SECTION 2
TOPICS OF INTEREST

2.0 TOPICS OF INTEREST

Several topics were raised a number of times in public comments on the *Draft SPD Supplemental EIS.* Because these topics were of broad interest or concern, the U.S. Department of Energy (DOE) is providing, in this section, its responses that address these topic areas:

- National Environmental Policy Act Process
- Alternatives
- Pit Disassembly and Conversion
- MOX Fuel Program
- Nuclear Reactor Safety
- Environmental Justice
- Long-Term Management of Used Fuel and High-Level Radioactive Waste

2.1 National Environmental Policy Act Process

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

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

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

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

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

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

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

2.2 Alternatives

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

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

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

This *SPD Supplemental EIS* evaluates alternatives for 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned. The alternatives for this surplus plutonium being considered and analyzed in this *Final SPD Supplemental EIS* include immobilization at SRS (Immobilization to DWPF Alternative), fabrication into MOX fuel at SRS with subsequent irradiation in one or more domestic commercial nuclear power reactors (MOX Fuel Alternative), vitrification with high-level radioactive waste (HLW) at SRS (H-Canyon/HB-Line to DWPF Alternative), and potential disposal as contact-handled transuranic (CH-TRU)[1] waste at WIPP (WIPP Alternative) (see Chapter 2, Section 2.3, of this *SPD Supplemental EIS*).

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

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

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

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

As described in Appendix B, Table B–2, of this *SPD Supplemental EIS,* the duration of the Immobilization to DWPF Alternative is expected to be similar to the durations of the other alternatives.

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

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

Cost, schedule, technical viability, worker and public safety, environmental impacts, security, and the ability to carry out international agreements are among the factors the decisionmaker may consider when selecting an alternative for implementation. For further discussion, refer to Section 2.1, National Environmental Policy Act Process, of this CRD.

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

Discussion: DOE annually re-evaluates available disposal capacity against projected inventories of all TRU waste that is expected to be disposed at WIPP. Based on estimates in the *Annual Transuranic Waste Inventory Report – 2012* (DOE 2012a), approximately 24,700 cubic meters (872,000 cubic feet) of unsubscribed[3] CH-TRU waste capacity could support the actions analyzed in this *SPD Supplemental EIS*. Depending on the alternative chosen by DOE, CH-TRU waste generated at SRS and LANL as a result of surplus plutonium disposition activities could use between 24 percent (under the No Action Alternative) and 108 percent (under the WIPP Alternative using pipe overpack containers [POCs]) of the unsubscribed WIPP disposal capacity. If Fast Flux Test Facility (FFTF) fuel can be disposed directly and criticality control overpacks (CCOs)[4] are assumed to be used, CH-TRU waste generated at SRS and LANL under the WIPP Alternative would use 65 percent of the unsubscribed WIPP disposal capacity instead of 108 percent. Disposal of CH-TRU waste under all alternatives evaluated in this *SPD Supplemental EIS* would be in accordance with the WIPP waste acceptance criteria and, with the exception of a scenario that would use only POCs for disposal of 13.1 metric tons (14.4 tons) of surplus plutonium under the WIPP Alternative, would remain within WIPP's disposal capacity (see Chapter 2, Section 2.6.2; Chapter 4, Section 4.5.3.6.3; and Appendix B, Sections B.1.3 and B.3).

2.3 Pit Disassembly and Conversion

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

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

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

Discussion: DOE has ongoing programs to better understand the geology and seismology of the LANL region in order to predict the likelihood of severe earthquakes. DOE recognizes that LANL is in the vicinity of active faults and continues to take appropriate actions to further improve the safety basis that

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[3] *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.*

[4] *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.*

documents the hazards and controls in place at LANL to ensure safety and to implement facility modification and upgrades as necessary.

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

This *SPD Supplemental EIS* evaluates several accident scenarios for varying levels of damage caused by earthquakes (see Chapter 4, Section 4.1.2.2, and Appendix D, Sections D.1.5.2.11 and D.2.9) and describes concerns identified by DNFSB through August 2014. The accident scenario with the highest impacts takes into account a major fire occurring as a result of a severe earthquake that causes major structural damage to PF-4. Until ongoing seismic upgrades to the PF-4 structures are completed (scheduled for early 2016), a design-basis earthquake with a return interval of about 1 in 8,300 years might initiate structural damage to the facility. Although the earthquake by itself is not a beyond-design-basis event, the level of damage (building collapse), spills, impacts, and fires postulated for this scenario is estimated to decrease the probability of releases of the magnitude considered by a factor of 10 to 100; hence, the overall event is extremely unlikely. DOE estimates that up to 3 LCFs could occur in the offsite population at LANL as a result of radiation exposure from the damaged PF-4; the annual frequency of this accident is estimated to range from 1 chance in 100,000 to 1 chance in 10,000,000.

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

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

2.4 MOX Fuel Program

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

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

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

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

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

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

2.5 Nuclear Reactor Safety

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

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

With regard to concerns raised about the reactor containment structures at Browns Ferry, NRC reviewed the Browns Ferry operating history as part of its safety evaluation of TVA's request to extend the Browns Ferry operating licenses and determined that the containment structures are sound and able to continue safe operation for another 20 years (see http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/lra-bfn.pdf for TVA's license renewal application). In 2006, NRC issued a license renewal safety evaluation report (NRC 2006a, 2006b) that documented an in-depth review of

Browns Ferry and concluded that TVA be granted a 20-year operating license renewal for Browns Ferry, in accordance with 10 CFR Part 54. NRC approved the Browns Ferry license renewal request on May 4, 2006. Refer to Section 2.5, Topic C, below for further discussion of the Browns Ferry Nuclear Plant containment.

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

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

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

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

Discussion: DOE used current data to develop representative core inventories for both partial MOX and full LEU fuel cores for the accident analysis in this *SPD Supplemental EIS*. This *SPD Supplemental EIS* analyzes the risks associated with the use of a partial MOX fuel core under various accident scenarios, including failures that could lead to a core meltdown, and concludes that the risks are comparable to those associated with the use of a full LEU core (see Chapter 4, Section 4.1.2.4, and Appendix J, Section J.3.2). The risks to the maximally exposed individual (MEI)[5] and the offsite population of developing a fatal cancer as a result of one of these accidents, regardless of whether the reactors are using partial MOX or full LEU fuel cores, are small (see Appendix J, Section J.3).

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

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

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

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

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

Discussion: The March 11, 2011, earthquake and subsequent tsunami in Japan caused substantial damage to reactors at the Fukushima Dai-ichi Nuclear Power Station. At the time of the accident, Unit 3 was operating with a partial MOX fuel core. However, at least one authority has determined that the accident involved failures unrelated to the use of MOX fuel. The United Kingdom's Office of Nuclear Regulation examined the Fukushima accident and stated, "[t]here is no evidence to suggest that the presence of MOX fuel in Reactor Unit 3 significantly contributed to the health impact of the accident on or off the site." With respect to the use of MOX fuel in U.K. reactors, the statement is made that the information to date about Fukushima Dai-ichi does not add to knowledge about the safety of the use of MOX fuel (ONR 2011).

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

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

2.6 Environmental Justice

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

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

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

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

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

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

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

DOE has terminated the program for a geologic repository for used nuclear fuel and HLW at Yucca Mountain, Nevada. Notwithstanding the decision to terminate the Yucca Mountain program, DOE remains committed to meeting its obligations to manage and ultimately dispose of used nuclear fuel and HLW. DOE established the Blue Ribbon Commission on America's Nuclear Future to conduct a comprehensive review and evaluate alternative approaches for meeting these obligations. The Commission report to the Secretary of Energy of January 26, 2012 (BRCANF 2012) provided a strong foundation for the development of the Administration's January 2013 *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (DOE 2013). 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.