, but additional shipments of CH-TRU waste from LANL to WIPP. The incident-free and accident impacts associated with shipments from SRS to WIPP would envelope similar shipments from LANL to WIPP because of the longer distances traveled and the larger total population along the route from SRS to WIPP as compared to the distances traveled and the total population along the route from LANL to WIPP. Furthermore, there would be fewer incident-free and accident risks associated with shipment of disassembled pit plutonium from LANL to SRS, because the total number of these shipments would be smaller. Therefore, the overall transportation impacts under the WIPP Alternative would be lower to the extent that preparation of pit plutonium for potential WIPP disposal occurred at LANL rather than SRS.

4.1.6 Environmental Justice

Estimates of entire populations and minority and low-income subsets of populations in the vicinity of SRS and LANL have been projected to the year 2020 (see Chapter 3, Sections 3.1.11 and 3.2.11). Consistent with the human health analysis, impacts were analyzed on the potentially affected populations within 50 miles (80 kilometers) of the facilities at SRS and LANL that could be engaged in surplus plutonium activities. In addition, impacts were analyzed on populations in close proximity to the facilities (radial distances of 5, 10, and 20 miles [8, 16, and 32 kilometers]). However, no populations reside within 5 miles (8 kilometers) of the proposed facilities at SRS.