CHAPTER 2
ALTERNATIVES FOR DISPOSITION OF SURPLUS PLUTONIUM

2. ALTERNATIVES FOR DISPOSITION OF SURPLUS PLUTONIUM

Chapter 2 of this *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* describes the actions proposed by the U.S. Department of Energy for the disposition of 13.1 metric tons (14.4 tons) of surplus plutonium. Section 2.1 describes the options for pit disassembly and conversion. Section 2.2 describes the disposition options. Section 2.3 describes the alternatives analyzed in this *SPD Supplemental EIS*, consisting of the No Action Alternative and four action alternatives. Section 2.4 describes alternatives considered, but dismissed from detailed study and Section 2.5 describes the Preferred Alternative. The chapter concludes with a summary comparison of environmental impacts (Section 2.6). Appendix B provides a more detailed description of the facilities and operations addressed in the alternatives.

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

Pit Disassembly and Conversion Options. Currently, surplus pit plutonium is not in a form 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 Record of Decision (ROD) for the *Surplus Plutonium Disposition Final Environmental Impact Statement (SPD EIS)* (65 *Federal Register* [FR] 1608), DOE made a decision to construct, operate, and eventually decommission a stand-alone Pit Disassembly and Conversion Facility (PDCF) at the Savannah River Site (SRS). DOE is reconsidering that decision and analyzing other pit disassembly and conversion options that would use existing facilities and a workforce experienced in these operations. As part of that reconsideration, DOE commissioned a study that examined, among other things, use of existing plutonium processing infrastructure at Los Alamos National Laboratory (LANL) and H-Canyon/HB-Line at SRS, and the delivery of both plutonium metal and plutonium oxide to the Mixed Oxide Fuel Fabrication Facility (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 Pit Disassembly and Conversion Project (PDC) at K-Area at SRS; (3) a pit disassembly and conversion capability in the Plutonium Facility (PF-4) in Technical Area 55 (TA-55) at LANL and metal oxidation in MFFF at SRS; and (4) a pit disassembly and conversion capability in PF-4 at LANL with pit disassembly in the K-Area Complex, conversion in H-Canyon/HB-Line, and metal oxidation in MFFF at SRS. Pit disassembly and conversion options are described in Section 2.1, and the impacts of each option are described in Appendix F of this *SPD Supplemental EIS*.

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 mixed oxide (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 for all pit disassembly and

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

conversion options.[2] Regardless of the action alternative selected, pit disassembly and conversion would be necessary for 35 metric tons (38.6 tons) of surplus plutonium.

Plutonium Disposition Options. DOE evaluates the impacts of four options for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium: (1) immobilization and vitrification at the Defense Waste Processing Facility (DWPF) at SRS; (2) MOX fuel fabrication and use in domestic commercial nuclear power reactors;[3] (3) processing at H-Canyon/HB-Line and vitrification at DWPF; and (4) preparation for potential disposal as contact-handled transuranic (CH-TRU) waste at the Waste Isolation Pilot Plant (WIPP), an existing deep geologic repository in southeastern New Mexico, in H-Canyon/HB-Line at SRS or in H-Canyon/HB-Line and facilities in TA-55 at LANL such as PF-4.[4] Plutonium disposition options are described in Section 2.2, and the impacts of each option are described in Appendix G of this *SPD Supplemental EIS*.

Alternatives. DOE evaluates the impacts of four action alternatives, which are combinations of the pit disassembly and conversion options and disposition options, and a No Action Alternative. **Table 2–1** summarizes the pit disassembly and conversion and disposition pathways for the 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium. Each disposition option could be combined with different pit disassembly and conversion options (see **Table 2–2**). The action alternatives are: (1) Immobilization to DWPF Alternative – glass can-in-canister immobilization for both surplus non-pit and disassembled and converted pit plutonium and subsequent filling of the canister with high-level radioactive waste (HLW) at DWPF; (2) MOX Fuel Alternative – fabrication of the disassembled and converted pit plutonium and much of the non-pit plutonium into MOX fuel at MFFF for use in domestic commercial nuclear power reactors to generate electricity and potential disposition of the surplus 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 2–2). The alternatives are described in Section 2.3 and the impacts of each alternative are described in Chapter 4 of this *SPD Supplemental EIS*.

Preferred Alternative

The U.S. Department of Energy (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) due to DOE's reassessment of potential plutonium disposition strategies. 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 Preferred Alternative.

This *SPD Supplemental EIS* evaluates disposition alternatives that include irradiation of mixed oxide (MOX) fuel in Tennessee Valley Authority (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.

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

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

[4] *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 (Appendix B, Section B.1.3). Minor modifications to the K-Area Complex may be needed to provide this capability.*

Table 2–1 Pit Disassembly and Conversion and Plutonium Disposition Pathways Under the Action Alternatives

<table>
<tr><th colspan="2" rowspan="2">Plutonium Type</th><th rowspan="2">Description</th><th colspan="5">Pit Disassembly and Conversion</th><th colspan="4">Plutonium Disposition</th></tr>
<tr><th>PDCF at F-Area</th><th>PDC at K-Area</th><th>H-Canyon/ HB-Line</th><th>Oxidation in MFFF</th><th>PF-4 at LANL</th><th>Immobilization</th><th>MFFF [a]</th><th>H-Canyon/ HB-Line</th><th>WIPP [b]</th></tr>
<tr><td colspan="2">Pits (7.1 metric tons)</td><td>Plutonium metal</td><td>X</td><td>X</td><td>X [c]</td><td>X [d]</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td></tr>
<tr><td rowspan="2">Non-Pit (6 metric tons)</td><td>Metal and oxide (4 metric tons)</td><td>Low levels of impurities</td><td></td><td></td><td></td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Metal and oxide (2 metric tons) [e]</td><td>Higher levels of impurities</td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td>X</td><td>X</td></tr>
</table>

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 Fast Flux Test Facility fuel.

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

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

	Options		
Alternatives	***Pit Disassembly and Conversion*** [b]	***Plutonium Disposition*** [c]	***MOX Fuel Use in Domestic Commercial Nuclear Power Reactors***
No Action [d]	PDCF at F-Area at SRS	MOX Fuel (34 metric tons)	Generic Reactors
Immobilization to DWPF [e]	PDCF at F-Area at SRS PF-4 at LANL and MFFF at SRS PF-4 at LANL, and HC/HBL 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; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; LANL= Los Alamos National Laboratory; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; TVA = Tennessee Valley Authority; WIPP = Waste Isolation Pilot Plant.

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

[b] All pit disassembly and conversion options include the ongoing production of 2 metric tons of plutonium oxide at PF-4 at LANL as documented in previous National Environmental Policy Act (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.

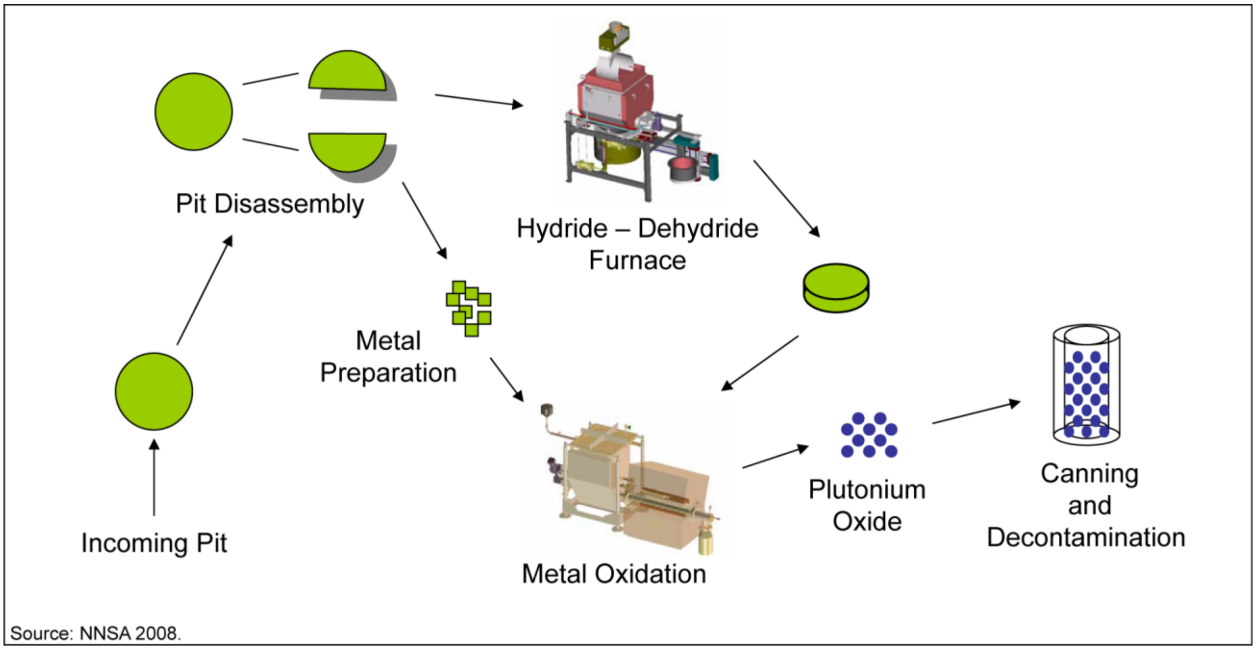
Note: To convert metric tons to tons, multiply by 1.1023.

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

2.1 Additional Description of Pit Disassembly and Conversion Options

This section describes four options for converting plutonium pits and plutonium metal to a form suitable for use with the disposition options (**Figure 2–1**). Pit disassembly and conversion capabilities could be located at SRS and LANL. Pits would be transported by the DOE/National Nuclear Security Administration (NNSA) Secure Transportation Asset Program[5] operated by NNSA's Office of Secure Transportation from the Pantex Plant (Pantex), near Amarillo, Texas, to PF-4 at LANL, and possibly to K-Area storage at SRS as well, depending on where the capability was ultimately located.



Source: NNSA 2008.

Figure 2–1 Pit Disassembly and Conversion by Oxidation

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

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[5] *See Appendix E, Section E.2.4, 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.*

2.1.1 PDCF at F-Area at SRS (PDCF)

Under this option, DOE would construct and operate a stand-alone PDCF in F-Area, as described in the *SPD EIS* (DOE 1999b), to convert plutonium pits and non-pit metal to an oxide form suitable for feed to MFFF or for immobilization or disposal at WIPP.[6] PDCF would be a new facility constructed in F-Area near MFFF. Pits would be mechanically disassembled. As part of the metal preparation process, plutonium would be mechanically or chemically separated from other materials. The plutonium metal that was bonded with highly enriched uranium (HEU) or other material would be size-reduced and separated from these materials via a hydride/dehydride process. The hydride/dehydride process converts plutonium metal to plutonium hydride, which can be easily removed from other materials. The plutonium hydride would then be converted back to plutonium metal or to plutonium oxide (DOE 1999b). All mechanically or chemically separated plutonium metal would be converted to plutonium oxide via an oxidation process. The plutonium oxide would be sealed in DOE-STD-3013 containers[7] for transfer to facilities for subsequent disposition.

2.1.2 PDC at K-Area at SRS (PDC)

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

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

Under this option, a new stand-alone pit disassembly and conversion capability (i.e., PDCF or PDC) would not be constructed at SRS. DOE would use PF-4 at LANL for pit disassembly and conversion. The existing ARIES capability in PF-4 would be supplemented with equipment to process additional material. Pits would be disassembled and some plutonium would be converted to plutonium oxide and shipped to SRS by NNSA's Secure Transportation Asset Program. In addition, some of the plutonium could be shipped as metal to 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 suitable for subsequent fabrication into MOX fuel.[8]

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

Under this option, pit disassembly and conversion capabilities would be located at both LANL and SRS. Pit disassembly and conversion would take place in PF-4 at LANL as described in Section 2.1.3, and plutonium metal and plutonium oxide would be shipped to SRS 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.

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[6] *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.*

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

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

2.2 Additional Description of Plutonium Disposition Options

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

2.2.1 Immobilization and DWPF

Under this option, plutonium would be immobilized using a can-in-canister immobilization capability to be constructed at K-Area. Non-pit plutonium would be brought to the immobilization capability from K-Area storage, while pit plutonium in metal or oxide form would be brought to the immobilization capability from PDCF or H-Canyon/HB-Line at SRS, or PF-4 at LANL. Clean oxides not requiring conversion would be stored pending immobilization. Metals and alloys would be converted to oxide in one of two oxidation furnaces housed within gloveboxes. The cladding from the Fast Flux Test Facility (FFTF) fuel from the Hanford Site would be removed, and the fuel pellets sorted according to fissile material content. Pellets containing plutonium or enriched uranium would be ground to an acceptable particle size for proper mixing. Plutonium oxide feed would be prepared to produce individual batches with the desired composition, and then milled to reduce the size of the oxide powder to achieve faster and more-uniform distribution during the subsequent melting process. The milled oxide would be blended with borosilicate glass frit (i.e., small glass particles) containing neutron absorbers (e.g., gadolinium, boron, hafnium). The mixture would be melted in a platinum/rhodium melter vessel and drained into stainless steel cans. The cans would be loaded into canisters and transferred to DWPF to be filled with an HLW[9]/glass mixture (DOE 1999b, 2007c; 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, if 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 2.1.2) are mutually exclusive because there is insufficient space at the K-Area Complex to construct and operate both capabilities.

2.2.2 MOX Fuel

Under this option, plutonium would be fabricated into MOX fuel at MFFF, which is currently under construction at F-Area (DOE 2003b). 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 2.1, plutonium would be shipped from PDCF, PDC, or H-Canyon/HB-Line at SRS, or PF-4 at LANL. Some of the plutonium from PF-4 could be shipped as plutonium metal and converted to plutonium oxide at MFFF or at H-Canyon/HB-Line.

The MOX fuel would be used in domestic commercial nuclear power reactors (65 FR 1608).[10] 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 the U.S. Nuclear Regulatory Commission (NRC) in accordance with Title 10 of the *Code of Federal Regulations* (CFR), Parts 50 or 52 (10 CFR Parts 50 or 52).

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[9] *HLW is used to surround the plutonium and thereby provide a proliferation barrier.*

[10] *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.*

When the MOX fuel completes its time within the reactor core, it would be withdrawn from the reactor in accordance with the plant's standard refueling procedures and placed in the plant's used fuel pool for cooling among other used fuel (also known as spent fuel). Used MOX fuel has a slightly greater heat content than used low-enriched uranium (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.

2.2.3 H-Canyon/HB-Line and DWPF

Under this option, non-pit plutonium would be brought to H-Canyon/HB-Line from K-Area storage. Plutonium processing in H-Canyon/HB-Line would start with dissolution of the majority of the material that is in oxide form in HB-Line, and dissolution of most of the metals in H-Canyon. Unirradiated FFTF fuel would be repackaged into carbon steel containers suitable for dissolution in H-Canyon. The dissolved solutions would then be transferred to the separations process. Any uranium present in the solutions would be recovered or discarded to the high-level waste system. The plutonium solutions from H-Canyon/HB-Line would be transferred to the Liquid Radioactive Waste Tank Farm, to be combined with HLW pending vitrification at DWPF. Canister-filling operations in DWPF and storage in the Glass Waste Storage Buildings (GWSBs) for these solutions would be similar to the operations described in Section 2.2.1.

2.2.4 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 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 an existing glovebox. Metals would be converted to oxide using an existing or new furnace. Oxide would be repackaged into suitable cans, mixed/blended with inert material, and loaded into pipe overpack containers (POCs) or criticality control overpacks (CCOs).[11] 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 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.

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 at the K-Area Complex for potential WIPP disposal would be enveloped by those for PDC (see Appendix F).

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[11] *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.*

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 transuranic (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).

2.3 Alternatives

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

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

2.3.1 No Action Alternative

Under the No Action Alternative, the 13.1 metric tons (14.4 tons) of surplus plutonium analyzed in this *SPD Supplemental EIS* would be managed through the approaches illustrated in **Figure 2–2**. 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 2007d); 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 2012i).[12]

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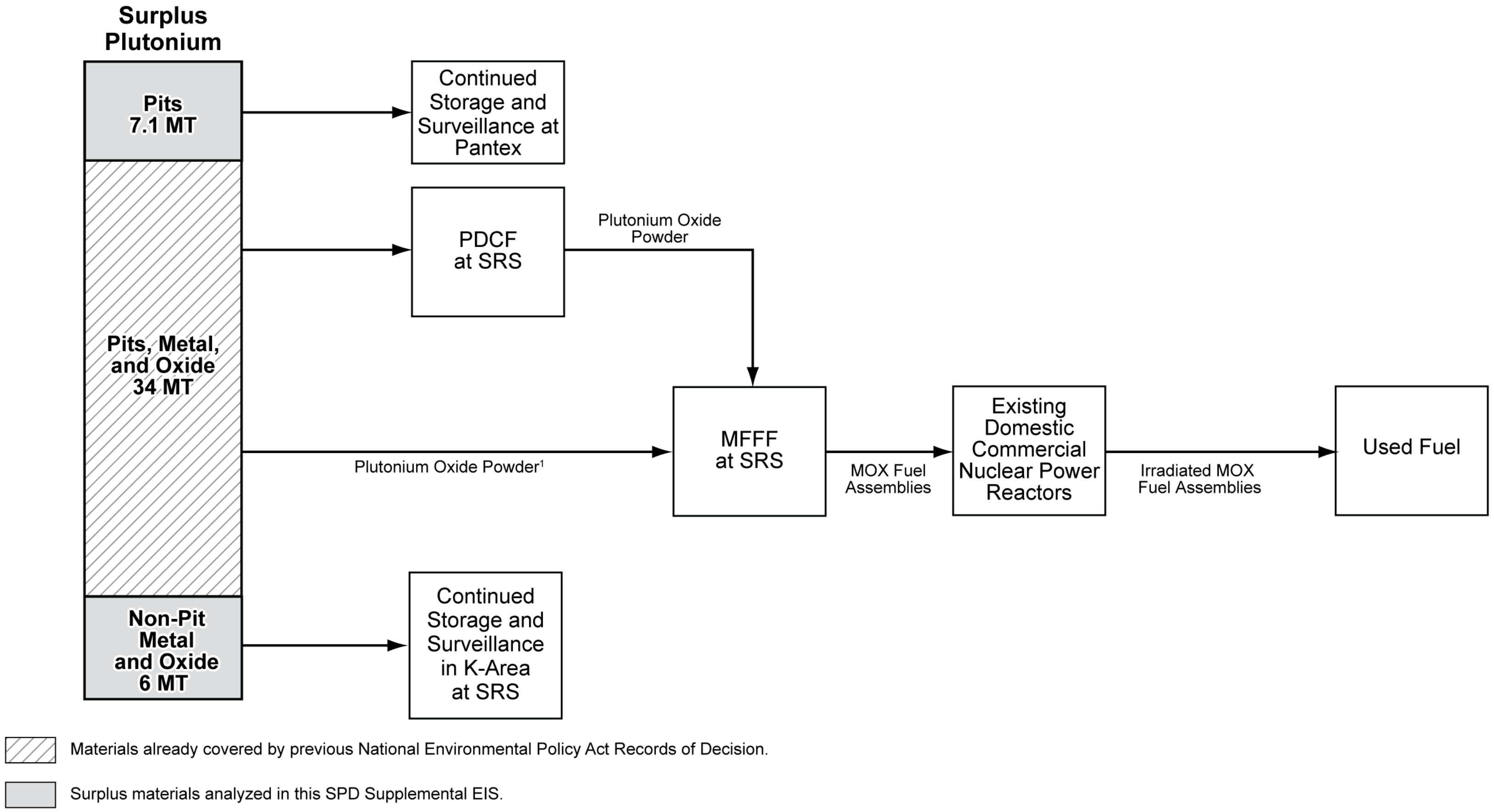
[12] *The remaining 1.9 metric tons (2.1 tons) of pit plutonium declared excess in 2007 are included in the 34 metric tons (37.5 tons) already designated for fabrication into MOX fuel at MFFF (see Chapter 1, Section 1.5).*



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

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

Figure 2–2 No Action Alternative

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 Section 2.1.1. The 34 metric tons (37.5 tons) of plutonium would be fabricated into MOX fuel at MFFF, as described in Section 2.2.2, for use at 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.

2.3.2 Immobilization to DWPF Alternative

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

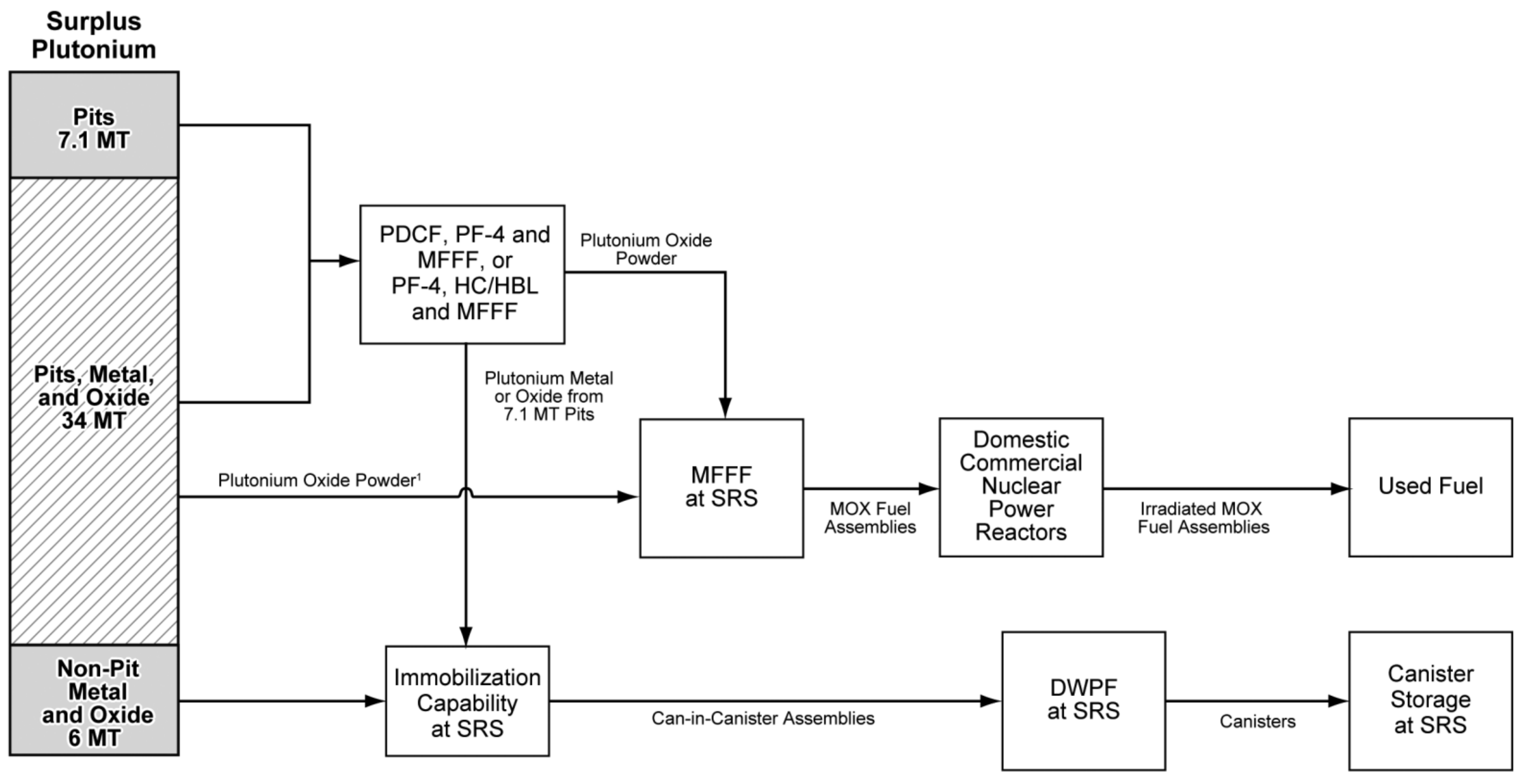
Plutonium immobilization would need to be completed consistent with DOE’s program for HLW vitrification at DWPF; this program has been developed in accordance with applicable permits and consent orders. DOE expects that there would be insufficient HLW with the characteristics needed to enable vitrification 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 2.2.1, the immobilization capability and PDC at K-Area (Section 2.1.2) 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 under the Immobilization to DWPF Alternative would be possible: PDCF; PF-4 and MFFF; or PF-4, H-Canyon/HB-Line, and MFFF. These options are discussed in Section 2.1.

2.3.3 MOX Fuel Alternative

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

The 7.1 metric tons (7.8 tons) of surplus pit plutonium and 4 metric tons (4.4 tons) of surplus non-pit plutonium, along with the 34 metric tons (37.5 tons) of surplus plutonium addressed in previous decisions (a total of 45.1 metric tons [49.7 tons]), would be fabricated into MOX fuel at MFFF, as described in Section 2.2.2. 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 K-Area at SRS for potential disposal as CH-TRU waste at WIPP in accordance with the WIPP waste acceptance criteria, as described in Section 2.2.4. The four options for pit disassembly and conversion under the MOX Fuel Alternative are discussed in Section 2.1.



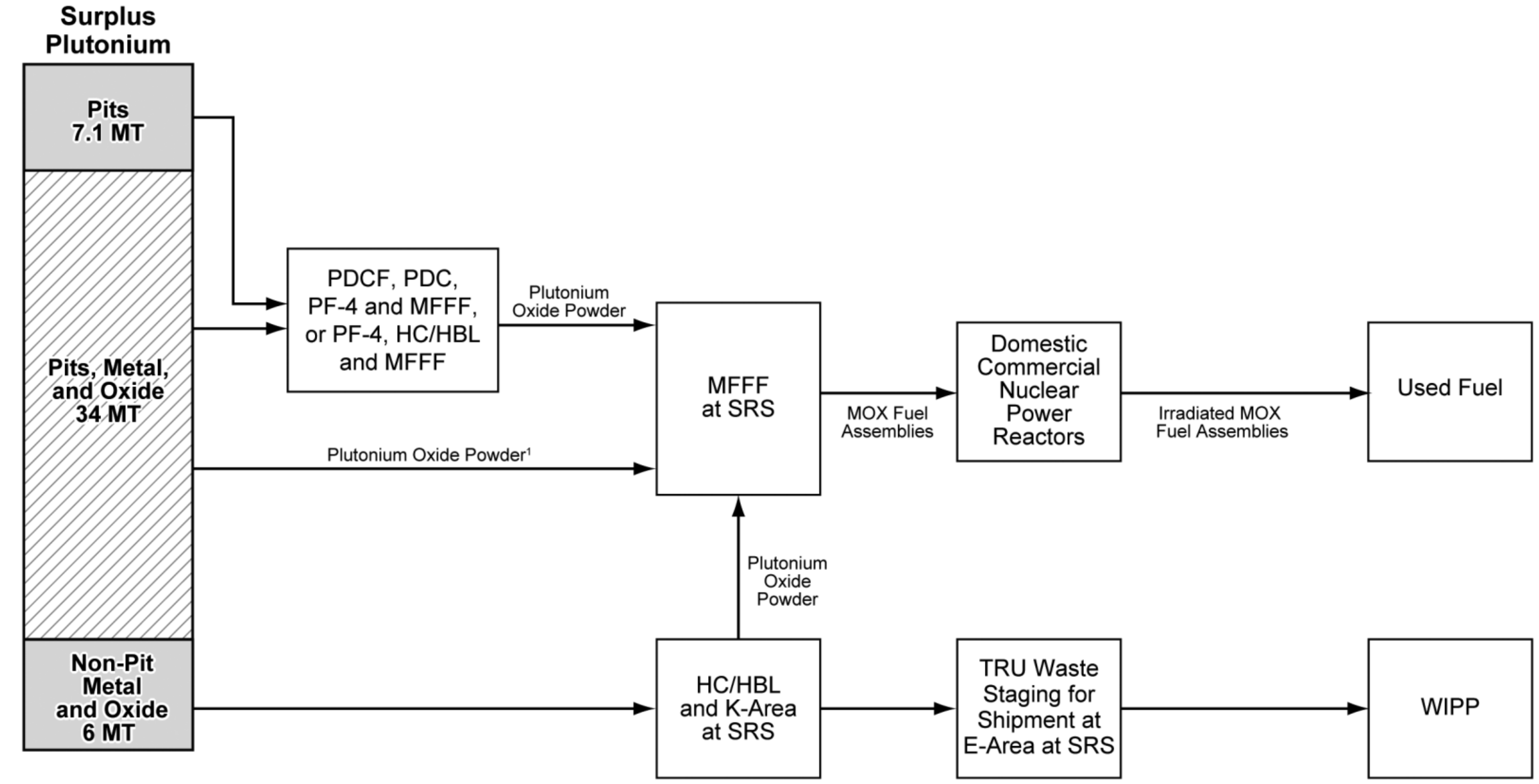
▨ Materials already covered by previous National Environmental Policy Act Records of Decision.

▩ Surplus materials analyzed in this *SPD Supplemental EIS*.

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

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

Figure 2–3 Immobilization to DWPF Alternative



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

▩ 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.

Figure 2–4 MOX Fuel Alternative

2.3.4 H-Canyon/HB-Line to DWPF Alternative

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

2.3.5 WIPP Alternative

The WIPP Alternative evaluates disposition of 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium at WIPP using the approaches illustrated in **Figure 2–6**. 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 be disposed of at WIPP as CH-TRU waste, as described in Section 2.2.4. The four options for pit disassembly and conversion under this alternative would be the same as those under the MOX Fuel Alternative.

2.4 Alternatives Considered but Dismissed from Detailed Study

DOE identified the following alternatives, which were considered for evaluation, but ultimately dismissed from detailed study in this *SPD Supplemental EIS* as discussed in Subsections 2.4.1 through 2.4.3: (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 to the alternatives identified by DOE that were considered but dismissed from detailed study, as discussed above, public comments received in response to the proposed action and upon review of the *Draft SPD Supplemental EIS* also 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.[13] DOE considered these other alternatives but dismissed them from detailed consideration, as discussed in Subsections 2.4.4 through 2.4.9.

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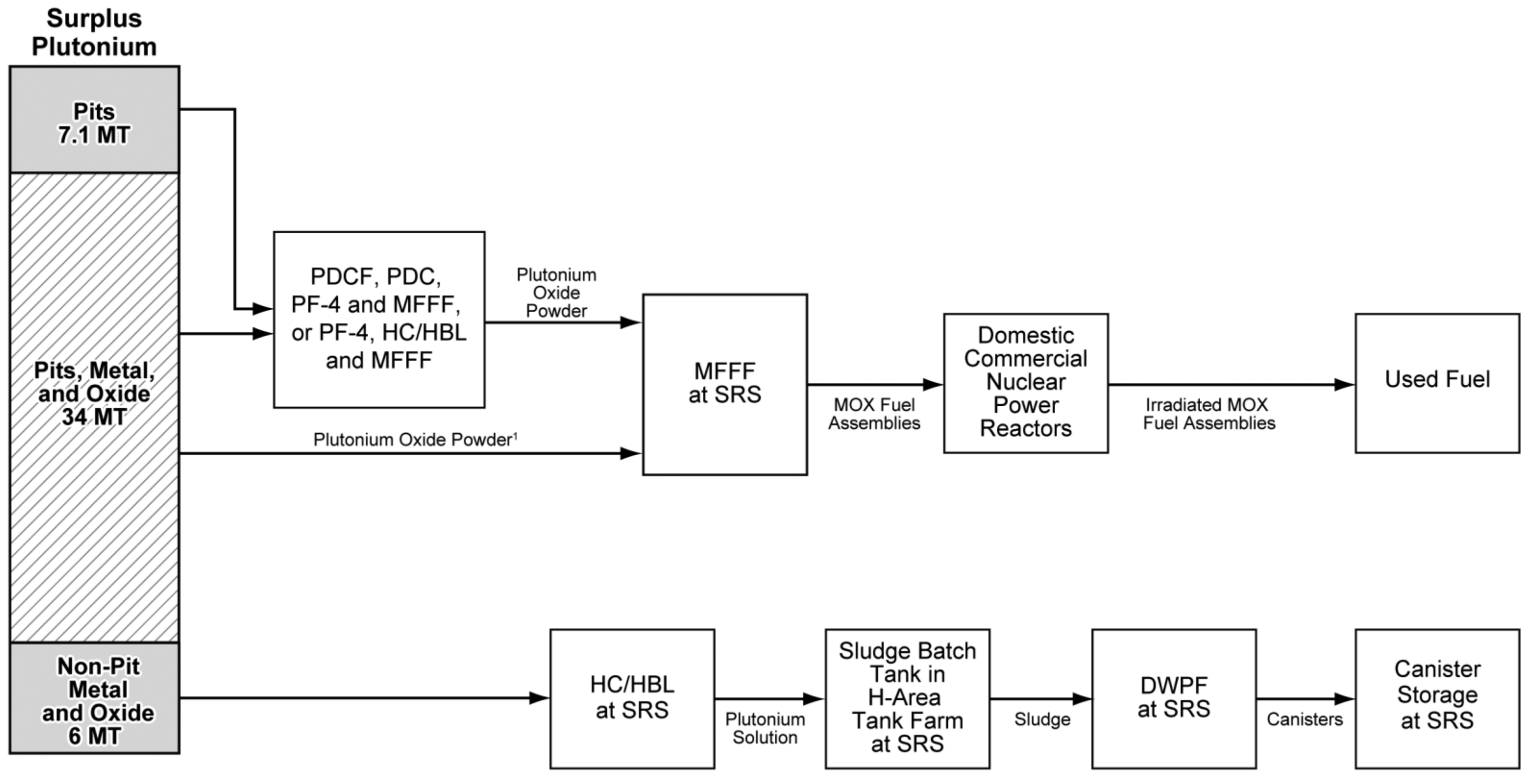
[13] *The Foreword refers to DOE's Plutonium Disposition Working Group options study which assesses options that could potentially provide a more cost-effective approach for the disposition of surplus U.S. weapons-grade plutonium. While the options paper included technologies dismissed in previous NEPA 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.



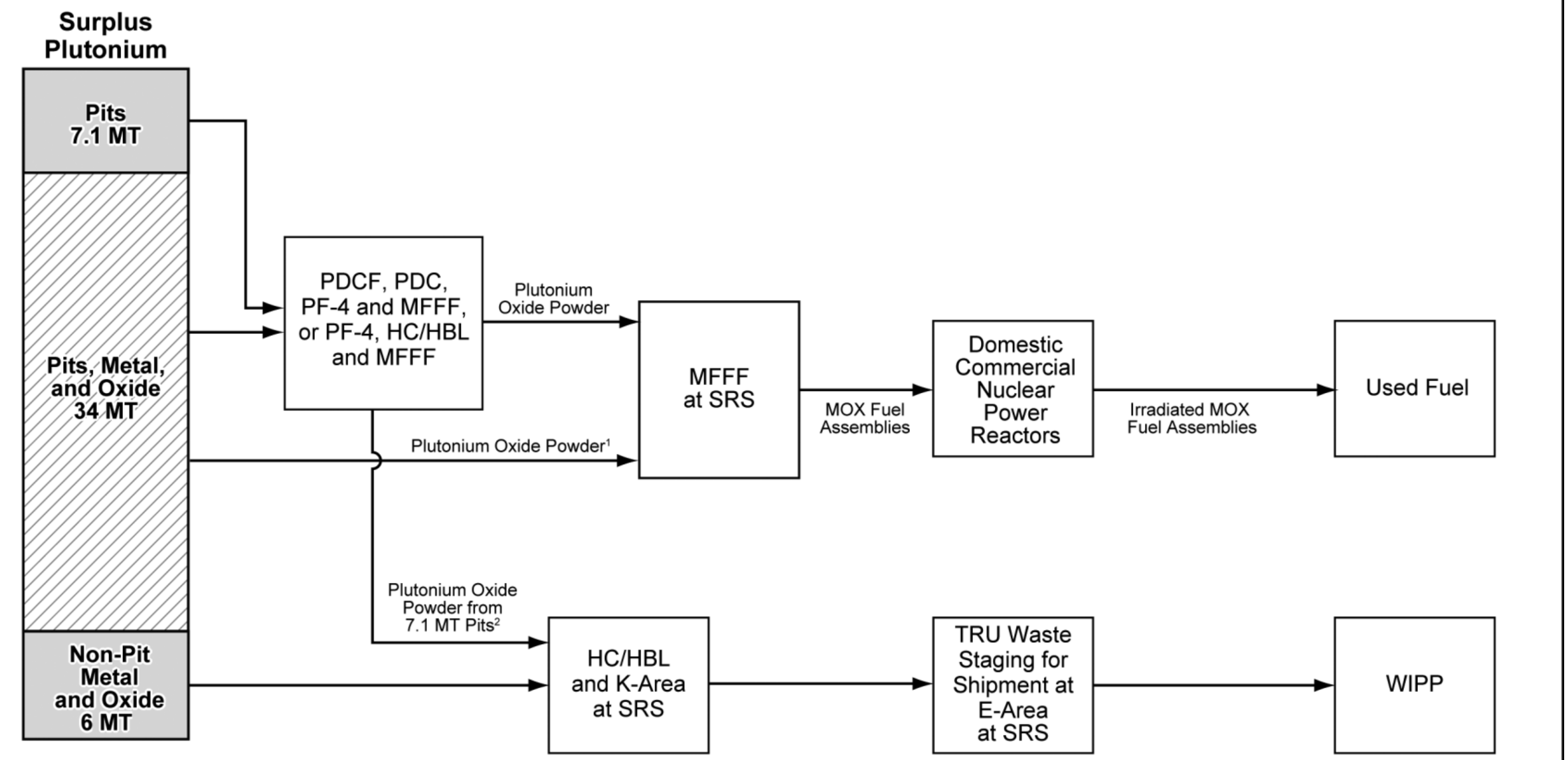
▨ Materials already covered by previous National Environmental Policy Act Records of Decision.

■ Surplus materials analyzed in this SPD Supplemental EIS.

DWPF = Defense Waste Processing Facility
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

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

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



▨ 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 2–6 WIPP Alternative

2.4.1 Ceramic Can-in-Canister Approach

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

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

In contrast, DOE has maintained research, development, and production infrastructure capabilities for glass waste forms. In 2003, work began on qualifying the waste form for inclusion in the Yucca Mountain Geologic Repository license application pursuant to 10 CFR Part 63.[14] Understanding of the glass approach has also benefited from parallel work to develop or qualify similar processes for other applications, including the immobilization of HLW.

Studies have shown that neither waste form has significant advantages over the other in terms of resistance to theft or diversion; resistance to retrieval, extraction, and reuse; technical viability; environment, safety, and health; cost effectiveness; or timeliness. The choice between ceramic and glass immobilized waste forms would also not significantly affect surplus plutonium disposition, or other nonproliferation missions (DOE 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.

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

Under the MOX Fuel Alternative, DOE is considering disposition of the entire 7.1 metric tons (7.8 tons) of surplus plutonium pits and approximately 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

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[14] *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 2013a). *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.*

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

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

2.4.4 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 of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (*Storage and Disposition PEIS*) (DOE 1996c). This approach is not considered in detail in this *Final SPD Supplemental EIS* for the reasons given in the ROD for the *Storage and Disposition PEIS* (62 FR 3014).

2.4.5 Disposal of 13.1 Metric Tons (14.4 tons) of Surplus Plutonium at a Second Repository Similar to the Waste Isolation Pilot Plant

The *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,[15] which is based on estimates contained in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012e). 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 2012e), 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 2.3.5) has been revised since the *Draft SPD Supplemental EIS* was issued to include this possibility (see Chapter 1, Section 1.8).

2.4.6 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 1999b). In the *SPD EIS* ROD (65 FR 1608), DOE selected construction of a PDCF at SRS (65 FR 1608) 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.

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[15] *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.*

2.4.7 Modification of the MOX Fuel Fabrication Facility to Incorporate Pit Disassembly and Conversion

A commentor suggested that DOE consider modifying the 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 2.1.3 and 2.1.4); 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.

2.4.8 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 to a foreign country would involve nonproliferation and national security concerns, among others.

2.4.9 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 1996c) 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 concept is developed and successfully operated, it may be considered in future NEPA analyses.

2.5 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.

2.6 Summary of Environmental Consequences

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

2.6.1 Comparison of Potential Consequences of Alternatives

Table 2–3 (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 2–3 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 2–3. 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 2–3 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 resources 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 boiling water reactors and pressurized water reactors. 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 storage, 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 2–3.

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

Greenhouse gases emitted by operations of the proposed surplus plutonium disposition facilities at SRS and LANL would add a relatively small increment to emissions of these gases in the United States and the world. Overall greenhouse gas emissions in the United States during 2010 totaled about 6.8 billion metric tons (7.5 billion tons) of carbon dioxide equivalent[17] (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 surplus plutonium disposition facilities at SRS and LANL would contribute incrementally to climate

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

change impacts. At present, there is no methodology that would allow DOE to estimate the specific impacts this increment of climate change would produce in the vicinity of 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.

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 2013d). 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 2013d). 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 2013i).

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 2013h, 2013j). 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.

Human Health – Workers. Total construction worker doses (SRS and LANL combined) would range from 0 to 6.6 person-rem for any of the alternatives implementing the PDCF or PDC Option for pit disassembly and conversion and from 140 to 150 person-rem for any of the action alternatives that implement the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion. No latent cancer fatalities (LCFs)[18] 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.

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[18] *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 is made using the risk estimator of 0.0006 latent fatal cancers per rem or person-rem (or 600 latent fatal cancers per 1 million rem or person-rem) (DOE 2003a) (see Appendix C, Section C.1.3). For acute doses to individuals equal to or greater than 20 rem, the factor is doubled (NCRP 1993).*

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

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

The annual dose to the population[19] surrounding SRS from operation of the proposed plutonium disposition activities would range from 0.45 to 0.97 person-rem across the alternatives, resulting in no LCFs. The annual dose to the offsite maximally exposed individual (MEI)[20] 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.

Based on information presented in this *SPD Supplemental EIS* and the *SPD EIS* (DOE 1999b), normal operation of reactors using partial MOX cores as opposed to LEU cores is not expected to result in any greater doses to the general population surrounding the reactor,[21] or the MEI. Doses from normal

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

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

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

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[22] 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 Immobilization to DWPF Alternative with the PF-4 and MFFF Option for pit disassembly and

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[22] *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 assumed to affect multiple facilities and are addressed separately.*

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., 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,* which concluded that MOX fuel use would not result in increases in the worker population at the reactor sites (DOE 1999b).

Waste Management. Nonradiological waste would be the major type of waste generated during construction at SRS, although some 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 site or off site; and nonhazardous solid and liquid wastes would be treated and disposed of on site. Sufficient SRS treatment, storage, and disposal capacity exists to manage the wastes generated during construction under all alternatives.

Small amounts of CH-TRU waste, LLW, and MLLW would be generated at LANL during modification of PF-4 to support the optional expanded 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 on site or off site. Sufficient LANL treatment, storage, and disposal capacity exists to manage the wastes generated during construction under all alternatives.

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

- 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 the PF-4 and MFFF or PF-4, H-Canyon/HB-Line, and MFFF Options
- 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 TRU 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 2008k:16). Based on estimates in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012e), approximately 24,700 cubic meters (872,000 cubic feet) of unsubscribed[23] CH-TRU waste capacity could support the actions analyzed in the *SPD Supplemental EIS*.[24] CH-TRU waste generation for the activities being considered under this *SPD Supplemental EIS* alternatives would represent 24 to 108 percent of this unsubscribed disposal capacity.[25] 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 is made to ship the FFTF portion of non-pit plutonium inventory as CH-TRU waste directly to WIPP, and if CCOs were used as packaging of some materials rather than the assumed POCs.

Decisions about disposal of TRU waste would be made within the context of the needs of the entire DOE complex. For purpose 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 for the action alternatives. It was assumed for analysis in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b) that TRU waste would be received at WIPP over about a 35-year period, through approximately 2033, but because the total quantity of TRU waste that may be disposed of at WIPP is statutorily established by the WIPP Land Withdrawal Act, the actual operating period for WIPP will depend on the volumes of TRU waste that are disposed of at WIPP by all DOE waste generators. Waste minimization across the DOE complex could extend the WIPP operating period. The potential impacts and resolution of these issues would be evaluated as additional information becomes available during the course of operations.

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[23] *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.*

[24] *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 2011e, 2012c:9). This includes approximately 3,560 cubic meters (126,000 cubic feet) of CH-TRU waste from MFFF and the Waste Solidification Building (DOE 2012e). 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.*

[25] *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.*

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

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

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

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

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

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

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

Environmental Justice. As discussed in Chapter 4, Section 4.1.6, of this *SPD Supplemental EIS*, the potential environmental impacts and risks associated with the proposed surplus plutonium disposition activities are essentially the same or lower for minority and low-income populations residing near SRS or LANL as they are for nonminority and non-low-income populations. 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[26] for populations near LANL was analyzed in the *Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (LANL SWEIS)* (DOE 2008f); 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 analyzed 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.

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[26] *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 surround ding 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 2–3 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	***Alternative***				
	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 BFN and SQN				
	Not applicable; no shipments to the Browns Ferry or Sequoyah Nuclear Plants are planned under the No Action Alternative.	Shipments – 6,400 to 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 within 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.

BFN = Browns Ferry Nuclear Plant; 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; SQN = Sequoyah Nuclear Plant; 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 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 2–3. 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 2–3 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 addressed 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.

2.6.2 Summary of Cumulative Impacts

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

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

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). 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 proposed under the *SPD Supplemental EIS* alternatives would disturb a maximum of 52 acres (21 hectares) of land, or approximately 0.03 percent of available SRS land 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 cumulative impacts at LANL, 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 similar-sized housing development or a commercial project. Emissions of fugitive dust from these activities would be controlled using water sprays and other engineering and management practices, as appropriate. The maximum ground-level concentrations off site and along roads to which the public has regular access would be below ambient air quality standards. Because earthmoving activities related to the actions considered in this cumulative impacts analysis would occur at different times and locations, air quality impacts are not likely to be cumulative.

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

The cumulative maximum concentrations of nonradiological air pollutants at the site boundary from operation of all SRS facilities would meet regulatory standards. It is unlikely that actual concentrations would be as high as those projected for existing activities at SRS because the values for existing activities are based on maximum permitted allowable emissions and not on actual emissions. In general, the contribution from *SPD Supplemental EIS* alternatives would be less than significant impact levels except for nitrogen dioxide 1-hour contributions for all alternatives and $PM_{2.5}$ [particulate matter less than or equal to 2.5 microns in aerodynamic diameter] 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 would not be expected to change. There would be no increase in emissions of criteria or nonradioactive toxic air pollutants from operation of PF-4; therefore, it would not contribute to cumulative impacts (see Chapter 4, Section 4.1.1).

Human Health. Radiological health effects are estimated in terms of radiological dose and excess LCF risk for the offsite population, hypothetical MEI, and radiological workers. The maximum cumulative regional population dose is estimated to be 25 person-rem per year (including impacts from SRS and the Vogtle Electric Generating Plant). This population dose is expected to result in no LCFs. Activities 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 (10 millirem per year from the air pathway, 4 millirem per year from the liquid pathway, and 100 millirem per year for all pathways).[27] 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 2.6.1, 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 would not be 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 would be 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 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 including the PF-4 and MFFF Option for pit disassembly and conversion) to about 2,100 (under the Immobilization to DWPF Alternative including the PDCF Option for pit disassembly and conversion). By comparison, approximately 215,000 people are employed in the ROI. In the ROI, in addition to the direct jobs, an estimated

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

2,500 indirect jobs[28] could be created. Anticipated fluctuations in ROI employment are unlikely to greatly stress housing and community services in the ROI.

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

If higher levels of pit disassembly and conversion were performed at PF-4 under any of the action alternatives, there would be an increase of approximately 493 LANL employees. This additional employment would result in no change in the cumulative socioeconomic conditions of the LANL ROI, but would help to offset workforce reductions currently being pursued at LANL. The number of LANL employees supporting pit disassembly operations at PF-4 would represent a small fraction of the LANL workforce (approximately 13,500 in 2010) and an even smaller fraction of the regional workforce (approximately 163,000 in 2011). However, future employment due to surplus plutonium disposition activities at LANL could reduce the adverse socioeconomic effects of an expected workforce reduction (LANL 2012d). In the LANL ROI, in addition to the direct jobs, an estimated 499 indirect jobs[29] could be created if higher levels of pit disassembly and conversion were performed in PF-4. Any fluctuations in ROI employment are unlikely to greatly stress housing and community services in the ROI.

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

Including activities proposed in this *SPD Supplemental EIS*, projected LANL and Los Alamos County activities would annually require approximately 880,000 megawatt-hours of electricity and 1.67 billion gallons (6.32 billion liters) of water to support operation of the proposed pit disassembly and conversion activities and other LANL and Los Alamos County operations. LANL would remain within its electricity and water capacities.

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

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

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

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

Activity (duration)		*Solid LLW*	*Solid MLLW*	*Solid Hazardous Waste*	*Solid Nonhazardous Waste* [a]
Present and Reasonably Foreseeable Future Actions		**466,000**	**6,100**	**6,100**	**3, 700,000**
SPD Supplemental EIS Alternatives [b]	No Action	16,000	0	66	31,000
	Immobilization to DWPF [c]	14,000 – 24,000	900	910 – 960	18,000 – 39,000
	MOX Fuel [c]	12,000 – 34,000	0 – 210	7 – 7,000	17,000 – 43,000
	H-Canyon/HB-Line to DWPF [c]	11,000 – 32,000	0 – 210	7 – 7,000	15,000 – 42,000
	WIPP	10,000 – 31,000	0 – 210	5 – 7,000	13,000 – 39,000
Total [d]		**480,000 – 500,000**	**6,100 – 7,000**	**6,100 – 13,000**	**3,700,000**

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

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

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

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

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

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

Under the H-Canyon/HB-Line to DWPF Alternative, some surplus plutonium materials would be dissolved at H-Canyon/HB-Line, mixed with HLW, and vitrified at DWPF. Because the dissolved plutonium would displace some of the HLW feed to DWPF, implementation of the H-Canyon/HB-Line to DWPF Alternative could result in generation of up to 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 in the GWSBs at S-Area pending their offsite disposition.

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

Table 2–5 lists cumulative volumes of LLW, MLLW, hazardous waste, and solid nonhazardous sanitary wastes that would be generated at LANL under the *SPD Supplemental EIS* alternatives. Cumulative waste volumes from existing site activities are projected over 30 years, a period of time that exceeds the projected periods of construction or operation of all plutonium disposition facilities under the action alternatives addressed in this *SPD Supplemental EIS*. TRU waste projections for SRS and LANL are presented in **Table 2–6**. Waste generation volumes from existing site activities are derived from the *Final Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (CMRR-NF SEIS)* (DOE 2011g:4-119), which updates project waste generation volumes presented in the *LANL SWEIS* (DOE 2008f). Since publication of the *CMRR-NF SEIS,* the Los Alamos Science and Engineering Complex project, referred to in the *LANL SWEIS* as the Science Complex, was cancelled; however, projected waste generation from this project is negligible. The cumulative waste volumes also include wastes from possible disposal of greater-than-Class C waste at LANL pursuant to the *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (DOE 2011a:1-9, 5-89). Also considered in the cumulative analysis is the maximum potential waste generation under the Removal with Off-Site Disposal Alternative as presented in the *Final Environmental Assessment for the Expansion of Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 of Sandia Canyon at LANL* (DOE 2010e:78).

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

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 2−6 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 the estimates contained in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012e).

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 2008k:16). Based on estimates in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012e), 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.[30]

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[30] *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.*

Table 2–5 Total Cumulative Waste Generation at Los Alamos National Laboratory (cubic meters)

Activity (duration)		*Solid LLW*	*Solid MLLW*	*Solid Hazardous Waste*	*Solid Nonhazardous Waste*
Present and Reasonably Foreseeable Future Actions					
Existing site activities (30 years) [a]		570,000 –2,800,000	8,200 – 420,000	48,000 – 86,000	1,500,000 – 1,600,000
GTCC facilities (DOE 2011a:5-89) [b]		250	0	440	780,000
GTCC disposal at LANL (DOE 2011a:1-9)		12,000	170	0	0
Expansion of SERF and environmental restoration of Reach S-2 of Sandia Canyon (DOE 2010e) [c]		0	0	38,300	38,300
Subtotal Baseline Plus Other Actions		*580,000 – 2,900,000*	*8,400 – 430,000*	*87,000 – 125,000*	*2,300,000 – 2,400,000*
SPD Supplemental EIS Alternatives	No Action	200	2	0	0
	Immobilization to DWPF	200 – 4,000	2 – 87	0 – 4	0
	MOX Fuel	200 – 4,000	2 – 87	0 – 4	0
	H-Canyon/HB-Line to DWPF	200 – 4,000	2 – 87	0 – 4	0
	WIPP	200 – 4,000	2 – 87	0 – 4	0
Total		**580,000 – 2,900,000**	**8,400 – 430,000**	**87,000 – 125,000**	**2,300,000 – 2,400,000**

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

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

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

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

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

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

	Alternatives				
Activity	*No Action*	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Subtotal baseline plus other actions at SRS	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 2012e: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.

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 2011a), the *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE 2012h), and the *Final Long-Term Management and Storage of Elemental Mercury Supplemental Environmental Impact Statement* (DOE 2013f), 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.

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 1943 through 2073 (131 years) (see Chapter 4, Section 4.5.3.7 of this *SPD Supplemental EIS*). The general population collective dose was estimated to be about 436,000 person-rem (resulting in 262 LCFs). Worker doses under *SPD Supplemental EIS* alternatives would be about 230 to 650 person-rem, resulting in no (0.1 to 0.4) LCFs. General population doses under *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 2011b). 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 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.* Chapter 4, Section 4.5.3.8, of this *SPD Supplemental EIS* evaluated the cumulative impacts of additional activities in the areas surrounding SRS and LANL and reached the same conclusion.