4.20 ALTERNATIVE 11A

Alternative 11A would involve constructing and operating the pit conversion and immobilization facilities in the existing FMEF building in the 400 Area at Hanford. Under this alternative, all surplus plutonium is immobilized; none is fabricated into MOX fuel.

4.20.1 Construction

4.20.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 11A at Hanford, including modification of FMEF for pit disassembly and conversion and plutonium conversion and immobilization, were analyzed as described in Appendix F.1. Sources of construction impacts include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from construction activities at Hanford, with standards and guidelines is presented as Table 4–133. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Emissions from trucks carrying materials and wastes and employee vehicles are estimated to increase about 3 percent over the No Action emissions. Total vehicle emissions associated with activities at Hanford would likely decrease somewhat from current emissions during the planned construction period because of a decrease in overall site employment.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with the construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats, as none are known to occur on or in the immediate vicinity of the proposed site location (see Section 4.26). Traffic associated with the construction of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

Table 4–133. Evaluation of Air Pollutant Concentrations Associated with Construction Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m³)[a]	SPD Increment (Fg/m³)	Total Site Concentration (Fg/m³)	Site as a Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	1.12	35.2	0.35
	1 hour	40,000	7.64	55.9	0.14
Nitrogen dioxide	Annual	100	0.0853	0.335	0.34
PM_{10}	Annual	50	0.0942	0.112	0.22
	24 hours	150	3.29	4.05	2.7
Sulfur dioxide	Annual	50	0.00796	1.64	3.2
	24 hours	260	0.0885	9	3.4
	3 hours	1,300	0.602	30.2	2.3
	1 hour	660	1.81	34.7	5.3
Other regulated pollutants					
Total suspended particulates	Annual	60	0.195	0.213	0.35
	24 hours	150	6.44	7.21	4.8
Hazardous and other toxic compounds					
Other toxics[b]	Annual	0.12	0	0.000006	0.005

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; WDEC 1994.

4.20.1.2 Waste Management

Table 4–134 compares the wastes generated during modification of the FMEF building at Hanford with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year modification period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during modification. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Hazardous wastes generated during modification of the FMEF building would be typical of those generated during modification of an industrial facility. Any hazardous wastes generated during modification would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the modification period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid wastes generated during modification of the FMEF building would be packaged in conformance with standard industrial practice and shipped to offsite commercial facilities for recycling or

Table 4–134. Potential Waste Management Impacts of Construction Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	31	NA	NA	NA
Nonhazardous				
Liquid	10,000	4[c]	NA	4[d]
Solid	1,100	NA	NA	NA

[a] See definitions in Appendix F.8.

[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year modification period.

[c] Percent of capacity of the 400 Area sanitary sewer.

[d] Percent of capacity of the Energy Northwest (formerly Washington Public Power Supply System) Sewage Treatment Facility.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at Hanford.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during modification of the FMEF building would be managed at the Energy Northwest (formerly WPPSS) Sewage Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generated during modification is estimated to be 4 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 4 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the Energy Northwest Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the Energy Northwest Sewage Treatment Facility (Mecca 1997). Therefore, management of these wastes should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

4.20.1.3 Socioeconomics

Construction-related employment requirements for Alternative 11A would be as indicated in Table 4–135.

Table 4–135. Construction Employment Requirements for Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Year	Pit Conversion	Immobilization	Total
2001	76	0	76
2002	116	277	393
2003	72	391	463
2004	0	343	343
2005	0	228	228

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Source: UC 1998a, 1999a, 1999b.

At its peak in 2003, construction of the pit conversion and immobilization facilities at Hanford under this alternative would require 463 construction workers and generate another 475 indirect jobs in the region. The total employment requirement of 938 direct and indirect jobs represents 0.2 percent of the projected REA workforce, and thus should have no major impact on the REA. This requirement should also have a negligible impact on community services currently offered in the ROI. In fact, it should help offset the approximately 15 percent reduction in Hanford employment (i.e., from 12,882 to 11,000 workers) projected for the years 1997–2005.

4.20.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. According to a recent radiation survey (Antonio 1998) conducted in the 400 Area, a construction worker would not be expected to receive doses above natural background levels. Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.20.1.5 Facility Accidents

The construction of surplus plutonium disposition facilities at Hanford could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 1,503 person-years of construction labor and standard industrial accident rates, approximately 150 cases of nonfatal occupational injury or illness and 0.21 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.20.1.6 Environmental Justice

As discussed in the other parts of Section 4.20.1, construction under Alternative 11A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 11A at Hanford would have no significant impacts on minority or low-income populations.

4.20.2 Operations

4.20.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 11A at Hanford were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including those from surplus plutonium disposition facilities, with standards and guidelines is presented as Table 4–136. Concentrations for immobilization in the ceramic and glass forms are the same. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the PM_{10} and total suspended particulates standards attributable to natural sources would be expected to continue. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

Table 4–136. Evaluation of Air Pollutant Concentrations Associated With Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m³)[a]	SPD Increment (Fg/m³)	Total Site Concentration (Fg/m³)	Site as a Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.548	34.6	0.35
	1 hour	40,000	3.73	52	0.13
Nitrogen dioxide	Annual	100	0.0729	0.323	0.32
PM_{10}	Annual	50	0.0044	0.0223	0.045
	24 hours	150	0.0489	0.819	0.55
Sulfur dioxide	Annual	50	0.00401	1.63	3.1
	24 hours	260	0.0446	8.95	3.4
	3 hours	1,300	0.304	29.9	2.3
	1 hour	660	0.91	33.8	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.0044	0.0223	0.037
	24 hours	150	0.0489	0.819	0.55
[Text deleted.]					

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.

Note: No nonradiological hazardous or other toxic compounds would be emitted from these processes.

Source: EPA 1997a; WDEC 1994.

For a discussion of how the operation of the pit conversion and immobilization facilities at Hanford would affect the ability to continue to meet NESHAPs limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAPs limits applicable to operation of these facilities.

The increased concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide are a small fraction of the PSD Class II area increments as summarized in Table 4–137.

Table 4–137. Evaluation of Air Pollutant Increases Associated With Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Increase in Concentration (Fg/m³)	PSD Class II Area Allowable Increment (Fg/m³)	Percent of Increment
Nitrogen dioxide	Annual	0.0729	25	0.29
PM_{10}	Annual	0.0044	17	0.026
	24 hours	0.0489	30	0.16
Sulfur dioxide	Annual	0.00401	20	0.02
	24 hours	0.0446	91	0.049
	3 hours	0.304	512	0.059

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.

Source: EPA 1997b.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

The combustion of fossil fuels associated with Alternative 11A would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 7×10^{-6} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

The location of these facilities at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing machines (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources could have onsite impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats, as none are known to occur on or in the immediate vicinity of the proposed site location (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus should not result in any increased in annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

4.20.2.2 Waste Management

Table 4–138 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at Hanford. Although HLW would be used in the immobilization process, no HLW would be generated by surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies. More detailed descriptions of waste management impacts are presented in Appendix H. The methods used to estimate these impacts are described in Appendix F.8.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored on the site until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated and disposed of at offsite commercial facilities. This SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS* that is being prepared by the DOE Richland Operations Office (DOE 1997b).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

Table 4–138. Potential Waste Management Impacts of Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	140	8	8	1 of WIPP
LLW	170	NA	NA	<1
Mixed LLW	2	<1	<1	<1
Hazardous	77	NA	NA	NA
Nonhazardous				
Liquid	89,000	38[d]	NA	38[e]
Solid	2,100	NA	NA	NA

[a] See definitions in Appendix F.8.

[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.

[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.

[d] Percent of capacity of the 400 Area sanitary sewer.

[e] Percent of capacity of the Energy Northwest (formerly Washington Public Power Supply System) Sewage Treatment Facility.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

TRU waste generated at surplus plutonium disposition facilities is estimated to be 8 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,400 m^3 (1,830 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 8 percent of the 17,000-m^3 (22,200-yd^3) storage capacity available at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.21 ha (0.52 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at Hanford should not be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d).

The 1,400 m^3 (1,830 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500 m^3 (220,400 yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

LLW would be packaged, certified, and accumulated at the new facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,700 m^3 (2,220 yd^3) of LLW would be generated over the operations period. LLW generated at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) capacity of the LLW Burial Grounds and 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480 m^3/ha disposal land usage factor for Hanford published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 1,700 m^3 (2,220 yd^3) of waste would require 0.48-ha (1.2-acre) disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Mixed LLW generated at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (21,970-yd^3) capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at the should not have a major impact on the mixed LLW management system.

If all TRU waste and mixed LLW generated at surplus plutonium disposition facilities were processed in the Waste Receiving and Processing Facility, this additional waste would be 8 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of that facility.

Any hazardous wastes generated during operations would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operations period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous process wastewater would be treated if necessary before being discharged with sanitary wastewater to the 400 Area sanitary sewer system, which connects to the Energy Northwest (formerly WPPSS) Sewage Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at Hanford is estimated to be 38 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 38 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the Energy Northwest Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the Energy Northwest Sewage Treatment Facility (Mecca 1997). Therefore, management of nonhazardous liquid waste at Hanford should not have a major impact on the treatment system.

4.20.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and immobilization facilities at Hanford in 2006 under Alternative 11A, an estimated 812 new workers would be required to operate them (UC 1998a, 1999a, 1999b). This level of employment should generate another 2,056 indirect jobs in the region. The total employment requirement of 2,868 direct and indirect jobs represents only about 0.7 percent of the projected REA workforce, and thus should have no major impact on the REA. Some of the new jobs created under this alternative would be filled from the ranks of the unemployed, currently 11 percent of the REA's population.

In the ROI, however, this employment requirement could have minor impacts on community services, for it should coincide with an overall increase in site employment in connection with construction of the tank waste remediation system. Assuming that 91 percent of the new employees associated with this alternative resided in the ROI, an increase of 2,610 new jobs in the workforce would result in an overall population increase of approximately 4,842 persons. This increase, in conjunction with the population growth forecast by the State of Washington, would engender increased construction of local housing units. Given the current population-to-student ratio in the ROI, a population increase of this size would be expected to include 1,002 students, and local school districts would presumably have to increase the number of classrooms to accommodate them.

Therefore, community services in the ROI would be expected to change to reflect the population growth as follows: 62 teachers would be added to maintain the current student-to-teacher ratio of 16:1; 7 police officers would be added to maintain the current officer-to-population ratio of 1.5:1,000; 16 firefighters would be added to maintain the current firefighter-to-population ratio of 3.4:1,000; and 7 physicians would be added to maintain the current physician-to-population ratio of 1.4:1,000. According to estimates, then, an additional 93 positions would have to be created to maintain community services at current levels. The ratio of hospital beds to population in the ROI would drop from 2.1 to 2.0 beds per 1,000 persons unless additional beds were provided. Moreover, the average school enrollment would increase to 94.5 percent from the current rate of 92.5 percent unless additional classrooms were built. None of these projected changes should have major impacts on the level of community services currently offered in the ROI.

4.20.2.4 Human Health Risk

During normal operations, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under Alternative 11A would be as follows.

Radiological Impacts. Table 4–139 reflects the potential radiological impacts on three individual receptor groups: the population living within 80 km (50 mi) of Hanford in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of incident-free operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–139. Potential Radiological Impacts on the Public of Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	Immobilization		Total[a]
		Ceramic	Glass	
Population within 80 km for year 2010				
Dose (person-rem)	6.9	0.016	0.015	6.9
Percent of natural background[b]	5.9×10^{-3}	1.4×10^{-5}	1.3×10^{-5}	5.9×10^{-3}
10-year latent fatal cancers	0.034	8.0×10^{-5}	7.5×10^{-5}	0.034
Maximally exposed individual				
Annual dose (mrem)	0.017	2.2×10^{-4}	2.0×10^{-4}	0.017
Percent of natural background[b]	5.7×10^{-3}	7.3×10^{-5}	6.7×10^{-5}	5.8×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	1.1×10^{-9}	1.0×10^{-9}	8.6×10^{-8}
Average individual within 80 km[c]				
Annual dose (mrem)	0.017	4.1×10^{-5}	3.9×10^{-5}	0.017
10-year latent fatal cancer risk	8.5×10^{-8}	2.1×10^{-10}	2.0×10^{-10}	8.6×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities. This total includes the higher of the values for the ceramic and glass immobilization alternatives.

[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Source: Appendix J.

Given incident-free operation of both facilities, the total population dose in the year 2010 would be 6.9 person-rem. The corresponding number of LCFs in this population from 10 years of operation would be

0.034. The dose to the maximally exposed member of the public from annual operation of both facilities would be 0.017 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 8.6×10^{-8}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the CAA [NESHAPs], and the SDWA).

Doses to involved workers from normal operations are given in Table 4–140; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192 and 298 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–140. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–140. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 11A: Pit Conversion in FMEF and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	397	780
Total dose (person-rem/yr)	192	298	490
10-year latent fatal cancers	0.77	1.2	2.0
Average worker dose (mrem/yr)	500	750	628[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.5×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998a, 1999a, 1999b.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operations at Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.20.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Hanford are substantially equivalent to those included in Alternative 2 (see Table 4–30), and the potential consequences of such accidents from operation of the immobilization facility at Hanford are presented in Tables 4–141 and 4–142. The design layout for the 50-t (55-ton) immobilization alternatives would be the same as for the 17-t (19-ton) immobilization alternatives, with the result being that the throughput of the facility would be lower. To be conservative, the 50-t (55-ton) immobilization scenario has been used as the nominal case throughout the accident analysis, so the results referenced from the earlier accident sections are directly applicable here. The plutonium conversion portion of the facility (i.e., the part of the process when nonpit plutonium is converted to plutonium dioxide), however, would operate at the design rate regardless of whether the alternative processes 17 t (19 ton) or 50 t (55 ton), both cases would involve the same material throughput.

The consequences and frequencies of the analyzed accidents associated with plutonium conversion are thus identical for both.

For the immobilization portion of the facility, the frequencies of process-specific accidents (e.g., melter spill) would be higher for the 50-t (55-ton) alternatives, as more operations would be performed over time. This difference, however, would be smaller than the frequency range used for scenario characterization. Thus, for all practical purposes, the analytical results for the two different sets of immobilization alternatives are the same.

Table 4–141. Accident Impacts of Alternative 11A: Ceramic Immobilization in FMEF at Hanford (50-t Case)

		Impacts on Noninvolved Worker		Impacts at Site Boundary		Impacts on Population Within 80 km	
Accident	**Frequency (per year)**	**Dose (rem)[a]**	**Probability of Cancer Fatality[b]**	**Dose (rem)[a]**	**Probability of Cancer Fatality[b]**	**Dose (person-rem)[a]**	**Latent Cancer Fatalities[c]**
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	Unlikely	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	Unlikely	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Glovebox fire (sintering furnace)	Extremely unlikely	1.7×10^{-6}	6.8×10^{-10}	2.6×10^{-7}	1.3×10^{-10}	8.3×10^{-4}	4.1×10^{-7}
Design basis earthquake	Unlikely	3.9×10^{-4}	1.6×10^{-7}	5.9×10^{-5}	3.0×10^{-8}	1.9×10^{-1}	9.6×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	1.7×10^{-2}	6.8×10^{-6}	6.5×10^{-4}	3.2×10^{-7}	1.6	7.8×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	1.4×10^{2}	5.7×10^{-2}	5.4	2.7×10^{-3}	1.3×10^{4}	6.5

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual. See Appendix K.1.4.2 for a more detailed discussion of pathways.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value that assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: FMEF, Fuels and Materials Examination Facility; HYDOX, hydride oxidation.

For the earthquake scenarios, the difference would depend on whether the 50-t (55-ton) alternatives involved operation with higher throughput or more shifts. If it involved higher throughput, then more material would be

vulnerable to an earthquake during operations, and the contribution of the immobilization portion of the facility to the source term would be marginally greater. If it involved more shifts, then the contribution of the immobilization portion of the facility to the source term would be the same for an earthquake that occurred during operations, but an earthquake would be more likely to occur during operations. The bounding source term for the immobilization portion of the facility in the analyzed earthquake scenarios is the same for the two sets of alternatives (the 50-t [55-ton] alternatives versus the 17-t [19-ton] alternatives with fewer shifts). The frequency of that source term differs marginally, but the difference is smaller than the frequency range used for scenario characterization. Thus, for all practical purposes, the analytical results for the two are the same.

Table 4–142. Accident Impacts of Alternative 11A: Glass Immobilization in FMEF at Hanford (50-t Case)

		Impacts on Noninvolved Worker		Impacts at Site Boundary		Impacts on Population Within 80 km	
Accident	Frequency (per year)	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (person-rem)[a]	Latent Cancer Fatalities[c]
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Explosion in HYDOX furnace	Unlikely	3.8×10^{-3}	1.5×10^{-6}	5.8×10^{-4}	2.9×10^{-7}	1.9	9.4×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	3.0×10^{-7}	1.2×10^{-10}	4.6×10^{-8}	2.3×10^{-11}	1.5×10^{-4}	7.4×10^{-8}
Hydrogen explosion	Unlikely	4.2×10^{-4}	1.7×10^{-7}	6.4×10^{-5}	3.2×10^{-8}	2.1×10^{-1}	1.0×10^{-4}
Melter eruption	Unlikely	1.6×10^{-6}	6.3×10^{-10}	2.4×10^{-7}	1.2×10^{-10}	7.7×10^{-4}	3.8×10^{-7}
Melter spill	Unlikely	3.7×10^{-7}	1.5×10^{-10}	5.6×10^{-8}	2.8×10^{-11}	1.8×10^{-4}	9.0×10^{-8}
Design basis earthquake	Unlikely	3.5×10^{-4}	1.4×10^{-7}	5.2×10^{-5}	2.6×10^{-8}	1.7×10^{-1}	8.4×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	3.1×10^{-3}	1.2×10^{-6}	1.2×10^{-4}	5.8×10^{-8}	2.8×10^{-1}	1.4×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	1.3×10^{2}	5.0×10^{-2}	4.8	2.4×10^{-3}	1.2×10^{4}	5.8

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual. See Appendix K.1.4.2 for a more detailed discussion of pathways.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value that assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: FMEF, Fuels and Materials Examination Facility; HYDOX, hydride oxidation.

More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The accident scenarios and consequences for the bounding tritium release and criticality accidents would remain the same as discussed in Section 4.3.2.5.

A beyond-design-basis earthquake at Hanford could result in the collapse of pit conversion (as described in Section 4.3.2.5) and immobilization facilities in FMEF (as described below), and an estimated 18 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude at Hanford is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. The consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 1.8×10^{-4}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the decisions made in the SPD EIS ROD, site emergency management programs would be modified to consider new accidents not in the current program.

Nonradiological Accidents. Plutonium disposition operations at Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 8,532 person-years of labor and the standard DOE occupational accident rates, approximately 310 cases of nonfatal occupational injury or illness and 0.23 fatality could be expected for the duration of operations.

4.20.2.6 Transportation

Operational transportation impacts may be divided into two parts: impacts due to incident-free transportation and those due to transportation accidents. They may be further divided into nonradiological and radiological impacts. Nonradiological impacts are specifically vehicular, such as vehicular emissions and traffic accidents. Radiological impacts are those related to the dose received by transportation workers and the public during normal operations

and in the case of accidents in which the radioactive materials being shipped may be released. For more detailed information on the transportation analysis performed for this SPD EIS, see Appendix L.

Under Alternative 11A, transportation to and from Hanford would include the shipment of plutonium pits and clean plutonium metal via SST/SGT from sites throughout the DOE complex to the pit conversion facility.[28] During dismantlement of the pits, some HEU would be recovered. The pit conversion facility would ship HEU via SST/SGT to ORR for storage.[29] After conversion, the plutonium in the pit conversion facility would be in the form of plutonium dioxide. This material would be transferred within the FMEF building at Hanford for immobilization.

It is assumed that depleted uranium hexafluoride needed for immobilization would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide. After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the immobilization facility at Hanford.

Immobilization at Hanford under this alternative would require that surplus nonpit plutonium in various forms be shipped from current storage locations (i.e., Hanford, INEEL, LLNL, LANL, RFETS, and SRS) to the immobilization facility at Hanford. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SST/SGTs.

Under the preferred technology alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to HLW in the 200 Area. This intrasite transportation—from 400 Area to 200 Area—could require the temporary shutdown of roads on Hanford. It would, however, provide for all the necessary security and for reduced risk to the public; SST/SGTs would not be required.

After the immobilized plutonium was encased by HLW at HLWVF, it would eventually be shipped to a potential geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 395 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 11A. The *Yucca Mountain Draft EIS* evaluates different options for the shipment of these canisters to a potential geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS conservatively assumes that all of these shipments would be made by truck, one canister per truck.

[28] Work is currently under way to repackage all pits at Pantex from the AL–R8 container into the AL–R8 SI container for long-term storage. The AL–R8 is not an offsite shipping container as was the AT–400A analyzed in the SPD Draft EIS. Therefore, if the decision were made to site the pit conversion facility at a site other than Pantex, the surplus pits would have to be taken out of the AL–R8 SI and placed in a yet-to-be-developed shipping container. This operation would also require the replacement of some pit-holding fixtures to meet transportation requirements. Under such alternatives, this change would result in a total repackaging exposure of 208 person-rem to Pantex personnel. An increase in worker doses of this magnitude could result in an increase in the expected number of LCFs of 8.3×10^{-2} over the life of the program.

[29] Classified nuclear material parts would also result from pit disassembly. Although current plans are to store these parts at the pit conversion facility, this SPD EIS analyzes the possible transport of these nuclear material parts to LANL. Therefore, the transportation impacts are slightly overstated.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.20.1.2 and 4.20.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In all, approximately 2,200 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 3.7 million km (2.3 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 68 person-rem; the dose to the public, 71 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.027 LCF among transportation workers and 0.036 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.011.

Impacts of Accidents During Transportation (Consequences). The maximum foreseeable offsite transportation accident under this alternative (probability of occurrence: greater than 1 in 10 million per year) is a shipment of plutonium pits from one of DOE's storage locations to the pit conversion facility with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. If this accident were to occur, it could result in a dose of 87 person-rem to the public for an LCF risk of 0.044 and 96 rem to the hypothetical MEI for an LCF risk of 0.096. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year. (See Appendix L.6.)

Impacts of Accidents During Transportation (Risk). The total transportation accident risks were estimated by summing the risks to the affected population from all hypothetical accidents. For Alternative 11A, those risks are as follows: a radiological dose to the population of 0.5 person-rem, resulting in a total population risk of 3×10^{-4} LCF; and traffic accidents resulting in 0.054 fatality.

4.20.2.7 Environmental Justice

As discussed in other parts of Section 4.20.2, routine operations conducted under Alternative 11A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 10 million (see Table 4–139). The number of LCFs expected among the general population residing near Pantex from accident-free operations would increase by approximately 0.034.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.20.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–30, 4–141, and 4 –142). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the site pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.20.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 11A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

4.21 ALTERNATIVE 11B

Alternative 11B would involve constructing and operating the pit conversion facility in Zone 4 West at Pantex and the immobilization facility at Hanford. The immobilization facility would be located in the existing FMEF building in the 400 Area. Under this alternative, all surplus plutonium would be immobilized; none would be fabricated into MOX fuel.

4.21.1 Construction

4.21.1.1 Air Quality and Noise

Potential air quality and noise impacts of construction of the pit conversion facility under Alternative 11B at Pantex would be the same as those for Alternative 4A (see Section 4.6.1.1).

Potential air quality and noise impacts of construction of the immobilization facility under Alternative 11B at Hanford would be the same as those for Alternative 8 (see Section 4.16.1.1).

4.21.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as those for Alternative 4A. See Section 4.6.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At Hanford, construction impacts of this alternative would be the same as those for Alternative 8. See Section 4.16.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Hanford.

4.21.1.3 Socioeconomics

Construction-related employment requirements under Alternative 11B would be as indicated in Table 4–143.

Table 4–143. Construction Employment Requirements Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Year	Pit Conversion	Immobilization	Total
2001	297	0	297
2002	451	207	658
2003	276	376	652
2004	0	414	414
2005	0	226	226

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.
Source: UC 1998e, 1999a, 1999b.

At its peak in 2002, construction of the new pit conversion facility at Pantex under this alternative would require 451 construction workers and generate another 381 indirect jobs in the region. As this total employment requirement of 832 direct and indirect jobs represents only 0.3 percent of the projected REA workforce, it should have no major impact on the REA. Moreover, it should have little impact on community services within the ROI.

In fact, it should help offset the nearly 40 percent reduction in the Pantex total workforce (i.e., from 2,944 to 1,750 workers) projected for the years 1997–2005.

At its peak in 2004, construction of the immobilization facility at Hanford would require 414 construction workers and should generate another 425 indirect jobs in the region. This total employment requirement of 839 direct and indirect jobs represents only 0.2 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have little effect on the community services currently offered in the ROI. In fact, it should help offset the nearly 15 percent reduction in Hanford's workforce (i.e., from 12,882 to approximately 11,000 workers) projected for the years 1997–2005.

4.21.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. According to results of recent radiation surveys (DOE 1997f, Antonio 1998) conducted in the Zone 4 area at Pantex and the 400 Area at Hanford, construction workers would not be expected to receive any additional radiation exposure above natural background levels in those areas. Nonetheless, if deemed necessary, construction workers may be monitored (badged) as a precautionary measure.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at Pantex or Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.21.1.5 Facility Accidents

The construction of surplus plutonium disposition facilities at Pantex and Hanford could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 2,247 person-years of construction labor and standard industrial accident rates, approximately 220 cases of nonfatal occupational injury or illness and 0.31 fatality could be expected. As all construction would be in nonradiological areas, no radiological accidents should occur during construction.

4.21.1.6 Environmental Justice

As discussed in the other parts of Section 4.21.1, construction under Alternative 11B would pose no significant risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities at Pantex and Hanford under Alternative 11B would have no significant impacts on minority or low-income populations.

4.21.2 Operations

4.21.2.1 Air Quality and Noise

Potential air quality impacts of the operation of the new pit conversion facility under Alternative 11B at Pantex are the same as those for Alternative 4A (see Section 4.6.2.1). Noise impacts are the same as those for Alternative 4A at Pantex (see Section 4.6.2.1).

Potential air quality impacts from the operation of the immobilization facility under Alternative 11B at Hanford were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from operation of the immobilization facility, with standards and guidelines is presented as Table 4–144. Concentrations for immobilization in the ceramic and glass forms are the same.

Table 4–144. Evaluation of Air Pollutant Concentrations at Hanford Associated With Operations Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m^3)[a]	SPD Increment (Fg/m^3)	Total Site Concentration (Fg/m^3)	Site as a Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.271	34.4	0.34
	1 hour	40,000	1.84	50.1	0.13
Nitrogen dioxide	Annual	100	0.0376	0.288	0.29
PM_{10}	Annual	50	0.00265	0.0206	0.041
	24 hours	150	0.0295	0.8	0.53
Sulfur dioxide	Annual	50	0.00249	1.63	3.1
	24 hours	260	0.0277	8.94	3.4
	3 hours	1,300	0.0188	29.8	2.3
	1 hour	660[b]	0.564	33.5	5.1
Other regulated pollutants					
Total suspended particulates	Annual	60	0.00265	0.021	0.034
	24 hours	150	0.0295	0.8	0.53

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

[b] At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; WDEC 1994.

Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards as a result of Hanford activities. Occasional exceedances of the standards for PM_{10} and total suspended particulates attributable to natural sources would be expected to continue. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of the facility.

For a discussion of how the operation of the immobilization facility at Hanford would affect the ability to continue to meet NESHAPs limits regarding airborne radiological emissions, see Section 4.32.1.4. There are no other NESHAPs limits applicable to operation of this facility.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide resulting from operation of the immobilization facility would be a small fraction of the PSD Class II area increments, as summarized in Table 4–145.

Total vehicle emissions associated with activities at Hanford would likely decrease somewhat because of an expected decrease in overall site employment during this timeframe.

The location of this facility at Hanford relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operation would include new

or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of this facility would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 7.1 km [4.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite

Table 4–145. Evaluation of Air Pollutant Increases at Hanford Associated With Operations Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Pollutant	Averaging Period	Increase in Concentration (Fg/m³)	PSD Class II Area Allowable Increment (Fg/m³)	Percent of Increment
Nitrogen dioxide	Annual	0.0376	25	0.15
PM_{10}	Annual	0.00265	17	0.016
	24 hours	0.0295	30	0.098
Sulfur dioxide	Annual	0.00249	20	0.012
	24 hours	0.0277	91	0.03
	3 hours	0.0188	512	0.0036

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

noise levels would be small. However, some noise sources could have onsite impacts, such as the disturbance of wildlife. Noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats, as none are known to occur on or in the immediate vicinity of the proposed site location (see Section 4.26). Traffic associated with operation of this facility would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus should not result in any increased annoyance of the public.

The combustion of fossil fuels associated with Alternative 11B would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 6×10^{-5} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.21.2.2 Waste Management

At Pantex, operations impacts of this alternative would be the same as those for Alternative 4A. See Section 4.6.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

Table 4–146 reflects a comparison of the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operation of the immobilization facility at Hanford. Although HLW would be used in the immobilization process, no HLW would be generated by the facilities. Waste generation at Hanford should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate

shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored on the site until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated and disposed of at offsite commercial facilities. This SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–146. Potential Waste Management Impacts of Operations at Hanford Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford[a]

Waste Type[b]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[c]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[d]	130	7	8	1 of WIPP
LLW	110	NA	NA	<1
Mixed LLW	1	<1	<1	<1
Hazardous	75	NA	NA	NA
Nonhazardous				
Liquid	44,000	19[e]	NA	19[f]
Solid	340	NA	NA	NA

[a] Information summarized from Appendix H.
[b] See definitions in Appendix F.8.
[c] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.
[d] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[e] Percent of capacity of the 400 Area sanitary sewer.
[f] Percent of capacity of the Energy Northwest (formerly Washington Public Power Supply System) Sewage Treatment Facility.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading of the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generated at the immobilization facility at Hanford has been estimated at 7 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 1,300 m^3 (1,700 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 8 percent of the 17,000-m^3 (22,200-yd^3) storage capacity at Hanford. Assuming that the waste were stored in 208-l (55-gal) drums that can to be stacked two high, and adding a 50 percent factor for aisle space, a storage area of about 0.18 ha (0.44 acre) would be required. Therefore, impacts from the management of additional quantities of TRU waste at Hanford should not to be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d).

The 1,480 m^3 (1,936 yd^3) of additional TRU wastes generated by surplus plutonium disposition facilities at Pantex and Hanford would be 1 percent of the 143,000-m^3 (187,000-yd^3) contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3).

Impacts of the disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

At Hanford, LLW would be packaged, certified, and accumulated at the immobilization facility before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,100 m^3 (1,440 yd^3) of LLW would be generated over the operations period. According to estimates, LLW generated at surplus plutonium disposition facilities would be less than 1 percent of the 1.74 million-m^3 (2.28 million-yd^3) capacity of the LLW Burial Grounds and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Judging from the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 1,100 m^3 (1,440 yd^3) of waste would require 0.31 ha (0.77 acre) of disposal space at Hanford. Therefore, impacts from the management of this additional LLW at Hanford should not be major.

At Hanford, mixed LLW would be stabilized, packaged, and stored on the site for treatment and disposal in a manner consistent with the site treatment plan. Mixed LLW generated at the immobilization facilities would in all likelihood be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (22,000-yd^3) capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system. If all TRU waste and mixed LLW generated at surplus plutonium disposition facilities at Hanford were processed in the Waste Receiving and Processing Facility, this additional waste would be 7 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of that facility.

At Hanford, any hazardous wastes generated during operation of the immobilization facility would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operations period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for offsite disposal. It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management systems at Hanford.

At Hanford, nonhazardous wastewater generated by the immobilization facilities would be treated if necessary before being discharged to the 400 Area sanitary sewer system, which connects to the Energy Northwest (formerly WPPSS) Sewage Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities would be an estimated 19 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 19 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the Energy Northwest Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the Energy Northwest Sewage Treatment Facility (Mecca 1997). Therefore, management of nonhazardous liquid waste at Hanford should not have a major impact on the treatment system.

4.21.2.3 Socioeconomics

Under Alternative 11B, operation of the pit conversion facility at Pantex would begin in 2004 and should require 400 workers (UC 1998e) . This level of employment should generate another 1,355 indirect jobs within the region. As the total employment requirement of 1,755 direct and indirect jobs represents only 0.7 percent of the projected REA workforce, there should be no major impact on the REA. Moreover, the additional required workers should not markedly impact community services within the Pantex ROI. In fact, they should help offset

the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,944 to 1,750 workers) projected for the years 1997–2005.

Startup and operation of the immobilization facility at Hanford in 2006 under Alternative 11B would require an estimated 367 workers (UC 1999a, 1999b). This level of employment would be expected to generate another 929 related jobs in the region. The total employment requirement of 1,296 direct and indirect jobs represents 0.3 percent of the projected REA workforce, and thus should have no major impact on the REA. Some of the new jobs created under this alternative could be filled from the ranks of unemployed, currently 11 percent of the REA's population.

However, this employment requirement could have minor impacts on community services in the ROI, as it should coincide with an expected increase in overall site employment for construction of the tank waste remediation system. Assuming that 91 percent of the new employees associated with this alternative resided in the ROI, an increase of 1,180 new jobs within the workforce would result in an overall population increase of approximately 2,189 persons. This population increase, in conjunction with the normal population growth forecast by the State of Washington, would engender increased construction of local housing units. Given the current population-to-student ratio in the ROI, a population of this size would be expected to include 453 students, and local school districts would increase the number of classrooms to accommodate them.

Community services in the ROI would be expected to change to accommodate the population growth as follows: 28 teachers would be added to maintain the current student-to-teacher ratio of 16:1; 3 police officers would be added to maintain the current officer-to-population ratio of 1.5:1,000; 7 firefighters would be added to maintain the current firefighter-to-population ratio of 3.4:1,000; and 3 physicians would be added to maintain the current physician-to-population ratio of 1.4:1,000. Thus, an additional 41 positions would have to be created to maintain community services at current levels. Hospitals in the ROI would remain at 2.1 beds per 1,000 persons unless additional beds were provided. Moreover, average school enrollment would increase to 93.4 percent from the current 92.5 percent unless additional classrooms were built. None of these projected changes would have a major impact on the level of community services currently offered in the ROI.

4.21.2.4 Human Health Risk

During normal operations, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under Alternative 11B would be as follows.

Radiological Impacts. Presented in Table 4–147 are the potential radiological impacts on three individual receptor groups for Pantex and Hanford: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of incident-free operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of both disposition facilities, the total population dose in the year 2010 would be 0.60 person-rem. The corresponding number of LCFs in the populations around Pantex and Hanford from 10 years of operation would be 3.0×10^{-3}. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization facilities at Hanford would be 2.2×10^{-4} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.1×10^{-9}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the CAA [NESHAPs], and the SDWA).

Table 4–147. Potential Radiological Impacts on the Public of Operations Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

		Immobilization	
Impact	**Pit Conversion**	**Ceramic**	**Glass**
Population within 80 km for year 2010			
Dose (person-rem)	0.58	0.016	0.015
Percent of natural background[a]	5.8×10^{-4}	1.4×10^{-5}	1.3×10^{-5}
10-year latent fatal cancers	2.9×10^{-3}	8.0×10^{-5}	7.5×10^{-5}
Maximally exposed individual			
Annual dose (mrem)	0.062	2.2×10^{-4}	2.0×10^{-4}
Percent of natural background[a]	0.019	7.3×10^{-5}	6.7×10^{-5}
10-year latent fatal cancer risk	3.1×10^{-7}	1.1×10^{-9}	1.0×10^{-9}
Average exposed individual within 80 km[b]			
Annual dose (mrem)	1.9×10^{-3}	4.1×10^{-5}	3.9×10^{-5}
10-year latent fatal cancer risk	9.5×10^{-9}	2.1×10^{-10}	2.0×10^{-10}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and Hanford (387,800) in 2010.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Source: Appendix J.

Doses to involved workers from normal operations are given in Table 4–148; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities is estimated to be 192 and 266 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–148. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–148. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 11B: Pit Conversion in New Construction at Pantex, and Immobilization in FMEF and HLWVF at Hanford

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	355	738
Total dose (person-rem/yr)	192	266	458
10-year latent fatal cancers	0.77	1.1	1.8
Average worker dose (mrem/yr)	500	750	(a)
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	(a)

[a] This value holds no statistical relevance because the facilities are at different sites.

Key: FMEF, Fuels and Materials Examination Facility; HLWVF, high-level-waste vitrification facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998e, 1999a, 1999b.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operations at Pantex or Hanford under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.21.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex are presented in Table 4–60. The potential consequences of such accidents from operation of the immobilization facility at Hanford are equivalent to those described for Alternative 11A (see Tables 4–141 and 4–142). More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for this alternative would be associated with a tritium release from the pit conversion facility (see Section 4.6.2.5). At Hanford, the design basis accidents for the immobilization facility would be equivalent to those described for Alternative 11A (see Section 4.20.2.5).

A beyond-design-basis earthquake at Pantex could result in collapse of the pit conversion facility and an estimated 1.5 LCFs among the general population (as described in Section 4.6.2.5). A similar earthquake at Hanford could result in a total collapse of FMEF with an estimated 6.5 LCFs (as described in Section 4.20.2.5). In the event of such an earthquake, additional radiological impacts could be expected from the other operations at Pantex or Hanford, as well as catastrophic nonradiological impacts from the collapse of buildings, offices, and other structures. The frequency of a beyond-design-basis earthquake is estimated at between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition PEIS,* the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the tritium release. The consequences of such an accident would include an LCF probability of 8.7×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate

injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the decisions made in the SPD EIS ROD, site emergency management programs would be modified to consider new accidents not in the current program.

Nonradiological Accidents. Plutonium disposition operation activities at Pantex and Hanford could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 8,037 person-years of labor and the standard DOE occupational accidents rates, approximately 290 cases of nonfatal occupational injury or illness and 0.22 fatality could be expected for the duration of operations.

4.21.2.6 Transportation

Operational transportation impacts may be divided into two parts: impacts due to incident-free transportation and those due to transportation accidents. They may be further divided into nonradiological and radiological impacts. Nonradiological impacts are specifically vehicular, such as vehicular emissions and traffic accidents. Radiological impacts are those related to the dose received by transportation workers and the public during normal operations and in the case of accidents in which the radioactive materials being shipped may be released. For more detailed information on the transportation analysis performed for this SPD EIS, see Appendix L.

Under Alternative 11B, transportation to and from Pantex would include the shipment of plutonium pits and clean plutonium metal via SST/SGT from sites throughout the DOE complex to the pit conversion facility.[30] During dismantlement of the pits, some HEU would be recovered. The pit conversion facility would ship HEU via SST/SGT to ORR for storage.[31] After conversion, the plutonium in the pit conversion facility would be in the form of plutonium dioxide. This material would be shipped to Hanford for immobilization.

It is assumed that depleted uranium hexafluoride needed for immobilization would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide. After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the immobilization facility at Hanford.

Immobilization at Hanford under this alternative would require that surplus nonpit plutonium in various forms be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LLNL, LANL, and RFETS) to the

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[30] Work is currently under way to repackage all pits at Pantex from the AL–R8 container into the AL–R8 SI container for long-term storage. This effort would be completed over 10 years, and the estimated dose to involved workers received from this repackaging activity would be about 104 person-rem. The SPD Draft EIS analyzed repackaging of the pits in an AT–400A container. The change to the AL–R8 SI changes the long-term storage period for pits from 50 to 30 years because of the need to replace a seal in the container after 30 years; the AT–400A does not require that activity. After seal replacement, the pits could continue to be stored for another 30 years.

[31] Classified nuclear material parts would also result from pit disassembly. Although current plans are to store these parts at the pit conversion facility, this SPD EIS analyzes the possible transport of these nuclear material parts to LANL. Therefore, the transportation impacts are slightly overstated.

immobilization facility at Hanford. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SST/SGTs.

Under the preferred technology alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to HLWVF in 200 Area. This intrasite transportation—from 400 Area to 200 Area—could require the temporary shutdown of roads on Hanford. It would, however, provide for all the necessary security and for reduced risk to the public; SST/SGTs would not be required.

After the immobilized plutonium was encased by HLW at HLWVF, it would be shipped to a potential geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 395 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 11B. The *Yucca Mountain Draft EIS* evaluates different options for the shipment of these canisters to a potential geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS conservatively assumes that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.21.1.2 and 4.21.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

However, TRU waste generated at Pantex was not covered by the WM PEIS ROD as there was no such waste at Pantex at the time the ROD was issued, and none was likely to be generated in ongoing site operations. Location of the pit conversion facility at Pantex would result in the generation of TRU waste, as described in Section 4.21.2.2. Moreover, a fairly large increase in the amount of LLW at Pantex (i.e., 25 percent of the site's current storage capacity) could be expected under this alternative. Currently, this type of waste is shipped to the NTS for disposal. In order to account for the transportation of TRU waste from Pantex to WIPP and LLW from Pantex to NTS, additional shipments are analyzed in this SPD EIS.

In all, approximately 1,900 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 2.5 million km (1.6 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 68 person-rem; the dose to the public, 71 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.027 LCF among transportation workers and 0.036 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.007.

Impacts of Accidents During Transportation (Consequences). The maximum foreseeable offsite transportation accident under this alternative (probability of occurrence: greater than 1 in 10 million per year) is a shipment of surplus nonpit plutonium from a DOE storage facility to Hanford with an accident in a rural population zone under neutral (average) weather conditions. Because surplus nonpit plutonium shipments include

plutonium oxide, an accident involving plutonium oxide is conservatively used to estimate the impacts of the maximum foreseeable accident. If this accident were to occur, it could result in a dose of 624 person-rem to the public for an LCF risk of 0.3 and 684 rem to the hypothetical MEI for an LCF risk of 0.68. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year. (See Appendix L.6.)

Impacts of Accidents During Transportation (Risks). The total transportation accident risks were estimated by summing the risks to the affected population from all hypothetical accidents. For Alternative 11B, those risks are as follows: a radiological dose to the population of 1 person-rem, resulting in a total population risk of 7×10^{-4} LCF; and traffic accidents resulting in 0.045 fatality.

4.21.2.7 Environmental Justice

As discussed in other parts of Section 4.21.2, routine operations conducted under Alternative 11B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million (see Table 4–147); the likelihood for the MEI residing near Hanford would be essentially zero. The number of LCFs expected among the general population residing near Pantex and Hanford from accident-free operations would increase by approximately 2.9×10^{-3} and 8.0×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.21.2.5). A beyond-design-basis earthquake at the sites would be expected to result in LCFs among the general population (see Tables 4–60, 4–141, and 4–142). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.21.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 11B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

4.22 ALTERNATIVE 12A

Alternative 12A would involve constructing and operating the pit conversion and immobilization facilities in new buildings in F-Area at SRS. Under this alternative, all surplus plutonium is immobilized; none is fabricated into MOX fuel.

4.22.1 Construction

4.22.1.1 Air Quality and Noise

Sources of potential air quality impacts of construction under Alternative 12A at SRS include emissions from fuel-burning construction equipment, soil disturbance by construction equipment and other vehicles, the operation of a concrete batch plant, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from SRS construction activities, with standards and guidelines is presented as Table 4–149. Concentrations of air pollutants, especially PM_{10} and total suspended particulates, would likely increase at the site boundary, but should not exceed the Federal or State ambient air quality standards. Air pollution impacts during construction would be mitigated by applying, as appropriate, standard dust control practices such as watering or sweeping of roads and watering of exposed areas.

Table 4–149. Evaluation of Air Pollutant Concentrations Associated With Construction Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m^3)[a]	SPD Increment (Fg/m^3)	Total Site Concentration (Fg/m^3)	Site as a Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	3.8	675	6.7
	1 hour	40,000	17.3	5,110	13
Nitrogen dioxide	Annual	100	0.169	11.5	12
PM_{10}	Annual	50	0.0784	5.02	10
	24 hours	150	4.59	90.3	60
Sulfur dioxide	Annual	80	0.0541	16.7	21
	24 hours	365	1.33	223	61
	3 hours	1,300	8	733	56
Other regulated pollutants					
Total suspended particulates	Annual	75	0.156	45.5	61
Hazardous and other toxic compounds					
Other toxics[b]	24 hours	150	0	20.7	14

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

[b] Various toxic air pollutants (e.g., lead, benzene, hexane) could be emitted during construction and were analyzed as benzene.

Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.

Source: EPA 1997a; SCDHEC 1996a.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The proposed locations of surplus plutonium disposition facilities at SRS relative to the site boundary and sensitive receptors were examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during construction would include heavy construction equipment, employee vehicles, and truck traffic. Traffic noise associated with the construction of these facilities would occur on the site and along offsite local and regional transportation routes used to bring construction materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from construction equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could result in onsite impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats, as none are known to occur in F- or S-Area (see Section 4.26). Traffic associated with the construction of these facilities would likely produce less than a 1-dB increase in noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Construction workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, administrative controls, engineering controls, and personal hearing protection equipment.

4.22.1.2 Waste Management

Table 4–150 compares the wastes generated during the construction of surplus plutonium disposition facilities at SRS with the existing treatment, storage, and disposal capacity for the various waste types. It is anticipated that no TRU waste, LLW, or mixed LLW would be generated during the 3-year construction period. In addition, no soil contaminated with hazardous or radioactive constituents should be generated during construction. However, if any were generated, the waste would be managed in accordance with site practice and applicable Federal and State regulations. Construction waste generation would be the same for the ceramic and glass immobilization technologies because the same size facility would be built under either scenario. For this SPD EIS, it is assumed that hazardous waste and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–150. Potential Waste Management Impacts of Construction Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	85	NA	NA	NA
Nonhazardous				
Liquid	26,000	9[c]	NA	2[d]
Solid	2,300	NA	NA	NA

[a] See definitions in Apprendix F.8.

[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year construction period.

[c] Percent of capacity of the F-Area's sanitary sewer.

[d] Percent of capacity of Central Sanitary Wastewater Treatment Facility.

Key: DWPF, Defense Waste Processing Facility; NA, not applicable (i.e., it is assumed that the majority of the hazardous waste and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Hazardous wastes generated during the construction of surplus plutonium disposition facilities would be typical of those generated during construction of an industrial facility. Any hazardous wastes generated during construction would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during construction should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid wastes generated during the construction of surplus plutonium disposition facilities would be packaged in conformance with standard industrial practice and shipped to commercial or municipal facilities for recycling or disposal. The additional waste load generated during construction should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous liquid wastes generated during the construction of surplus plutonium disposition facilities would be managed at the Central Sanitary Wastewater Treatment Facility, even though it is likely that much of this waste would be collected in portable toilets and would be managed at offsite facilities. Nonhazardous liquid waste generated during the construction of these facilities is estimated to be 9 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, 2 percent of the 1,449,050-m^3/yr (1,895,357-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and within the 1,032,950-m^3/yr (1,351,099-yd^3/yr) excess capacity of the Central Sanitary Wastewater Treatment Facility (Sessions 1997). Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during construction.

4.22.1.3 Socioeconomics

Construction-related employment requirements for Alternative 12A would be as indicated in Table 4–151.

Table 4–151. Construction Employment Requirements for Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	Immobilization	Total
2001	297	0	297
2002	451	506	957
2003	276	920	1,196
2004	0	1,014	1,014
2005	0	552	552

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998c, 1999c, 1999d.

At its peak in 2003, construction of new pit conversion and immobilization facilities at SRS under this alternative would require 1,196 construction workers and generate another 960 indirect jobs in the region. This total employment requirement of 2,156 direct and indirect jobs in 2003 represents less than 0.8 percent of the projected REA workforce, and thus should have no major impacts on the REA. It should also have little effect on community services currently offered in the ROI. In fact, it should help offset the 20 percent reduction in SRS employment (i.e., from 15,032 to 12,000 workers) projected for the years 1997–2005.

4.22.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–152. Construction worker exposure to radiation deriving from other activities at the site, past or

Table 4–152. Potential Radiological Impacts on Construction Workers of Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	Immobilization[b]	Total
Total dose (person-rem/yr)	1.4	1.5	2.9
Annual latent fatal cancers[c]	5.6×10^{-4}	6.0×10^{-4}	1.2×10^{-3}
Average worker dose (mrem/yr)	4	4	4[d]
Annual latent fatal cancer risk	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] An estimated average of 341 workers would be associated with annual construction operations.

[b] An estimated average of 374 workers would be associated with annual construction operations at the new facility location adjacent to APSF, if built. The number would be the same for immobilization in either ceramic or glass.

[c] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations, per ICRP 1991.

[d] Represents an average of the doses for both facilities.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: ICRP 1991; NAS 1990; UC 1998c, 1999c, 1999d.

present, would be limited to ensure that doses are kept as low as is reasonably achievable. To this end, construction workers would be monitored (badged) as appropriate.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.22.1.5 Facility Accidents

Construction of pit conversion and immobilization facilities at SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 4,016 person-years of construction labor and standard industrial accident rates, approximately 400 cases of nonfatal occupational injury or illness and 0.56 fatality could be expected (DOL 1997a, 1997b). As all construction would be in nonradiological areas, no radiological accidents should occur.

4.22.1.6 Environmental Justice

As discussed in the other parts of Section 4.22.1, construction under Alternative 12A would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities under Alternative 12A at SRS would have no significant impacts on minority or low-income populations.

4.22.2 Operations

4.22.2.1 Air Quality and Noise

Potential air quality impacts of the operation of facilities under Alternative 12A at SRS were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including those from surplus plutonium disposition facilities, with standards and guidelines is presented as Table 4–153. Concentrations for immobilization in the ceramic and glass forms are the same. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts

Table 4–153. Evaluation of Air Pollutant Concentrations Associated with Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m^3)[a]	SPD Increment (Fg/m^3)	Total Site Concentration (Fg/m^3)	Site as a Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.246	671	6.7
	1 hour	40,000	1.03	5,100	13
Nitrogen dioxide	Annual	100	0.0529	11.4	11
PM_{10}	Annual	50	0.00364	4.94	9.9
	24 hours	150	0.058	85.8	57
Sulfur dioxide	Annual	80	0.0852	16.8	21
	24 hours	365	1.17	223	61
	3 hours	1,300	3.09	728	56
Other regulated pollutants					
Total suspended particulates	Annual	75	0.00364	45.4	61
[Text deleted.]					

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.

Note: No nonradiological hazardous or other toxic compounds would be emitted from these processes.

Source: EPA 1997a; SCDHEC 1996a.

during operation would be mitigated; for example, HEPA filtration has been included in the design of these facilities.

For a discussion of how the operation of the pit conversion and immobilization facilities at SRS would affect the ability to continue to meet NESHAPs limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAPs limits applicable to operation of these facilities.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide are a small fraction of the PSD Class II area increments as summarized in Table 4–154.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The combustion of fossil fuels associated with Alternative 12A would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

The location of these facilities at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operations would include new or existing machines (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from equipment would not likely annoy

Table 4–154. Evaluation of Air Pollutant Increases Associated With Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration (Fg/m^3)	PSD Class II Area Allowable Increment (Fg/m^3)	Percent of Increment
Nitrogen dioxide	Annual	0.0529	25	0.21
PM_{10}	Annual	0.00364	17	0.021
	24 hours	0.058	30	0.19
Sulfur dioxide	Annual	0.0852	20	0.43
	24 hours	1.17	91	1.3
	3 hours	3.09	512	6

Key: DWPF, Defense Waste Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

the public. These noise sources would be far enough away from offsite areas that their contribution to offsite noise levels would be small. Some noise sources could have onsite impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats, as none are known to occur in F- or S-Area (see Section 4.26). Noise from traffic associated with operation of these facilities would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus would not result in any increased annoyance of the public.

Operations workers could be exposed to noise levels higher than the acceptable limits specified by OSHA in its noise regulations (OSHA 1997). However, DOE has implemented appropriate hearing protection programs to minimize noise impacts on workers. These include the use of administrative controls, engineering controls, and personal hearing protection equipment.

4.22.2.2 Waste Management

Table 4–155 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from operating surplus plutonium disposition facilities at SRS. Although HLW would be used in the immobilization process, no HLW would be generated by surplus plutonium disposition facilities. Waste generation should be the same for the ceramic and glass immobilization technologies, except for nonhazardous sanitary wastewater generation.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored on the site until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated on the site in the Consolidated Incineration Facility and treated and disposed of at

offsite commercial facilities. This SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c)..

Table 4–155. Potential Waste Management Impacts of Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

		Estimated Additional Waste Generation as a Percent of[b]		
Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	150	9	4	1 of WIPP
LLW	170	1	NA	6
Mixed LLW	2	<1	1	NA
Hazardous	91	1	18	NA
Nonhazardous				
Liquid	82,000	30[d]	NA	6[e]
Solid	2,700	NA	NA	NA

[a] See definitions in Appendix F.8.

[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 10-year operation period.

[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.

[d] Percent of capacity of the F-Area sanitary sewer.

[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.

Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generated at surplus plutonium disposition facilities is estimated to be 9 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,500 m^3 (1,960 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 4 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and allowing a 50 percent factor for aisle space, a storage area of about 0.21 ha (0.52 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d).

The 1,500 m^3 (1,960 yd^3) of TRU wastes generated by these facilities would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

LLW would be packaged, certified, and accumulated at the new facilities before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,700 m^3 (2,220 yd^3) of LLW would be generated over the

operations period. LLW generated at surplus plutonium disposition facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility and 6 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 1,700 m^3 (2,220 yd^3) of waste would require 0.19 ha (0.47 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generated at surplus plutonium disposition facilities is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste would be packaged at the generating facility for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generated at surplus plutonium disposition facilities is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 18 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at surplus plutonium disposition facilities were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent to the Three Rivers Landfill for disposal (DOE 1998c:3-42). It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

Nonhazardous wastewater would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities at SRS is estimated to be 30 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, 6 percent of the 1,449,050-m^3/yr (1,895,357-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and within the 1,032,950-m^3/yr (1,351,099-yd^3/yr) excess capacity of the Central Sanitary Wastewater Treatment Facility (Sessions 1997). Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.22.2.3 Socioeconomics

After construction, startup, and testing of the pit conversion and immobilization facilities in 2006 under Alternative 12A, an estimated 751 new workers would be required to operate them (UC 1998c, 1999c, 1999d). This level of employment would generate another 1,343 indirect jobs in the region. The total employment requirement of 2,094 direct and indirect jobs represents 0.7 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have a negligible impact on community services currently offered in the ROI. In fact, it should help to offset the 33 percent reduction in SRS's total workforce (i.e., 15,032 to 10,000 workers) projected for the years 1997–2010.

4.22.2.4 Human Health Risk

During normal operations, there would be both radiological and hazardous chemical releases to the environment, and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under Alternative 12A would be as follows.

Radiological Impacts. Table 4–156 reflects the potential radiological impacts on three individual receptor groups: the population living within 80 km (50 mi) of SRS in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of incident-free operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–156. Potential Radiological Impacts on the Public of Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	Immobilization		Total[a]
		Ceramic	Glass	
Population within 80 km for year 2010				
Dose (person-rem)	1.6	5.8×10^{-3}	5.3×10^{-3}	1.6
Percent of natural background[b]	6.9×10^{-4}	2.5×10^{-6}	2.3×10^{-6}	6.9×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	2.9×10^{-5}	2.7×10^{-5}	8.0×10^{-3}
Maximally exposed individual				
Annual dose (mrem)	3.7×10^{-3}	5.8×10^{-5}	5.3×10^{-5}	3.8×10^{-3}
Percent of natural background[b]	1.3×10^{-3}	2.0×10^{-5}	1.8×10^{-5}	1.3×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	2.9×10^{-10}	2.7×10^{-10}	1.9×10^{-8}
Average exposed individual within 80 km[c]				
Annual dose (mrem)	2.0×10^{-3}	7.4×10^{-6}	6.7×10^{-6}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	3.7×10^{-11}	3.4×10^{-11}	1.0×10^{-8}

[a] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities. This total includes the higher of the values for the ceramic and glass immobilization alternatives.

[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive approximately 232,000 person-rem.

[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS APSF, if built, in 2010 (approximately 790,000).

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Source: Appendix J.

Given incident-free operation of both facilities, the total population dose in the year 2010 would be 1.6 person-rem. The corresponding number of LCFs in this population from 10 years of operation would be 8.0×10^{-3}. The dose to the maximally exposed member of the public from annual operation of both facilities would be 3.8×10^{-3} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 1.9×10^{-8}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the CAA [NESHAPs], and the SDWA).

Doses to involved workers from normal operations are given in Table 4–157; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit conversion facility workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192 and 254 person-rem, respectively. The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–157. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–157. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 12A: Pit Conversion in New Construction and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	339	722
Total dose (person-rem/yr)	192	254	446
10-year latent fatal cancers	0.77	1.0	1.8
Average worker dose (mrem/yr)	500	750	618[a]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.5×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998c, 1999c, 1999d.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operation activities at SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.22.2.5 Facility Accidents

The potential consequences of postulated bounding accidents from operation of the pit conversion facility at SRS are substantially equivalent to those of Alternative 3 (see Table 4–43), and the potential consequences of such accidents from operation of the immobilization facility in new construction and DWPF at SRS are as presented in Tables 4–158 and 4–159. The relationship between the accident analysis results for the 50-t (55-ton) alternatives and the 17-t (19-ton) immobilization alternatives is discussed in Section 4.20.2.5. More details on the method of analysis, assumptions, and specific accident scenarios are presented in the discussion of Alternative 2 in Section 4.3.2.5.

Public. The most severe consequences of a design basis accident for the pit conversion facility and the immobilization facility would be equivalent to those discussed in Section 4.4.2.5.

A beyond-design-basis earthquake at SRS could result in collapse of the pit conversion (as described in Section 4.4.2.5) and immobilization facilities (as described below), and an estimated 6.8 LCFs among the general population. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude at SRS is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

Noninvolved Worker. Consistent with the analysis presented in the *Storage and Disposition PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. The consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. The consequences of such an accident would include an LCF probability of 1.0×10^{-4}.

Table 4–158. Accident Impacts of Alternative 12A: Ceramic Immobilization in New Construction at SRS (50-t Case)

		Impacts on Noninvolved Worker		Impacts at Site Boundary		Impact on Population Within 80 km	
Accident	Frequency (per year)	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (person-rem)[a]	Latent Cancer Fatalities[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	Unlikely	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Glovebox fire (sintering furnace)	Extremely unlikely	3.8×10^{-7}	1.5×10^{-10}	7.2×10^{-8}	3.6×10^{-11}	3.1×10^{-4}	1.5×10^{-7}
Design basis earthquake	Unlikely	8.8×10^{-5}	3.5×10^{-8}	1.7×10^{-5}	8.3×10^{-9}	7.2×10^{-2}	3.6×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	6.3×10^{-3}	2.5×10^{-6}	2.5×10^{-4}	1.2×10^{-7}	5.8×10^{-1}	2.9×10^{-4}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.3×10^{1}	2.1×10^{-2}	2.1	1.0×10^{-3}	4.8×10^{3}	2.5

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual. See Appendix K.1.4.2 for a more detailed discussion of pathways.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: HYDOX, hydride oxidation.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would either be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through

inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the decisions made in the SPD EIS ROD, site emergency management programs would be modified to consider new accidents not in the current program.

Table 4–159. Accident Impacts of Alternative 12A: Glass Immobilization in New Construction at SRS (50-t Case)

		Impacts on Noninvolved Worker		Impacts at Site Boundary		Impacts on Population Within 80 km	
Accident	**Frequency (per year)**	**Dose (rem)[a]**	**Probability of Cancer Fatality[b]**	**Dose (rem)[a]**	**Probability of Cancer Fatality[b]**	**Dose (person-rem)[a]**	**Latent Cancer Fatalities[c]**
Criticality	Extremely unlikely	1.0×10^{-2}	4.2×10^{-6}	1.6×10^{-3}	7.8×10^{-7}	1.5	8.0×10^{-4}
Explosion in HYDOX furnace	Unlikely	8.6×10^{-4}	3.4×10^{-7}	1.6×10^{-4}	8.1×10^{-8}	7.1×10^{-1}	3.5×10^{-4}
Glovebox fire (calcining furnace)	Extremely unlikely	6.8×10^{-8}	2.7×10^{-11}	1.3×10^{-8}	6.5×10^{-12}	5.6×10^{-5}	2.8×10^{-8}
Hydrogen explosion	Unlikely	9.5×10^{-5}	3.8×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	7.8×10^{-2}	3.8×10^{-5}
Melter eruption	Unlikely	3.5×10^{-7}	1.4×10^{-10}	6.7×10^{-8}	3.3×10^{-11}	2.9×10^{-4}	1.4×10^{-7}
Melter spill	Unlikely	8.3×10^{-8}	3.3×10^{-11}	1.6×10^{-8}	7.8×10^{-12}	6.8×10^{-5}	3.3×10^{-8}
Design basis earthquake	Unlikely	7.7×10^{-5}	3.1×10^{-8}	1.5×10^{-5}	7.3×10^{-9}	6.4×10^{-2}	3.1×10^{-5}
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-3}	4.6×10^{-7}	4.4×10^{-5}	2.2×10^{-8}	1.0×10^{-1}	5.3×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	4.7×10^{1}	1.9×10^{-2}	1.8	9.1×10^{-4}	4.3×10^{3}	2.2

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual. See Appendix K.1.4.2 for a more detailed discussion of pathways.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: HYDOX, hydride oxidation.

Nonradiological Accidents. Plutonium disposition operations at SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 8,413 person-years of labor and the standard DOE occupational accident rates, approximately 300 cases of nonfatal occupational injury or illness and 0.23 fatality could be expected for the duration of operations.

4.22.2.6 Transportation

Operational transportation impacts may be divided into two parts: impacts due to incident-free transportation and those due to transportation accidents. They may be further divided into nonradiological and radiological impacts. Nonradiological impacts are specifically vehicular, such as vehicular emissions and traffic accidents. Radiological impacts are those related to the dose received by transportation workers and the public during normal operations and in the case of accidents in which the radioactive materials being shipped may be released. For more detailed information on the transportation analysis performed for this SPD EIS, see Appendix L.

Under Alternative 12A, transportation to and from SRS would include the shipment of plutonium pits and clean plutonium metal via SST/SGT from sites throughout the DOE complex to the pit conversion facility.[32] During dismantlement of the pits, some HEU would be recovered. The pit conversion facility would ship HEU via SST/SGT to ORR for storage.[33] After conversion, the plutonium in the pit conversion facility would be in the form of plutonium oxide. This material would be transferred through a secure tunnel to the MOX facility at SRS for fabrication into MOX fuel pellets.

Immobilization at SRS under this alternative would also require that surplus nonpit plutonium in various forms be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LLNL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SST/SGTs.

Under the preferred technology alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to DWPF in S-Area. This intrasite transportation—from F-Area to S-Area—could require the temporary shutdown of roads on SRS. It would, however, provide for all the necessary security and for reduced risk to the public; SST/SGTs would not be required.

After the immobilized plutonium was encased by HLW at DWPF, it would be shipped to a potential geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 395 additional canisters of HLW would

[32] Work is currently under way to repackage all pits at Pantex from the AL–R8 container into the AL–R8 SI container for long-term storage. The AL–R8 is not an offsite shipping container as was the AT–400A analyzed in the SPD Draft EIS. Therefore, if the decision were made to site the pit conversion facility at a site other than Pantex, the surplus pits would have to be taken out of the AL–R8 SI and placed in a yet-to-be-developed shipping container. This operation would also require the replacement of some pit-holding fixtures to meet transportation requirements. Under such alternatives, this change would result in a total repackaging exposure of 208 person-rem to Pantex personnel. An increase in worker doses of this magnitude could result in an increase in the expected number of LCFs of 8.3×10^{-2} over the life of the program.

[33] Classified nuclear material parts would also result from pit disassembly. Although current plans are to store these parts at the pit conversion facility, this SPD EIS analyzes the possible transport of these nuclear material parts to LANL. Therefore, the transportation impacts are slightly overstated.

be needed to meet the demands of surplus plutonium disposition under Alternative 12A. The *Yucca Mountain Draft EIS* evaluates different options for the shipment of these canisters to a potential geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS conservatively assumes that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.22.1.2 and 4.22.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

In all, approximately 2,200 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 4.4 million km (2.7 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 142 person-rem; the dose to the public, 147 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.057 LCF among transportation workers and 0.074 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.021.

Impacts of Accidents During Transportation (Consequences). The maximum foreseeable offsite transportation accident under this alternative (probability of occurrence: greater than 1 in 10 million per year) is a shipment of surplus nonpit plutonium from a DOE storage facility to SRS with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. Because surplus nonpit plutonium shipments include plutonium oxide, an accident involving plutonium oxide is conservatively used to estimate the impacts of the maximum foreseeable accident. If this accident were to occur, it could result in a dose of 87 person-rem to the public for an LCF risk of 0.044 and 96 rem to the hypothetical MEI for an LCF risk of 0.096. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year. (See Appendix L.6.)

Impacts of Accidents During Transportation (Risks). The total transportation accident risks were estimated by summing the risks to the affected population from all hypothetical accidents. For Alternative 12A, those risks are as follows: a radiological dose to the population of 1 person-rem, resulting in a total population risk of 6×10^{-4} LCF; and traffic accidents resulting in 0.081 fatality.

4.22.2.7 Environmental Justice

As discussed in other parts of Section 4.22.2, routine operations conducted under Alternative 12A would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near SRS would be approximately 1 in 50 million (see Table 4–156). The number of LCFs expected among the general population residing near SRS from accident-free operations would increase by approximately 8.0×10^{-3}.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.22.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–43, 4–158, and 4–159). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.22.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 12A would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

4.23 [Section deleted because alternative deleted.]

4.24 ALTERNATIVE 12B

Alternative 12B would involve constructing and operating the pit conversion facility in Zone 4 West at Pantex and the immobilization facility at SRS. The immobilization facility would be located in a new building in F-Area. Activities at Pantex would be the same as described for Alternative 4A (see Section 4.6). Under this alternative, all surplus plutonium would be immobilized; none would be fabricated into MOX fuel.

4.24.1 Construction

4.24.1.1 Air Quality and Noise

Potential air quality and noise impacts of construction of the pit conversion facility under Alternative 12B at Pantex would be the same as those for Alternative 4A (see Section 4.6.1.1).

Potential air quality and noise impacts of construction of the immobilization facility of SRS under Alternative 12B would be the same as those for Alternative 6A (see Section 4.10.1.1).

4.24.1.2 Waste Management

At Pantex, construction impacts of this alternative would be the same as those for Alternative 4A. See Section 4.6.1.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

At SRS, construction impacts of this alternative would be the same as those for Alternative 6A. See Section 4.10.1.2 for a description of the impacts of this alternative on the waste management infrastructure at SRS.

4.24.1.3 Socioeconomics

Construction-related employment requirements under Alternative 12B would be as indicated in Table 4–160.

Table 4–160. Construction Employment Requirements Under Alternative 12B: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Year	Pit Conversion	Immobilization	Total
2001	297	0	297
2002	451	506	957
2003	276	920	1,196
2004	0	1,014	1,014
2005	0	552	552

Key: DWPF, Defense Waste Processing Facility.
Source: UC 1998e, 1999c, 1999d.

At its peak in 2002, construction of the new pit conversion facility at Pantex under this alternative would require 451 construction workers and generate another 381 indirect jobs in the region. As the total employment requirement of 832 direct and indirect jobs represents only 0.3 percent of the projected REA workforce, it should have no major impact on the REA. It should also have little impact on community services within the ROI. In

fact, it should help offset the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,944 to 1,750 workers) projected for the years 1997–2005.

At its peak in 2004, construction of the immobilization facility at SRS would require 1,014 construction workers and generate another 814 indirect jobs in the region. The total employment requirement of 1,828 direct and indirect jobs represents 0.6 percent of the projected REA workforce, and thus should have no major impact on the REA. This requirement should also have little impact on community services within the ROI. In fact, it should help offset the nearly 20 percent reduction in SRS' overall labor force (i.e., from 15,032 to 12,000 workers) projected for the years 1997–2005.

4.24.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from construction activities. A summary of radiological impacts of construction activities on workers at risk is presented in Table 4–161. According to a recent radiation survey (DOE 1997f) conducted in the Zone 4 area at Pantex, construction workers would not be expected to receive any additional radiation exposure above natural background levels in the area. Data indicate, however, that a construction worker in F-Area at SRS could receive exposures to radiation that derives from other activities, past or present, at the site. Regardless of location, construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

Table 4–161. Potential Radiological Impacts on Construction Workers of Alternative 12B: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion[a]	Immobilization[b]
Total dose (person-rem/yr)	0	1.5
Annual latent fatal cancers[c]	0	6.0×10^{-4}
Average worker dose (mrem/yr)	0	4
Annual latent fatal cancer risk	0	1.6×10^{-6}

[a] An estimated average of 342 workers would be associated with annual construction operations.

[b] An estimated average of 374 workers would be associated with annual construction operations at the new facility location adjacent to APSF, if built. The number would be the same for immobilization in either ceramic or glass.

[c] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations, per ICRP 1991.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1997f; ICRP 1991; NAS 1990; UC 1998e, 1999c, 1999d.

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of construction activities at Pantex or SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.24.1.5 Facility Accidents

The construction of new surplus plutonium disposition facilities at Pantex and SRS could result in worker injuries or fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated 4,016 person-years of construction labor and standard industrial accident rates, approximately 400 cases of nonfatal occupational injury or illness and 0.56 fatality could be expected. As all construction would be in nonradiological areas, no radiological accidents should occur during construction.

4.24.1.6 Environmental Justice

As discussed in the other parts of Section 4.24.1, construction under Alternative 12B would pose no significant health risks to the public. The risks would be negligible regardless of the racial or ethnic composition or the economic status of the population. Therefore, construction activities conducted under Alternative 12B at Pantex and SRS would have no significant impacts on minority or low-income populations.

4.24.2 Operations

4.24.2.1 Air Quality and Noise

Potential air quality and noise impacts of operation of the new pit conversion facility under Alternative 12B at Pantex would be the same as those for Alternative 4A (see Section 4.6.2.1).

Potential air quality impacts of the operation of the immobilization facility under Alternative 12B at SRS were analyzed using ISCST3. Operational impacts would result from process emissions, emergency diesel generator testing, trucks moving materials and wastes, and employee vehicles. Emissions from these sources are summarized in Appendix G.

A comparison of maximum air pollutant concentrations, including the contribution from the immobilization facility, with standards and guidelines is presented as Table 4–162. Concentrations of air pollutants would likely increase at the site boundary, but would not exceed the Federal or State ambient air quality standards. Air pollution impacts during operation would be mitigated; for example, HEPA filtration has been included in the design of this facility.

For a discussion of how the operation of the immobilizatiion facility at SRS would affect the ability to continue to meet NESHAPs limits regarding airborne radiological emissions, see Section 4.32.4.4. There are no other NESHAPs limits applicable to operation of this facility.

The increases in concentrations of nitrogen dioxide, PM_{10}, and sulfur dioxide from the operation of this facility at SRS would be a small fraction of the PSD Class II area increments, as summarized in Table 4–163.

Total vehicle emissions associated with activities at SRS would likely decrease somewhat from current emissions because of an expected decrease in overall site employment during this timeframe.

The location of this facility at SRS relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Noise sources during operation would include new or existing sources (e.g., cooling systems, vents, motors, material-handling equipment), employee vehicles, and truck traffic. Traffic noise associated with operation of this facility would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Given the distance to the site boundary (about 8.7 km [5.4 mi]), noise emissions from equipment would not likely annoy the public. These noise sources would be far enough away from offsite areas that the contribution to offsite noise levels would be small. Some noise sources could have onsite impacts, such as the disturbance of wildlife. However, noise would be unlikely to affect federally listed threatened or endangered species or their critical habitats, as none are known to occur

in F- or S-Area (see Section 4.26). Noise from traffic associated with operation of this facility would likely produce less than a 1-dB increase in traffic noise levels along roads used to access the site, and thus should not result in any increased annoyance of the public.

Table 4–162. Evaluation of SRS Air Pollutant Concentrations Associated With Operations Under Alternative 12B: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m³)[a]	SPD Increment[b] (Fg/m³)	Total Site Concentration (Fg/m³)	Site as a Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.152	671	6.7
	1 hour	40,000	0.657	5,100	13
Nitrogen dioxide	Annual	100	0.0242	11.4	11
PM_{10}	Annual	50	0.00181	4.94	9.9
	24 hours	150	0.032	85.8	57
Sulfur dioxide	Annual	80	0.0442	16.7	21
	24 hours	365	0.61	223	61
	3 hours	1,300	1.63	727	56
Other regulated pollutants					
Total suspended particulates	Annual	75	0.00181	45.4	61

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
[b] Ceramic or glass option.
Key: DWPF, Defense Waste Processing Facility; SPD, surplus plutonium disposition.
Source: EPA 1997a; SCDHEC 1996a.

Table 4–163. Evaluation of Air Pollutant Increases Associated With Operations at SRS Under Alternative 12B: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Pollutant	Averaging Period	Increase in Concentration (Fg/m³)	PSD Class II Area Allowable Increment (Fg/m³)	Percent of Increment
Nitrogen dioxide	Annual	0.0242	25	0.097
PM_{10}	Annual	0.00181	17	0.011
	24 hours	0.032	30	0.11
Sulfur dioxide	Annual	0.0442	20	0.22
	24 hours	0.61	91	0.67
	3 hours	1.63	512	0.32

Key: DWPF, Defense Waste Processing Facility; PSD, prevention of significant deterioration.
Source: EPA 1997b.

The combustion of fossil fuels associated with Alternative 12B would result in the emission of carbon dioxide, one of the atmospheric gases that are believed to influence the global climate. Annual carbon dioxide emissions from this alternative would represent less than 2×10^{-4} percent of the 1995 annual U.S. emissions of carbon dioxide from fossil fuel combustion and industrial processes, and therefore would not appreciably affect global concentrations of this pollutant.

4.24.2.2 Waste Management

Operational impacts of this alternative at Pantex would be the same as for Alternative 4A. See Section 4.6.2.2 for a description of the impacts of this alternative on the waste management infrastructure at Pantex.

Table 4–164 reflects a comparison of the existing site treatment, storage, and disposal capacities with the expected waste generation rates from the operation of surplus plutonium disposition facilities at SRS.

Table 4–164. Potential Waste Management Impacts of Operations at SRS Under Alternative 12B: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Waste Type [a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of [b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	130	8	4	1 of WIPP
LLW	110	1	NA	4
Mixed LLW	1	<1	1	NA
Hazardous	89	1	17	NA
Nonhazardous				
Liquid	57,000	21[d]	NA	4[e]
Solid	850	NA	NA	NA

[a] See definitions in Appendix F.8.

[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared to estimated additional waste generation on an annual basis. All other storage and disposal capacities are compared to total estimated additional waste generation assuming a 10-year operation period.

[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.

[d] Percent of capacity of F-Area sanitary sewer.

[e] Percent of capacity of Central Sanitary Wastewater Treatment Facility.

Key: DWPF, Defense Waste Processing Facility; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Although HLW would be used in the immobilization process, no HLW would be generated by the facilities. Waste generation at SRS should be the same for the ceramic and glass immobilization technologies.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of on the site or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored onsite until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated on the site in the Consolidated Incineration Facility and treated and disposed of at offsite commercial facilities. This SPD EIS assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of the treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the new facilities. Drum-gas testing, real-time radiography, and loading of the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

According to estimates, TRU wastes generated at the immobilization facility at SRS would amount to 8 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 1,300 m^3 (1,700 yd^3) of TRU waste would be generated over the 10-year operation period. If all the TRU waste were stored on the site, this would be 4 percent of the 34,400-m^3 (45,000-yd^3) storage capacity available at the TRU Waste Storage Pads. Assuming that the waste were stored in 208-l (55-gal) drums that could be stacked two high, and adding a 50 percent factor for aisle space, a storage area of about 0.18 ha (0.44 acre) would be required. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d).

The 1,500 m^3 (1,960 yd^3) of TRU wastes generated by the facilities at Pantex and SRS would be 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of the disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

At SRS, LLW would be packaged, certified, and accumulated at the immobilization facility before transfer for additional treatment and disposal in existing onsite facilities. A total of 1,100 m^3 (1,440 yd^3) of LLW would be generated over the operational period. LLW generated at surplus plutonium disposition facilities has been estimated at 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 4 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Judging from the 8,687 m^3/ha disposal land usage factor for SRS published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 1,100 m^3 (1,440 yd^3) of waste would require 0.12 ha (0.30 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

At SRS, mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan. Mixed LLW generated at the immobilization facility would in all likelihood be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

At SRS, any hazardous wastes generated during operation of the immobilization facility would be packaged for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste were managed on the site, hazardous waste generation for this combination of facilities would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and 17 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. Management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous wastes generated at the immobilization facility at SRS were treated in the Consolidated Incineration Facility, this additional waste would be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent to the Three Rivers Landfill for disposal (DOE 1998c:3-42). It is unlikely that this additional waste load would have a major impact on the nonhazardous solid waste management system at SRS.

At SRS, nonhazardous wastewater generated by the immobilization facilities would be treated if necessary before being discharged to the F-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by surplus plutonium disposition facilities would be an estimated 21 percent of the 276,000-m^3/yr (361,000-yd^3/yr) capacity of the F-Area sanitary sewer, 4 percent of the 1,449,050-m^3/yr (1,895,357-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and within the 1,032,950-m^3/yr (1,351,099-yd^3/yr) excess capacity of the Central Sanitary Wastewater Treatment Facility (Sessions 1997). Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the treatment system.

4.24.2.3 Socioeconomics

Under Alternative 12B, operation of the pit conversion facility at Pantex would begin in 2004 and should require 400 workers (UC 1998e). This level of employment should generate another 1,355 indirect jobs within the region. The total employment requirement of 1,755 direct and indirect jobs represents less than 0.7 percent of the projected REA workforce, and thus should have no major impact on the REA. It should also have little impact on community services within the Pantex ROI. In fact, it should help offset the nearly 40 percent reduction in the total Pantex workforce (i.e., from 2,944 to 1,750 workers) projected for the years 1997–2010.

Startup and operation of the immobilization facility at SRS in 2006 under Alternative 12B would require an estimated 351 workers (UC 1999c, 1999d). This level of employment would be expected to generate another 628 indirect jobs within the region. The total employment requirement of 979 direct and indirect jobs represents 0.3 percent of the projected REA workforce, and thus should have no major impact on the REA. The additional required workers should also have little impact on community services within the ROI. In fact, they should help offset the 33 percent reduction in the total SRS workforce (i.e., 15,032 to 10,000 workers) projected for the years 1997–2010.

4.24.2.4 Human Health Risk

During normal operations, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses to, and potential health effects on, the public and workers under Alternative 12B would be as follows.

Radiological Impacts. Presented in Table 4–165 are the potential radiological impacts on three individual receptor groups for Pantex and SRS: the population living within 80 km (50 mi) in the year 2010, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected aggregate LCF risk to these groups from 10 years of incident-free operation. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of both disposition facilities, the total population dose in the year 2010 would be 0.59 person-rem. The corresponding number of LCFs in the populations around Pantex and SRS from 10 years of operation would be 2.9×10^{-3}. The dose to the maximally exposed member of the public from annual operation of the pit conversion facility at Pantex would be 0.062 mrem. From 10 years of operation, the corresponding risk of LCF to this individual would be 3.1×10^{-7}. The impacts on the average individual would be lower. The total dose to the maximally exposed member of the public from annual operation of the immobilization facility at SRS would be 5.8×10^{-5} mrem. From 10 years of operation, the corresponding LCF risk to this individual would be 2.9×10^{-10}. The impacts on the average individual would be lower.

Estimated impacts resulting from "Total Site" operations are given in the Cumulative Impacts section of this SPD EIS (see Section 4.32). Within that section, projected incremental impacts associated with the operation of the proposed surplus plutonium disposition facilities are added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These impacts are then compared against

applicable regulatory standards established by DOE and EPA (such as DOE Order 5400.5, the CAA [NESHAPs], and the SDWA).

Doses to involved workers from normal operations are given in Table 4–166; these workers are defined as those directly associated with process activities. Under this alternative, the annual average dose to pit

Table 4–165. Potential Radiological Impacts on the Public of Operations Under Alternative 12B: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Impact	Pit Conversion	Immobilization	
		Ceramic	Glass
Population within 80 km for year 2010			
Dose (person-rem)	0.58	5.8×10^{-3}	5.3×10^{-3}
Percent of natural background[a]	5.8×10^{-4}	2.5×10^{-6}	2.3×10^{-6}
10-year latent fatal cancers	2.9×10^{-3}	2.9×10^{-5}	2.7×10^{-5}
Maximally exposed individual			
Annual dose (mrem)	0.062	5.8×10^{-5}	5.3×10^{-5}
Percent of natural background[a]	0.019	2.0×10^{-5}	1.8×10^{-5}
10-year latent fatal cancer risk	3.1×10^{-7}	2.9×10^{-10}	2.7×10^{-10}
Average exposed individual within 80 km[b]			
Annual dose (mrem)	1.9×10^{-3}	7.4×10^{-6}	6.7×10^{-6}
10-year latent fatal cancer risk	9.5×10^{-9}	3.7×10^{-11}	3.4×10^{-11}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem. The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive approximately 232,000 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex (299,000) and SRS APSF (approximately 790,000), if built, in 2010.

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Source: Appendix J.

Table 4–166. Potential Radiological Impacts on Involved Workers of Operations Under Alternative 12B: Pit Conversion in New Construction at Pantex, and Immobilization in New Construction and DWPF at SRS

Involved Worker	Pit Conversion	Immobilization (Ceramic or Glass)	Total
Number of badged workers	383	339	722
Total dose (person-rem/yr)	192	254	446
10-year latent fatal cancers	0.77	1.0	1.8
Average worker dose (mrem/yr)	500	750	(a)
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	(a)

[a] This value holds no statistical relevance because the facilities are at different sites.

Key: DWPF, Defense Waste Processing Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1998e, 1999c, 1999d.

conversion workers would be 500 mrem; to immobilization facility workers, 750 mrem. The annual dose received by the total site workforce for each of these facilities has been estimated at 192 and 254 person-rem, respectively.

The risks and numbers of LCFs among the different workers from 10 years of operation are included in Table 4–166. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. No hazardous chemicals would be released as a result of operations at Pantex or SRS under this alternative; thus, no cancer or adverse, noncancer health effects would occur.

4.24.2.5 Facility Accidents

The potential consequences of postulated bounding facility accidents from operation of the pit conversion facility at Pantex would be equivalent to those of Alternative 4A (see Table 4–60); the potential consequences from operation of the immobilization facility at SRS, equivalent to those of Alternative 12A (see Tables 4–158 and 4–159).

Public. Thus, no LCFs would be expected among the public or the maximally exposed offsite individual from the design basis accidents at the facilities for Alternative 12B. For accidents for the pit conversion and immobilization facilities, see Sections 4.6.2.5 and 4.22.2.5, respectively.

The most severe consequences of design basis and beyond-design-basis accidents at the Pantex and SRS facilities would be equivalent to those described in Sections 4.6.2.5 and 4.22.2.5, respectively.

Noninvolved Worker. The noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be at a point 1,000 m (3,281 ft) downwind from the location of the accident. For design basis accidents, the radiological consequences for this worker were estimated to be highest for the tritium release at the pit conversion facility. Those consequences would include an LCF probability of 8.7×10^{-5}.

Maximally Exposed Involved Worker. No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and the accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the decisions made in the SPD EIS ROD, site emergency management programs would be modified to consider new accidents not in the current program.

Nonradiological Accidents. Plutonium disposition operation activities at Pantex and SRS could result in worker injuries and fatalities. DOE-required industrial safety programs would be in place to reduce the risks. Given the estimated employment of 7,861 person-years of labor and the standard DOE occupational accident rates,

approximately 280 cases of nonfatal occupational injury or illness and 0.21 fatality could be expected for the duration of operations.

4.24.2.6 Transportation

Operational transportation impacts may be divided into two parts: impacts due to incident-free transportation and those due to transportation accidents. They may be further divided into nonradiological and radiological impacts. Nonradiological impacts are specifically vehicular, such as vehicular emissions and traffic accidents. Radiological impacts are those related to the dose received by transportation workers and the public during normal operations and in the case of accidents in which the radioactive materials being shipped may be released. For more detailed information on the transportation analysis performed for this SPD EIS, see Appendix L.

Under Alternative 12B, transportation to and from Pantex would include the shipment of plutonium pits and clean plutonium metal via SST/SGT from sites throughout the DOE complex to the pit conversion facility.[34] During dismantlement of the pits, some HEU would be recovered. The pit conversion facility would ship HEU via SST/SGT to ORR for storage.[35] After conversion, the plutonium in the pit conversion facility would be in the form of plutonium dioxide. This material would be shipped to SRS for immobilization.

It is assumed that depleted uranium hexafluoride needed for immobilization would be shipped via commercial truck to the uranium conversion facility, where it would be converted into uranium dioxide. After conversion, the depleted uranium dioxide would be shipped via commercial truck from the conversion facility to the immobilization facility at SRS.

Immobilization at SRS under this alternative would also require that surplus nonpit plutonium in various forms be shipped from current storage locations (i.e., SRS, Hanford, INEEL, LLNL, LANL, and RFETS) to the immobilization facility at SRS. Even though these materials are not clean plutonium metal or pits, the quantity of the plutonium contained in them would require that they be treated as materials that could be used in nuclear weapons, and thus that shipments be made in SST/SGTs.

Under the preferred technology alternative for immobilization, the surplus plutonium would be immobilized in a ceramic matrix in small cans at the immobilization facility, placed in HLW canisters, and transported via specially designed trucks to DWPF in S-Area. This intrasite transportation—from F-Area to S-Area—could require the temporary shutdown of roads on SRS. It would, however, provide for all the necessary security and for reduced risk to the public; SST/SGTs would not be required.

After the immobilized plutonium was encased by HLW at DWPF, it would be shipped to a potential geologic repository for ultimate disposition. Because HLW would be displaced by the cans of immobilized plutonium suspended in the HLW canister, additional canisters—to accommodate the displaced HLW—would be required over the life of the immobilization program. According to estimates, up to 395 additional canisters of HLW would be needed to meet the demands of surplus plutonium disposition under Alternative 12B. The *Yucca Mountain*

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[34] Work is currently under way to repackage all pits at Pantex from the AL–R8 container into the AL–R8 SI container for long-term storage. This effort would be completed over 10 years, and the estimated dose to involved workers received from this repackaging activity would be about 104 person-rem. The SPD Draft EIS analyzed repackaging of the pits in an AT–400A container. The change to the AL–R8 SI changes the long-term storage period for pits from 50 to 30 years because of the need to replace a seal in the container after 30 years; the AT–400A does not require that activity. After seal replacement, the pits could continue to be stored for another 30 years.

[35] Classified nuclear material parts would also result from pit disassembly. Although current plans are to store these parts at the pit conversion facility, this SPD EIS analyzes the possible transport of these nuclear material parts to LANL. Therefore, the transportation impacts are slightly overstated.

Draft EIS evaluates different options for the shipment of these canisters to a potential geologic repository using either trucks or trains. The analysis revealed that shipment by train would pose the lower risk. However, no ROD has yet been issued regarding these shipments. To bound the risks associated with these additional shipments, this SPD EIS conservatively assumes that all of these shipments would be made by truck, one canister per truck.

Every alternative considered in this SPD EIS would require routine transportation of wastes from the proposed disposition facilities to treatment, storage, or disposal facilities on the sites. This transportation would be handled in the same manner as other site waste shipments, and as shown in Sections 4.24.1.2 and 4.24.2.2, would involve no major increase in the amounts of waste already being managed at these sites. The shipments would pose no greater risks than the ordinary waste shipments at these sites as analyzed in the WM PEIS.

However, TRU waste generated at Pantex was not covered by the WM PEIS ROD as there was no such waste at Pantex at the time the ROD was issued, and none was likely to be generated in ongoing site operations. Location of the pit conversion facility at Pantex would result in the generation of TRU waste, as described in Section 4.6.2.2. Moreover, a fairly large increase in the amount of LLW at Pantex (i.e., 25 percent of the site's current storage capacity) could be expected under this alternative. Currently, this type of waste is shipped to NTS for disposal. In order to account for the transportation of TRU waste from Pantex to WIPP, and LLW from Pantex to NTS, additional shipments are analyzed in this SPD EIS.

In all, approximately 2,000 shipments of radioactive materials would be carried out by DOE under this alternative. The total distance traveled on public roads by trucks carrying radioactive materials would be 3.9 million km (2.5 million mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities entailed by this alternative has been estimated at 142 person-rem; the dose to the public, 147 person-rem. Accordingly, incident-free transportation of radioactive material associated with this alternative would result in 0.057 LCF among transportation workers and 0.073 LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.018.

Impacts of Accidents During Transportation (Consequences). The maximum foreseeable offsite transportation accident under this alternative (probability of occurrence: about 1 in 10 million per year) is a shipment of surplus nonpit plutonium from a DOE storage facility to SRS with a severity category VIII accident in a rural population zone under neutral (average) weather conditions. Because surplus nonpit plutonium shipments include plutonium oxide, an accident involving plutonium oxide is conservatively used to estimate the impacts of the maximum foreseeable accident. If this accident were to occur, it could result in a dose of 624 person-rem to the public for an LCF risk of 0.3 and 684 rem to the hypothetical MEI for an LCF risk of 0.68. (The MEI receives a larger dose than the population because it is unlikely that a person would be in position, and remain in position, to receive this hypothetical maximum dose.) No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of accident, or occurrence in a more densely populated area were also evaluated, and estimated to have a probability lower than 1 chance in 10 million per year. (See Appendix L.6.)

Impacts of Accidents During Transportation (Risks). The total transportation accident risks were estimated by summing the risks to the affected population from all hypothetical accidents. For Alternative 12B, those risks are as follows: a radiological dose to the population of 2 person-rem, resulting in a total population risk of 0.001 LCF; and traffic accidents resulting in 0.078 fatality.

4.24.2.7 Environmental Justice

As discussed in other parts of Section 4.24.2, routine operations conducted under Alternative 12B would pose no significant health risks to the public. The likelihood of an LCF for the MEI residing near Pantex would be approximately 1 in 3 million; the likelihood for the MEI residing near SRS would be essentially zero (see Table 4–165). The number of LCFs expected among the general population residing near Pantex and SRS from accident-free operations would increase by approximately 2.9×10^{-3} and 2.9×10^{-5}, respectively.

Design basis accidents at the sites would not be expected to cause cancer fatalities among the public (see Section 4.24.2.5). A beyond-design-basis earthquake would be expected to result in LCFs among the general population (see Tables 4–60, 4–158, and 4–159). However, it is highly unlikely that a beyond-design-basis earthquake would occur. Accidents at the sites pose no significant risks (when the probability of occurrence is considered) to the population residing within the area potentially affected by radiological contamination.

As described in Section 4.24.2.6, no radiological or nonradiological fatalities would be expected to result from accident-free transportation conducted under this alternative. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

Thus, implementation of Alternative 12B would pose no significant risks to the public, nor would implementation of this alternative pose significant risks to groups within the public, including the risk of disproportionately high and adverse effects on minority and low-income populations.

4.25 [Section deleted because alternative deleted.]

4.26 ADDITIONAL ENVIRONMENTAL RESOURCE ANALYSES

This section presents the analysis of impacts on geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and infrastructure. It is likely that the proposed disposition activities would have minimal or no impacts on these resource areas at the candidate sites, regardless of the disposition alternative being considered. Therefore, impacts on these resource areas were evaluated in terms of the alternative that would have the greatest impact on the resource area.[36] The alternative analyzed is generally that which would locate the largest number of surplus plutonium disposition facilities at a given site.

4.26.1 Hanford

For Hanford, the maximum impacts on environmental resources would be experienced if Alternative 2 were implemented. Under this alternative, the pit conversion and immobilization facilities would be collocated in FMEF (with a new annex to FMEF constructed), and a new MOX facility would be built nearby. This alternative would require the maximum amount of ground disturbance, thereby maximizing the potential impacts on related resources such as geology and soils, ecological, and cultural. This alternative would also require the most water and place the maximum strain on infrastructure at the site. All the other Hanford alternatives evaluated in this SPD EIS would have fewer land and resource requirements, so none would result in greater impacts than those associated with Alternative 2.

4.26.1.1 Geology and Soils

4.26.1.1.1 Construction

Construction of all the surplus plutonium disposition facilities at Hanford with the MOX facility in a new building would have negligible impacts on the geologic or soil resources. In the *Storage and Disposition PEIS*, hazards from the large-scale geologic conditions at Hanford were analyzed in detail. The analysis determined that these conditions pose an acceptable risk to the proposed long-term storage facilities. Review of the data and analyses presented in the *Storage and Disposition PEIS* and the site-specific information in this SPD EIS indicates that large-scale geologic conditions would likewise not impact the proposed surplus plutonium disposition facilities. This is based on the relatively low seismic risk of the area to properly designed facilities and the expected minimal effects on the site from postulated volcanic events in the Cascade Region. The potential for other nontectonic events to affect the facilities is also low. More detailed descriptions of impacts of the potential geologic hazards at Hanford are included in the *Storage and Disposition PEIS* (DOE 1996a:4-45–4-47).

The soils at Hanford are considered suitable for standard construction techniques. Other than crushed rock, sand, and gravel, no economically viable geologic resources have been identified at Hanford. New construction could increase the use of crushed rock, sand, and gravel; however, large volumes of these materials are present, and the impact should be negligible. No soils at Hanford are currently classified as prime farmland.

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[36] During the conduct of the cultural resources impacts analysis, it was determined that construction of surplus plutonium disposition facilities at SRS could produce impacts on archaeologic resources requiring mitigation (see Section 4.26.4.4.1). DOE plans to avoid these sites, and it will not be necessary to disturb these areas.

4.26.1.1.2 Operations

Operation of all the facilities at Hanford would have negligible impacts on the geologic or soil resources as no operational-related ground disturbance is anticipated. As discussed above for construction, site geologic conditions are not expected to affect surplus plutonium disposition facilities.

Occurrence of all proposed actions at Hanford would result in a very small annual incremental dose to the local public from normal operations via the deposition of airborne radiological particulates on agricultural products. This dose, about 6.9 person-rem/yr, would only be 0.006 percent of the annual dose of natural background radiation (see Appendix J).

Ingestion doses at Hanford were assessed for eight food categories: leafy vegetables, root vegetables, fruits, grains, milk, meat, poultry, and eggs. Public doses incurred from the uptake of these foodstuffs were determined to be well below Federal, State, and local regulatory limits; therefore, potential radiological impacts on local farmlands would be essentially nonexistent.

4.26.1.2 Water Resources

4.26.1.2.1 Construction

Surface water is not proposed to be used under any of the alternatives being evaluated for Hanford (UC 1998a, 1998b, 1999a, 1999b). Therefore, no impacts on water availability for downstream users would be expected.

According to estimates, construction of all the proposed surplus plutonium disposition facilities at Hanford would require a maximum of 91 million l/yr (24 million gal/yr) of water (DOE 1999c; ORNL 1998; UC 1998a, 1998b, 1999a, 1999b). The combination of this volume and the current usage of approximately 41.7 million l/yr (11 million gal/yr) represents about 33 percent of the 400 Area groundwater capacity of about 398 million l/yr (105.1 million gal/yr) (see Section 3.2.11.2, Table 3–13). This volume also represents about 18 percent of the total capacity of the 400 Area water treatment plants, which are approved to withdraw 500 million l/yr (132.1 million gal/yr) of groundwater (Mecca 1997:180). This amount of water would not have a major effect on water availability to other users in the area. Wastewater would not be directly discharged to the groundwater. Therefore, no impacts on groundwater quality would be expected.

All wastewater would be held in the 400 Area water treatment facilities prior to discharge into the Energy Northwest (formerly WPPSS) treatment system, which is designed to meet National Pollutant Discharge Elimination System (NPDES) permit limitations. Therefore, no impacts on water quality would be expected (Mecca 1997:180). Similarly, construction activities would neither add to existing groundwater contamination in the 400 Area, nor impact the water quality of the Columbia River.

Proven construction techniques would be used to mitigate the impact of soil erosion on surface water, including the Columbia River. Because of the effectiveness of these techniques, no long-term impacts from soil erosion due to construction activities would be expected.

The proposed facilities would be constructed in the 400 Area, which is located above the elevations of the maximum probable (calculated) flood and the maximum historical flood (see Section 3.2.7.1.2). Therefore, the proposed facilities would neither affect nor be affected by flooding, including any flooding that would result from postulated failures of the Grand Coulee and Priest Rapids dams.

4.26.1.2.2 Operations

Surface water would not be used during operation of the proposed facilities, and there would be no impact on the availability of surface water to downstream users. As described in Section 4.3.2.2, wastewater would not be directly discharged to surface water, but would be treated in the Energy Northwest Sewage Treatment Facility, which has sufficient capacity to treat the wastewater flows from these activities. Because that facility would be able to treat these flows adequately to meet NPDES permit limitations, negligible impacts on surface water quality would be expected.

As detailed above in Section 4.26.1.1.2, there would be a very small annual incremental dose to the local public from normal operations via the food ingestion pathway. Due to the dilution capability of the Columbia River, as well as FMEF's location relative to the Columbia River, there would be no discernible contamination of aquatic biota (fish) or drinking water from surplus plutonium disposition activities at Hanford, either from the deposition of minute quantities of airborne particulates into the river or from any potential wastewater releases. Thus, it is estimated that no component of the public dose would be attributable to liquid pathways.

The annual maximum water usage for operation of all the proposed facilities at the 400 Area would be about 198 million l (52.3 million gal) (DOE 1999c; UC 1998a, 1998b, 1999a, 1999b). The combination of this volume and the current usage of approximately 41.7 million l/yr (11 million gal/yr) represents about 60 percent of the 400 Area groundwater capacity of about 398 million l/yr (105.1 million gal/yr). This also represents about 40 percent of the capacity of the 400 Area water treatment plant, which has an approved capacity of 500 million l/yr (132.1 million gal/yr) (Mecca 1997:180). Because other uses for water from this facility are small, this increased flow would not cause the plant to exceed its approved withdrawal rate. There would be no impact on the availability of groundwater for other users from the operation of all facilities at Hanford.

There would be no direct discharge of wastewater to the groundwater (UC 1998a, 1998b, 1999a, 1999b). All wastewater would be treated prior to discharge in facilities designed to meet NPDES permit limitations. Therefore, no impact on groundwater quality would be expected from the operation of all facilities at Hanford. Similarly, operations would not add to existing groundwater contamination in the 400 Area.

4.26.1.3 Ecological Resources

Ecological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. However, habitat disturbance would be minimal; the land area required for construction activities is small in relation to regionally available habitat, and construction would take place in previously disturbed or developed areas. Operational impacts would also be minimal because facility emissions to the environment would be processed in accordance with applicable permitting procedures. Therefore, impacts on nonsensitive and sensitive habitats, plant and animal species, and the overall biodiversity of the candidate site would be minimal.

4.26.1.3.1 Construction

Nonsensitive Habitat. Siting the three proposed facilities at Hanford would disturb a total of about 22.4 ha (55 acres) of land in the 400 Area. Some of this land (7.2 ha [18 acres]) would be used only temporarily as a laydown area during the 3.5-year construction phase for the immobilization facility, and some (5.7 ha [14 acres]) for the same purpose during the 5-year construction and startup phases for the MOX facility. The existing construction laydown area used to build FMEF would have the same use for the pit conversion facility (2.0 ha [4.9 acres]) (UC 1998a, 1998b, 1999a, 1999b). Vegetation in this area is characterized as post-fire shrub-steppe dominated by cheatgrass and small shrubs (Mecca 1997:Poston memo to Teal). Cheatgrass, a nonnative annual, would most likely recover the disturbed areas. This species can competitively exclude less vigorous native

species that provide important food or shelter for insects, small mammals, and birds (DOE 1995a). The associated animal populations would be affected. Some of the less-mobile or established animals (e.g., mice, rabbits, snakes, and lizards) within the construction zone could perish during land-clearing activities and from increased vehicular traffic. Furthermore, activities and noise associated with construction could cause larger mammals and birds to relocate to similar habitat in the area. Depending on the populations presently in those areas, the ecosystem dynamics could be altered, adding stress if food or shelter were limited. Prior to construction, the proposed site would be surveyed for nests of migratory birds in accordance with the Migratory Bird Treaty Act. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be drawn from groundwater sources (UC 1998a, 1998b, 1999a, 1999b).

Sensitive Habitat. Wetlands or critical habitat would not be affected because there are none in the construction zone. It is also unlikely that any federally listed threatened or endangered species would be affected because none have been sighted on or around the Central Plateau (DOE 1996f:4-34). However, Washington State–classified special-status species associated with shrub-steppe habitat could be affected during land-clearing activities (see Table 3–11). Animal species include the burrowing owl, ferruginous hawk, golden eagle, long-billed curlew, sage thrasher, Swainson's hawk, pygmy rabbit, desert night snake, and striped whipsnake. It is doubtful that the loggerhead shrike and sage sparrow would be affected, because most of their habitat in the 400 Area has been destroyed by fire. Plant species include crouching milkvetch, piper's daisy, squill onion, and stalked-pod milkvetch (DOE 1996f:4-34; Dirkes and Hanf 1997:F.1–F.3; Mecca 1997:Poston memo to Teal). The biological significance of areas designated as priority shrub-steppe habitat at Hanford and concern for potential impacts on such areas was raised by the Washington State Department of Fish and Wildlife based on the preliminary consultation conducted with the agency (McConnaughey 1998). Preconstruction surveys and additional consultations with the U.S. Fish and Wildlife Service (USFWS) and the Washington Department of Fish and Wildlife would be conducted, if appropriate, to ensure that impacts on any sensitive animal and plant species living in the vicinity of the 400 Area are negligible, and that appropriate mitigation actions are implemented to compensate for the destruction of priority shrub-steppe habitat.

Mitigative measures might include the avoidance of species and their habitats entirely or just during critical timeframes (e.g., during breeding season), or the relocation of sensitive species away from areas likely to be disturbed. Appropriate mitigations would be coordinated with regulatory agencies as part of the consultation process.

4.26.1.3.2 Operations

Nonsensitive Habitat. Activities associated with operation of the proposed facilities could impact wildlife in the area due to noise and human presence. As a result, animal species could leave the area and take up residence in similar habitat nearby, thus changing the ecosystem dynamics and adding stress to the habitat and its occupants. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters would be used (UC 1998a, 1998b, 1999a, 1999b). Aquatic resources should not be affected because groundwater would be used and liquid effluents would be sampled, treated, and disposed of in accordance with approved permits and procedures (UC 1998a, 1998b, 1999a, 1999b).

Sensitive Habitat. Operational impacts on wetlands or critical habitat would be unlikely because airborne and aqueous effluents would be controlled and permitted. It is also unlikely that any federally listed threatened or endangered species would be affected because none have been sighted on or around the Central Plateau (DOE 1996f:4-34). However, Washington State–classified special-status species could be affected by noise or human activity during operations, as discussed for construction (DOE 1996f:4-34; Dirkes and Hanf 1997:F.1–F.3; Mecca 1997a:Poston memo to Teal).

As a result of consultations with the USFWS field office in Moses Lake, Washington, and the Washington Department of Fish and Wildlife, concerns were also identified regarding the potential for impacts on sensitive aquatic species, particularly to anadromous fish occurring in the Hanford Reach of the Columbia River (McConnaughey 1998; Roy 1998). However, no discharge of effluents containing hazardous or radiological constituents or with a thermal component deleterious to aquatic life, including no direct discharge to the Columbia River, is anticipated from operation of the proposed facilities. Should this scenario change, additional consultations with the USFWS, National Marine Fisheries Service, and the Washington Department of Fish and Wildlife would be conducted as necessary to ensure that any potential impacts are adequately addressed.

Radiological impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded than any doses incurred would be well below Federal, State, and local regulatory limits (see Sections 4.26.1.1.2 and 4.26.1.2.2). Due to the very conservative approach used in assessing radiological impacts on the public, this is deemed to bound any exposures via subsistence agriculture, hunting, and fishing. Appendixes F and J detail the assessment protocol and the conservative data assumptions, respectively.

4.26.1.4 Cultural and Paleontological Resources

Prehistoric, historic, Native American, and paleontological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. The land area required for construction activities is fairly small, however, and any such resource disturbance would be minimized by confinement of the construction to previously disturbed or developed areas. Impacts of operations would be negligible because facility operations and security would restrict access to nearby prehistoric, historic, Native American, and paleontological resources. Continued compliance monitoring, before and after construction, would also help to limit or preclude impacts on these resources.

4.26.1.4.1 Construction

Siting all facilities at Hanford would disturb about 22.4 ha (55 acres) of land in the 400 Area. Some of this area (5.7 ha [14 acres]) would be used only temporarily as a laydown area during the 5-year construction and startup phases for the MOX facility, and some (7.2 ha [18 acres]) during the 3.5-year construction phase for the immobilization facility. The existing construction laydown area (2.0 ha [4.9 acres]) for FMEF would have the same use for the pit conversion facility (UC 1998a, 1998b, 1999a, 1999b).

Cultural resource surveys have been conducted within the proposed construction areas in and adjacent to the 200 East and 400 Areas (DOE 1996a:3-49). No prehistoric archaeological resources have been identified within the proposed construction areas, and no historic resources in the 200 East or 400 Area. Accordingly, construction activities should not directly impact any prehistoric or historic resources. Preconstruction surveys (as required) and construction monitoring for previously unknown resources would be conducted within the framework of the *Hanford Cultural Resources Management Plan* (Battelle 1989).

Native American resources have not been identified within the construction areas in and adjacent to the 200 East and 400 Areas. For this reason, no direct impacts would be incurred. Thus far, no paleontological resources have been identified within the proposed construction areas; therefore, no direct impacts would be expected.

No indirect impacts on prehistoric, historic, Native American, or paleontological resources would occur under the proposed construction due to the lack of known resources in the vicinity. Preliminary consultations with appropriate American Indian Tribal Governments and the State Historic Preservation Officer (SHPO) have been

performed and are documented in Appendix O. These consultations indicate that it is unlikely that significant cultural resources would be damaged. Inadvertent discoveries of cultural resources would be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects), and the *Hanford Cultural Resources Management Plan* (Battelle 1989).

4.26.1.4.2 Operations

Operation of the proposed facilities should have no direct impacts on cultural or paleontological resources. Once the facilities were operational, no direct land disturbance or other action with impact potential would be conducted beyond the facility's perimeter fence. Activities associated with operation of the proposed facilities should also have no indirect impacts on any known cultural or paleontological resources.

4.26.1.5 Land Use and Visual Resources

Land resources (land use and visual resources) could be affected by construction and operation of the proposed surplus plutonium disposition facilities. The land-use impact analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and land values, and other socioeconomic factors pertaining to land use. Impacts would vary from site to site depending on existing facility land-use configurations, adjoining land uses, and other environmental and containment factors. The visual resource impact analysis emphasized changes in the existing landscape character that could result from the proposed action. The visual resource assessment was based on the Visual Resource Management (VRM) methodology.

4.26.1.5.1 Construction

Use of the planned HLW vitrification facility and support facilities in the 200 East and 200 West Areas would be consistent with existing and future land uses as described in the *Hanford Remedial Action and Comprehensive Land Use Plan* (DOE 1996g). No changes in existing or future land uses at the 200 East Area would occur under Alternative 2.

Land area requirements at Hanford would include sufficient land for the modification of FMEF in the 400 Area to support operation of the pit conversion and immobilization facilities, and for construction of the MOX facility adjacent to FMEF (UC 1998a, 1998b, 1999a, 1999b). Table 4–167 provides an estimate of the total footprint area required, in terms of newly disturbed land, for construction and operation of the proposed facilities. The land required for the construction of facilities at Hanford under Alternative 2 would be about 22.4 ha (55 acres). This includes approximately 7.5 ha (19 acres) of new building footprints, new parking lots, and security areas that would remain in use throughout operations.

Table 4–167. Maximum New Facility and Construction Area Requirements at Hanford

Land Requirement	Pit Conversion (Existing)	Immobilization (Existing)	MOX (New)
Construction area[a] (ha)	2.0	7.2	5.7
New operational area (ha)	0.5	0.8	6.2

[a] For uses such as construction laydown, construction worker parking, and waste storage.
Source: UC 1998a, 1998b, 1999a, 1999b.

The remaining 14.9 ha (37 acres) would be needed temporarily during construction for laydown, temporary storage, and parking. Construction areas would not be used after the facilities became operational. A number

of these construction areas exist within the FMEF area but are currently inactive. Land area requirements for Alternative 2 would not be major, and no long-term or permanent loss of land would result from construction and operation of the proposed facilities at Hanford.

4.26.1.5.2 Operations

The pit conversion and immobilization facilities would be in FMEF in the 400 Area (UC 1998a, 1999a, 1999b). Operation of these facilities would conform to existing and future land uses as described in the *Hanford Remedial Action and Comprehensive Land Use Plan* (DOE 1996f). The 400 Area land is designated for reactor operations, which can include other operational uses such as pit disassembly, conversion, and immobilization. The MOX facility would be operated adjacent to FMEF in the 400 Area and would likewise conform to existing and future land uses as described in the *Hanford Remedial Action and Comprehensive Land Use Plan* (DOE 1996g:4.2-1; UC 1998b). Other Hanford land uses or special-status lands would not be affected by facility operations. There would also be no impact on Native American Treaty land-use rights from any of the Hanford alternatives.

The appearance of the modified FMEF and new facilities adjacent to FMEF would remain consistent with the industrialized landscape character and a VRM Class IV designation of the 400 Area. In height and size, the proposed facilities would be similar to existing buildings in the 400 Area (UC 1998a, 1998b, 1999a, 1999b). Construction and operation of the surplus plutonium disposition facilities would not effect a change in any natural features of visual interest in the area. The nearest sensitive viewpoint is Gable Mountain, which is 4.5 km (2.8 mi) away.

4.26.1.6 Infrastructure

4.26.1.6.1 Construction

Existing Hanford infrastructure would be capable of supporting the construction requirements for the proposed facilities included in Alternative 2. As shown in Table 4–168, construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Only 1.3 km (0.81 mi) of road would be required for construction deliveries and access to new and temporary facilities (UC 1998a, 1998b, 1999a, 1999b); this would not have a major impact. The total requirement for fuel oil during construction might be higher than currently available storage, but the majority of fuel oil usage would be associated with construction vehicle usage; therefore, storage would not be limiting. Table 4–168 reflects estimates of the additional annual infrastructure requirements for construction of the proposed facilities. Site resource availability and possible additional resource requirements are also presented.

Table 4–168. Maximum Annual Additional Site Infrastructure Requirements for Construction in 400 Area at Hanford

Resource	Facility Requirement: Pit Conversion	Immobilization	MOX	Total	Availability[a]	Additional Requirement
Transportation						
Roads (km)	0.1	0.2	1.0	1.3	420	1.3
Railroads (km)	0	0	0	0	204	0
Electricity						
Energy consumption (MWh/yr)	1,700	21,000	1,900	24,600	53,700	0
Peak load (MW)	1.0	3.4	2.5	6.9	22.5	0
Fuel						
Natural gas (m^3/yr)	NA	NA	NA	NA	NA	0
Oil (l/yr)	85,000	215,000	350,000	650,000	NA[b]	0
Coal (t/yr)	NA	NA	NA	NA	NA[b]	0
Water (l/yr)	2,000,000	66,000,000	23,000,000	91,000,000	356,260,000	0

[a] Capacity minus current usage, a calculation based on data provided in Sections 3.2.11.1 and 3.2.11.2.

[b] Not applicable due to the ability to procure additional resources.

Key: NA, not applicable.

Source: DOE 1999c; ORNL 1998; UC 1998a, 1998b, 1999a, 1999b.

4.26.1.6.2 Operations

Except for electricity, resources needed for operations under Alternative 2 are well within Hanford's capacity. The estimated total operational requirement for electricity is 97,000 MWh/yr, and availability to FMEF is 53,700 MWh/yr; hence, it appears that an additional 43,300 MWh/yr would be required, with an additional peak demand requirement of 9.8 MW. Additional electric power is already available in the 400 Area and could be easily supplied to a new building near FMEF (Sandberg 1998). The total fuel oil requirement for emergency generator testing during operations might also be higher than current site storage, but shortfalls could be met through additional procurements by normal contractual means. Table 4–169 reflects estimates of the additional annual resources required for operation of the proposed facilities. Available site resources and possible additional operational requirements are also presented.

4.26.2 INEEL

For INEEL, the maximum impacts on environmental resources would be experienced if Alternative 7 or 8 were implemented. Under these alternatives, the pit conversion and MOX facilities would be sited at INEEL. The alternatives would require the maximum ground disturbance at INEEL thereby maximizing the potential impacts on related resources such as geology and soils, ecological, and cultural. These alternatives would also require the most water and place the maximum strain on infrastructure at the site. None of the other alternatives evaluated in this SPD EIS include facilities being built at INEEL.

4.26.2.1 Geology and Soils

4.26.2.1.1 Construction

Construction of the pit conversion facility in FPF and the MOX facility in a new building at INEEL would have negligible impacts on the geologic and soil resources. In the *Storage and Disposition PEIS*, hazards of the

large-scale geologic conditions at INEEL were analyzed in detail. The analysis determined that these conditions pose an acceptable risk to the proposed long-term storage facilities. Review of the data and analyses

Table 4–169. Maximum Annual Additional Site Infrastructure Requirements for Operations in 400 Area at Hanford

Resource	Facility Requirement: Pit Conversion	Immobilization[a]	MOX	Total	Availability[b]	Additional Requirement
Transportation						
Roads (km)	0	0	0	0	420	0
Railroads (km)	0	0	0	0	204	0
Electricity						
Energy consumption (MWh/yr)	28,000	23,000	46,000	97,000	53,700	43,300
Peak load (MW)	6.8	4.2	21.3	32.3	22.5	9.8
Fuel						
Natural gas (m^3/yr)	NA	NA	NA	NA	NA	0
Oil (l/yr)	38,000	100,000	63,000	201,000	NA[c]	0
Coal (t/yr)	NA	NA	NA	NA	NA[c]	0
Water (l/yr)	62,000,000	68,000,000	68,000,000	198,000,000	356,260,000	0

[a] Data reflect the higher of the requirements for ceramic and glass.

[b] Capacity minus current usage, a calculation based on data provided in Sections 3.2.11.1 and 3.2.11.2.

[c] Not applicable due to coal no longer being used at Hanford.

Key: NA, not applicable.

Source: DOE 1999c; UC 1998a, 1998b, 1999a, 1999b.

presented in the *Storage and Disposition PEIS* and the site-specific information in this SPD EIS indicates that large-scale geologic conditions would likewise not impact the proposed surplus plutonium disposition facilities. Specifically, although a moderate seismic risk exists, this risk does not preclude the safe construction and operation of properly designed facilities. Also, the occurrence of volcanic activity during the lifetime of the proposed facilities has been deemed improbable. The potential for other nontectonic events to affect the facilities is also low. More detailed descriptions of impacts of the potential geologic hazards at INEEL are included in the *Storage and Disposition PEIS* (DOE 1996a:4-148–4-150).

The soils at INEEL are considered suitable for standard construction techniques. Within INEEL, economically viable sand, gravel, and pumice resources have been identified. New construction could increase the use of sand and gravel; however, large volumes of these materials are present, and the impact should be negligible. No soils at INEEL are currently classified as prime farmland.

4.26.2.1.2 Operations

Operation of the pit conversion facility in FPF and the MOX facility in a new building at INEEL would have negligible impacts on the geologic or soil resources as no operational-related ground disturbance is anticipated. As discussed above for construction, site geologic conditions are not expected to affect surplus plutonium disposition facilities.

Occurrence of all proposed actions at INEEL would result in a very small annual incremental dose to the local public from normal operations via the deposition of airborne radiological particulates on agricultural products. This dose, about 2.2 person-rem/yr, would only be 0.003 percent of the annual dose of natural background radiation (see Appendix J).

Ingestion doses at INEEL were assessed for eight food categories: leafy vegetables, root vegetables, fruits, grains, milk, meat, poultry, and eggs. Public doses incurred from the uptake of these foodstuffs were determined to be well below the Federal, State, and local regulatory limits; therefore, potential radiological impacts on local farmlands would be essentially nonexistent.

4.26.2.2 Water Resources

4.26.2.2.1 Construction

There would be no withdrawals of surface water for the proposed construction of the pit conversion and MOX facilities at INEEL (UC 1998f, 1998g). Thus, there would be no impact on the water availability to any downstream users. All wastewater during construction would be treated in approved facilities designed to meet NPDES permit limitations and be discharged to evaporation and percolation ponds, or would be available for recycling. In either case, no impact on surface water quality would be expected from construction activities.

It is estimated that proposed construction activities would use a maximum of about 27 million l/yr (7.1 million gal/yr) of water (DOE 1999c; ORNL 1998; UC 1998f, 1998g). The combination of the maximum estimated groundwater usage for construction of these facilities and the current INTEC usage of approximately 45.4 million l/yr (12 million gal/yr) represents about 32 percent of the INTEC groundwater capacity of 227.1 million l/yr (60 million gal/yr) (see Section 3.3.11.2, Table 3–25). This withdrawal volume would have no impact on groundwater availability to other users in the area. There would be no impacts on groundwater availability, and the withdrawals would be within DOE's groundwater allotment. All wastewater flows would be treated in evaporation and percolation ponds, or would be available for recycling. The *Storage and Disposition PEIS* concluded there would be no impacts on groundwater quality from these activities, and no new data have been developed to require that this conclusion be revised (DOE 1996a:4-396, 4-397, 4-686).

The potential site is not an area historically prone to flooding, but it could be in the floodplain if the Mackay Dam failed. The *Storage and Disposition PEIS* concluded that this flood would exceed either the 100- or 500-year floods. This dam failure would produce the probable maximum flood. The PEIS concluded the facilities would be designed to withstand such flooding (DOE 1996a:4-396, 4-686). Therefore, the facilities should neither affect nor be affected by flooding. Established construction techniques would be used to control soil erosion during construction. No long-term impacts would be expected from soil erosion during construction of the facilities.

Proven construction techniques would be used to minimize soil erosion impacts during construction. Due to the success of these techniques, there would be no long-term impact on water quality due to soil erosion from construction of the facilities.

4.26.2.2.2 Operations

Surface water would not be used for operation of the proposed pit conversion or MOX facilities at INEEL, and there would be no impact on the availability of surface water to downstream users (UC 1998f, 1998g). All process and sanitary wastewater would be discharged to evaporation and percolation ponds with no surface discharge, or would be treated in approved facilities designed to meet NPDES permit limitations (Abbott, Crockett, and Moor 1997:9).

As detailed above in Section 4.26.2.1.2, there would be a very small annual incremental dose to the local public from normal operations via the food ingestion pathway. Due primarily to the absence of any major water body in the vicinity of INTEC, there would be no discernible contamination of aquatic biota (fish) or drinking water from surplus plutonium disposition activities at INEEL, either from the deposition of minute quantities of airborne particulates into small water bodies or from any potential wastewater releases. Thus, it is estimated that no

component of the public dose would be attributable to liquid pathways. Therefore, no discernible impacts on surface water quality would be expected from these activities.

Current estimates of the water that would be needed during operation of the pit conversion and MOX facilities at INEEL are much lower than was assumed in the *Storage and Disposition PEIS*. The maximum estimated annual water usage for these facilities at INEEL is 117 million l (30.9 million gal) (DOE 1999c; UC 1998f, 1998g). The combination of this volume and the current usage of 45.4 million l/yr (12 million gal/yr) represents about 72 percent of the INTEC groundwater capacity of 227.1 million l/yr (60 million gal/yr). This reduced usage estimate would not change the analysis or conclusions of the *Storage and Disposition PEIS*. Because it was determined that there would be no impact on water availability at the higher rate, there would be no impact at this lower usage rate (DOE 1996a:4-397, 4-686).

As stated above, there would be no direct discharge of wastewater either to the surface water or to groundwater, and no discernible impacts on groundwater quality would be expected from these activities. This finding is consistent with the conclusions of the *Storage and Disposition PEIS* (DOE 1996a:4-397, 4-686).

4.26.2.3 Ecological Resources

Ecological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. However, habitat disturbance would be minimal; the land area required for construction activities is small in relation to regionally available habitat, and construction would take place in previously disturbed or developed areas. Operational impacts would also be minimal because facility emissions to the environment would be processed in accordance with applicable permitting procedures. Therefore, impacts on nonsensitive and sensitive habitats, plant and animal species, and the overall biodiversity of the candidate site would be minimal.

4.26.2.3.1 Construction

Nonsensitive Habitat. Siting the pit conversion and MOX facilities at INEEL would disturb approximately 14.4 ha (36 acres) of land inside the INTEC-protected area adjacent to FPF. Some of this land (5.7 ha [14 acres]) would be used temporarily during the 5-year construction and startup phases for the MOX facility (UC 1998g). Although an additional 2.0 ha (4.9 acres) of land would be required for construction of the pit conversion facility, this land was disturbed during construction of FPF (UC 1998f). Animal species that are adapted to disturbed industrial areas, such as small mammals (e.g., mice, rabbits, ground squirrels), birds (e.g., sparrows, finches), and reptiles (e.g., lizards), would be affected. Some of the less-mobile species within the construction zone could perish during land-clearing activities and from increased vehicular traffic. Furthermore, activities and noise associated with construction could cause larger mammals and birds to relocate to similar habitat in the area. Depending on the populations presently in those areas, the ecosystem dynamics could be altered, adding stress if food or shelter were limited. Prior to construction, the proposed site would be surveyed for nests of migratory birds in accordance with the Migratory Bird Treaty Act. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be drawn from groundwater sources (Abbott, Crockett, and Moor 1997:15; DOE 1996a:4-693; UC 1998f, 1998g).

Sensitive Habitat. Construction would have no impact on wetlands or critical habitat because there are none on the proposed site. It is also unlikely that any threatened, endangered, or other special-status species at INEEL would be affected because none have been sighted within the immediate environs of FPF (Abbott, Crockett, and Moor 1997:15; Werner 1997:WAG3 Report Summary). In the surrounding INTEC area, however, there could be peregrine falcon, bald eagle, ferruginous hawk, black tern, burrowing owl, white-faced ibis, loggerhead shrike, northern goshawk, trumpeter swan, pygmy rabbit, Townsend's western big-eared bat, long-eared and small-footed myotis, and northern sagebrush lizard. The USFWS Boise, Idaho, field office concurred with this listing

(as detailed in Table 3–23) in response to DOE's initial consultation (Ruesink 1998). Nevertheless, the Idaho Department of Fish and Game, Idaho Conservation Data Center provided additional information concerning several State special status plant species occurring at INEEL as a result of DOE's consultation request (see Table 3–23) (Stephens 1998, 1999). Preconstruction surveys and additional consultations with the USFWS and the Idaho Department of Fish and Game, Conservation Data Center would be conducted, if appropriate, to ensure that impacts on any sensitive animal and plant species living in the vicinity of FPF are negligible and that appropriate mitigation actions are implemented as needed.

Mitigative measures might include the avoidance of species and their habitats entirely or just during critical timeframes (e.g., during breeding season), or the relocation of sensitive species away from areas likely to be disturbed. Appropriate mitigations would be coordinated with regulatory agencies as part of the consultation process.

4.26.2.3.2 Operations

Nonsensitive Habitat. Activities associated with operation of the surplus plutonium disposition facilities could impact wildlife in the area due to noise and human presence. As a result, animal species could leave the area and take up residence in similar habitat nearby, thus changing the ecosystem dynamics and adding stress to the habitat and its occupants. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters would be used (UC 1998f, 1998g). Aquatic resources should not be affected because groundwater would be used and liquid effluents would be sampled, treated, and disposed of in accordance with approved permits and procedures (UC 1998f, 1998g).

Sensitive Habitat. Operational impacts on wetlands or other sensitive habitats would be unlikely because airborne and aqueous effluents would be controlled and permitted. It is also unlikely that any federally listed threatened or endangered species would be affected, although Idaho State–classified special-status species could be affected by noise or human activity during operations, as discussed for construction.

Radiological impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded than any doses incurred would be well below Federal, State, and local regulatory limits (see Sections 4.26.2.1.2 and 4.26.2.2.2). Due to the very conservative approach used in assessing radiological impacts on the public, this is deemed to bound any exposures via subsistence agriculture, hunting, and fishing. Appendixes F and J detail the assessment protocol and the conservative data assumptions, respectively.

4.26.2.4 Cultural and Paleontological Resources

Prehistoric, historic, Native American, and paleontological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. The land area required for construction activities is fairly small, however, and any such resource disturbance would be minimized by confinement of the construction to previously disturbed or developed areas. Impacts of operations would be negligible because facility operations and security would restrict access to nearby prehistoric, historic, Native American, and paleontological resources. Continued compliance monitoring, before and after construction, would also help to limit or preclude impacts on these resources.

4.26.2.4.1 Construction

Siting the pit conversion and MOX facilities at INEEL would disturb about 14.4 ha (36 acres) of land inside the INTEC-protected area adjacent to FPF. Some of this land (5.7 ha [14 acres]) would be used temporarily during the 5-year construction and startup phases for the MOX facility (UC 1998g). Although an additional 2.0 ha (4.9 acres) of land would be required for construction of the pit conversion facility, this land was previously disturbed during construction of FPF (UC 1998f).

Archaeological surveys have identified six prehistoric resources within the vicinity of the proposed construction area, but none are potentially eligible for nomination to the National Register of Historic Places. The surveys also identified two historic resources, a homestead and nearby trash dump, that may be eligible for nomination. Also, a historic building survey being conducted within INTEC is likely to identify structures potentially eligible for nomination to the National Register on the basis of relevance to the Cold War Era (Abbott, Crockett, and Moor 1997:16). Direct impacts of the proposed construction would be unlikely; however, consistent with the *INEL Management Plan for Cultural Resources*, surveys and monitoring would be conducted to ensure against impacts on National Register–eligible resources (Miller 1995).

Specific Native American resources have not been identified within the proposed construction area; however, resources important to the Shoshone and Bannock Tribes may be present in the vicinity. Direct consultations with the tribes have been initiated, consistent with a working agreement between DOE and the tribes, to ensure that there are no direct construction-related impacts. Paleontological resources are well documented within INEEL. No known resources have been reported within the proposed construction area; however, monitoring of construction excavations would be performed to ensure that no significant paleontological resources, if discovered, would be affected.

Indirect construction impacts on prehistoric, historic, Native American, or paleontological resources would be unlikely. Preliminary consultations with appropriate American Indian Tribal Governments and the SHPO have been performed and are documented in Appendix O. These consultations indicate that it is unlikely that significant cultural resources would be damaged. Inadvertent discoveries of cultural resources would be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects).

4.26.2.4.2 Operations

The proposed facilities should have no direct impacts on prehistoric, historic, or paleontological resources. However, operations-related noise and traffic could directly affect nearby Native American cultural resources (if identified in preconstruction consultations). To avoid such impacts, consultations with the Shoshone and Bannock Tribes would be conducted prior to operations.

There should also be no indirect impacts of operations on prehistoric, historic, or paleontological resources. However, any Native American resources in the vicinity of the proposed facility locations could experience indirect impacts such as access restrictions. Consultations with the Shoshone and Bannock Tribes would be conducted to avoid impacts of this nature.

4.26.2.5 Land Use and Visual Resources

Land resources (land use and visual resources) could be affected by construction and operation of the proposed surplus plutonium disposition facilities. The land-use impact analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and land values, and other socioeconomic factors pertaining to land use. Land-use impacts would vary from site to site depending on

existing facility land-use configurations, adjoining land uses, and other environmental and containment factors. The visual resource impact analysis emphasized changes in the existing landscape character that could result from the proposed action. The visual resource assessment was based on the VRM methodology.

4.26.2.5.1 Construction

Land area requirements at INEEL under Alternative 7 or 8 would include sufficient land for the modification of FPF to house the pit conversion facility and for construction of the MOX facility adjacent to FPF at INTEC (UC 1998f, 1998g). Table 4–170 provides an estimate of the total footprint area required, in terms of newly disturbed land, for construction and operation of the proposed facilities. The land required for the construction of facilities at INTEC for any of the INEEL alternatives would be about 14.4 ha (36 acres). This includes approximately 6.7 ha (17 acres) of new building footprints, new parking lots, and security areas that would remain in use throughout operations.

Table 4–170. Maximum New Facility and Construction Area Requirements at INEEL

Land Requirement	Pit Conversion (Existing)	MOX (New)
Construction area[a] (ha)	2.0	5.7
New operational area (ha)	0.5	6.2

[a] For uses such as construction laydown, construction worker parking, and waste storage.

Source: UC 1998f, 1998g.

The remaining 7.7 ha (19 acres) would be needed temporarily during construction for laydown, temporary storage, and parking. Construction areas would not be used after the facilities became operational. A number of these construction areas exist at INTEC. Land area requirements for Alternative 7 or 8 would not be major, and no permanent loss of land would result from construction and operation of the proposed facilities at INEEL.

4.26.2.5.2 Operations

The pit conversion facility activities would be in FPF, which is within the INTEC area (UC 1998f). FPF is an existing, structurally complete building that has not been used. Most of the support buildings required for operation of the pit conversion facility exist in INTEC. The MOX facility would be constructed within the existing INTEC area (UC 1998g). Operation of the pit conversion and MOX facilities would conform to existing and future land uses as described in the *INEEL Comprehensive Facility and Land Use Plan* (DOE 1997g). Land within INTEC is currently disturbed and designated for waste-processing operations. Other INEEL land uses or special-status lands at INEEL would not be affected by facility operations. There would be no impact on Native American Treaty land-use rights from any of the proposed INEEL alternatives.

The appearance of the modified FPF and new facilities that may be required at INTEC would remain consistent with its industrialized landscape character and a VRM Class IV designation. In height and size, the proposed facilities would be similar to existing buildings at INTEC (UC 1998f, 1998g). Construction and operation of the facilities would not effect a change in any natural features of visual interest in the area. The nearest sensitive viewpoint is Big Southern Butte National Natural Landmark, 20 km (12 mi) south of INTEC.

4.26.2.6 Infrastructure

4.26.2.6.1 Construction

Existing INEEL infrastructure would be capable of supporting the construction requirements for the proposed facilities included under Alternative 7 or 8. Construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Only 2.3 km (1.4 mi) of road would be required for construction deliveries and access to new and temporary facilities (UC 1998f, 1998g); this would not have a major impact. The total requirement for fuel oil during construction might be higher than currently available storage, but the majority of fuel oil usage would be associated with construction vehicle usage; therefore, storage would not be limiting. Table 4–171 reflects estimates of additional annual infrastructure requirements for construction of the proposed facilities. Site resource availability and possible additional resource requirements are also presented.

Table 4–171. Maximum Annual Additional Site Infrastructure Requirements for Construction in INTEC at INEEL

	Facility Requirement				
Resource	**Pit Conversion**	**MOX**	**Total**	**Availability[a]**	**Additional Requirement**
Transportation					
Roads (km)	1.3	1.0	2.3	445	2.3
Railroads (km)	0	0	0	48	0
Electricity					
Energy consumption (MWh/yr)	1,700	1,900	3,600	202,800	0
Peak load (MW)	1.0	2.5	3.5	22.2	0
Fuel					
Natural gas (m^3/yr)	NA	NA	NA	NA	0
Oil (l/yr)	110,000	350,000	460,000	NA[b]	0
Coal (t/yr)	NA	NA	NA	NA[b]	0
Water (l/yr)	4,000,000	23,000,000	27,000,000	181,680,000	0

[a] Capacity minus current usage, a calculation based on data provided in Sections 3.3.11.1 and 3.3.11.2.

[b] Not applicable due to the ability to procure additional resources.

Key: INTEC, Idaho Nuclear Technology and Engineering Center; NA, not applicable.

Source: DOE 1999c; ORNL 1998; UC 1998f, 1998g.

4.26.2.6.2 Operations

Resources needed for operations under Alternative 7 or 8 are well within INEEL capacity. The total fuel oil requirement for emergency generator testing during operations might be higher than current site storage, but shortfalls could be met through additional procurements by normal contractual means. Table 4–172 reflects estimates of additional annual resources required for operation of the proposed facilities. Available site resources and possible additional operational requirements are also presented.

4.26.3 Pantex

For Pantex, the maximum impacts on environmental resources would be experienced if Alternative 9 or 10 were implemented. Under these alternatives, the pit conversion and MOX facilities would be sited at Pantex. These

alternatives would require the maximum ground disturbance at Pantex, thereby maximizing the potential impacts on related resources such as geology and soils, ecological, and cultural. These alternatives would also

Table 4–172. Maximum Annual Additional Site Infrastructure Requirements for Operations in INTEC at INEEL

Resource	Facility Requirement			Availability[a]	Additional Requirement
	Pit Conversion	MOX	Total		
Transportation					
Roads (km)	0	0	0	445	0
Railroads (km)	0	0	0	48	0
Electricity					
Energy consumption (MWh/yr)	15,000	30,000	45,000	202,800	0
Peak load (MW)	3.9	5.2	9.1	22.2	0
Fuel					
Natural gas(m^3/yr)	NA	NA	NA	NA	0
Oil (l/yr)	38,000	63,000	101,000	NA[b]	0
Coal (t/yr)	2,100	2,100	4,200	NA[b]	0
Water (l/yr)	49,000,000	68,000,000	117,000,000	181,680,000	0

[a] Capacity minus current usage, a calculation based on data provided in Sections 3.3.11.1 and 3.3.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: INTEC, Idaho Nuclear Technology and Engineering Center; NA, not applicable.
Source: DOE 1999c; UC 1998f, 1998g.

require the most water and place the maximum strain on infrastructure at the site. All the other Pantex alternatives evaluated in this SPD EIS would require less ground disturbance, so none would result in greater impacts than those associated with Alternative 9 or 10.

4.26.3.1 Geology and Soils

4.26.3.1.1 Construction

Construction of the pit conversion and MOX facilities at Pantex would have no impact on the geologic and soil resources. In the *Storage and Disposition PEIS*, hazards of the large-scale geologic conditions at Pantex were analyzed in detail. The analysis determined that these conditions pose an acceptable risk to the proposed long-term storage facilities. Review of the data and analyses presented in the *Storage and Disposition PEIS* and the site-specific information in this SPD EIS indicates that large-scale geologic conditions would likewise not impact the proposed surplus plutonium disposition facilities. This is based on the relatively low seismic risk of the area to properly designed facilities and the extremely improbable occurrence of any volcanic activity during the lifetime of the proposed facilities. The potential for other nontectonic events to affect the facilities is also low. More detailed descriptions of impacts of the potential geologic hazards at Pantex are included in the *Storage and Disposition PEIS* (DOE 1996a:4-204–4-206).

The soils at Pantex are considered suitable for standard construction techniques. No economically viable geologic resources have been identified at Pantex. Pantex is underlain by soils of the Pullman-Randall association. The Pullman soil is classified as prime farmland. Pantex operations are not covered by the Farmland Protection Policy Act (FPPA) under Section 1540(c)(4) (7 U.S.C. Section 4201) (DOE 1996c:4-22).

4.26.3.1.2 Operations

Operation of the pit conversion and MOX facilities at Pantex would have negligible impacts on the geologic and soil resources as no operational-related ground disturbance is anticipated. As discussed above for construction, site geologic conditions are not expected to affect surplus plutonium disposition facilities.

Occurrence of all proposed actions at Pantex would result in a very small annual incremental dose to the local public from normal operations via the deposition of airborne radioactive particulates on agricultural products. This dose, about 0.56 person-rem/yr, would only be 0.0006 percent of the annual dose of natural background radiation (see Appendix J).

Ingestion doses at Pantex were assessed for eight food categories: leafy vegetables, root vegetables, fruits, grains, milk, meat, poultry, and eggs. Public doses incurred from the uptake of these foodstuffs were determined to be well below Federal, State, and local regulatory limits; therefore, potential radiological impacts on local farmlands would be essentially nonexistent.

4.26.3.2 Water Resources

4.26.3.2.1 Construction

Surface water would not be used for the construction of the proposed pit conversion or MOX facilities at Pantex (UC 1998e, 1998h). Thus, there would be no impact on water availability for downstream users. The *Storage and Disposition PEIS* determined that wastewater would be discharged to the wastewater treatment facilities north of Zone 12 (i.e., the Pantex Wastewater Treatment Facility), with discharge to the playa lakes, or be available for recycling, and that there would be no impact from these discharges (DOE 1996a:4-397, 4-686, 4-687). As further described in Sections 3.4.2.6 and 3.4.7.1.1, decisions subsequently made regarding planned improvements to the existing Wastewater Treatment Facility will result in the elimination of wastewater discharges from the facility to Playa 1 beginning in 2003. Treated effluent would be used for onsite irrigation instead of being discharged to Playa 1. As a result, operation of this upgraded and expanded facility will further ensure that there are no water quality impacts from construction of the proposed facilities.

Proven construction techniques would be used to mitigate the impact of soil erosion on receiving streams. Because of the effectiveness of these techniques, no long-term impacts from soil erosion due to construction activities would be expected.

The *Storage and Disposition PEIS* concluded that Pantex would neither affect nor be affected by flooding. For further information on this, consult the *Storage and Disposition PEIS* (DOE 1996a:3-157).

According to estimates, construction of the pit conversion and MOX facilities would use a maximum of about 35 million l/yr (9.2 million gal/yr) of groundwater (DOE 1999c; ORNL 1998; UC 1998e, 1998h). The combination of this volume and the current site usage of approximately 852 million l/yr (225 million gal/yr) represents about 23 percent of the groundwater capacity of approximately 3.8 billion l/yr (1 billion gal/yr) (see Section 3.4.11.1, Table 3–36). Pantex water use has decreased during the period from 1991 to 1995 by 231 million l (61 million gal) (M&H 1996:4-33, 9-8). The 35 million l/yr (9.2 million gal/yr) of water estimated to be used for construction of the pit conversion and MOX facilities would not increase water use above 1991 levels. The additional water use would be 0.1 percent of the 23.6 billion l (6.2 billion gal) of water pumped from the Carson County well fields by the city of Amarillo in 1995, and 0.03 percent of the 101 billion l (27 billion gal) of water applied for irrigation in Carson County in 1995. The amount of water required is relatively small in comparison with the available water resources, so there would be no impacts on groundwater capacity.

Although the expected drawdowns caused by withdrawing water required for this alternative are small, the overall decline in the groundwater level in the Ogallala aquifer near Amarillo is of concern. DOE is not proposing to use water from the Hollywood Road Wastewater Treatment Plant at this time, although this measure would be a viable action and could be used to mitigate impacts of additional water usage in the future.

The *Storage and Disposition PEIS* concluded that the facility would not have any impact on groundwater quality (DOE 1996a:4-686, 4-687). There are no new data which indicate that this conclusion should be revisited. Therefore, no impact on groundwater quality would be expected.

4.26.3.2.2 Operations

There would be no impacts on surface water availability from the proposed operation of the pit conversion and MOX facilities at Pantex because surface water would not be used for the operation of these facilities (UC 1998e, 1998h). All process and sanitary wastewater would be discharged to the Wastewater Treatment Facility. Beginning in 2003, treated effluent from this facility will no longer be discharged to Playa 1 but will instead be used for onsite irrigation.

As detailed above in Section 4.26.3.1.2, there would be a very small annual incremental dose to the local public from normal operations via the food ingestion pathway. Due primarily to the absence of any major water body in the vicinity of Zone 4, there would be no discernible contamination of aquatic biota (fish) or drinking water from surplus plutonium disposition activities at Pantex, either from the deposition of minute quantities of airborne particulates into small water bodies or from any potential wastewater releases. Thus, it is estimated that no component of the public dose would be attributable to liquid pathways. Therefore, no discernible impacts on surface water quality would be expected from these activities.

Current estimates indicate the pit conversion and MOX facilities would require a maximum of about 116 million l (30.6 million gal) of groundwater per year (DOE 1999c; UC 1998e, 1998h). The combination of this volume and the current site usage of approximately 852 million l/yr (225 million gal/yr) represents about 26 percent of the groundwater capacity of approximately 3.8 billion l/yr (1 billion gal/yr). Pantex water use has decreased during the period from 1991 to 1995 by 231 million l (61 million gal) (M&H 1996:4-33, 9-8). The 116 million l/yr (30.6 million gal/yr) of water estimated to be used by the pit conversion and MOX facilities would not increase water use above 1991 levels. The additional water use would be 0.5 percent of the 23.6 billion l (6.2 billion gal) of water pumped from the Carson County well fields by the city of Amarillo in 1995, and 0.1 percent of the 101 billion l (26.7 billion gal) of water applied for irrigation in Carson County in 1995. The amount of water required is relatively small in comparison with the available water resources, so there would be no impacts on groundwater capacity.

Although the expected drawdowns caused by withdrawing water required for this alternative are small, the overall decline in the groundwater level in the Ogallala aquifer near Amarillo is of concern. DOE is not proposing to use water from the Hollywood Road Wastewater Treatment Plant at this time, although this measure would be a viable action and could be used to mitigate impacts of additional water usage in the future.

As stated above, there would be no direct discharge of wastewater either to surface water or to the groundwater, and no discernible impacts on groundwater quality would be expected from these activities. This finding is consistent with the conclusions of the *Storage and Disposition PEIS* (DOE 1996a:4-398, 4-686, 4-687).

4.26.3.3 Ecological Resources

Ecological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. However, habitat disturbance would be minimal; the land area required for construction

activities is small in relation to regionally available habitat, and construction would take place in previously disturbed or developed areas. Operational impacts would also be minimal because facility emissions to the environment would be processed in accordance with applicable permitting procedures. Therefore, impacts on nonsensitive and sensitive habitats, plant and animal species, and the overall biodiversity of the candidate site would be minimal.

4.26.3.3.1 Construction

Nonsensitive Habitat. Siting the pit conversion and MOX facilities in new buildings in Zone 4 West at Pantex would disturb about 16.9 ha (42 acres). Some of this land (5.7 ha [14 acres]) would be used only temporarily during the 5-year construction and startup phases for the MOX facility (UC 1998h). Previously disturbed areas in Zone 4 West would be used for construction laydown for the pit conversion facility (2.0 ha [4.9 acres]) (UC 1998e). Zone 4 West at Pantex contains sufficient land area to accommodate the new building footprints. Thus, there should be no direct impacts on nonsensitive terrestrial or aquatic habitats. Animal species inhabiting areas surrounding Zone 4 could be affected by the increased noise associated with construction activities, and the additional vehicular traffic could result in higher mortality for individual members of local animal populations. Prior to construction, the proposed sites would be surveyed for nests of migratory birds in accordance with the Migratory Bird Treaty Act. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be drawn from groundwater sources (UC 1998e, 1998h).

Sensitive Habitat. Although portions of Playas 1, 2, and 3 are within 1.6 km (1 mi) of the proposed pit conversion and MOX facilities, no wetlands should be directly affected by construction actions, which would be limited to developed areas of Zone 4 West at Pantex. No critical habitat for any threatened or endangered species exists at Pantex; however, three special-status species (ferruginous hawk, western burrowing owl, and Texas horned lizard) might be found within the area surrounding Zone 4 (M&H 1997:22). Consultations were initiated by DOE with the USFWS and the Texas Parks and Wildlife Department to request comments on potential impacts on animal and plant species and asking for any additional sensitive species information. The USFWS field office in Arlington, Texas, had no additional information to provide and no comment on the SPD Draft EIS. Comments received from the Texas Parks and Wildlife Department in March 1999 indicated that the SPD EIS had largely addressed its general concerns as to impacts on rare or sensitive species. The agency did express its interest in safeguarding playa lake habitats, which support resident and migratory bird species, and in minimizing impacts on prairie dog towns present in the vicinity. Information was also provided by the agency regarding additional sensitive species occurring in Carson County, Texas, including documentation of the possible presence of the swift fox (*Vulpes velox*) in the vicinity of Zone 4 West (see Table 3–35) (Breslin 1999). Preconstruction surveys and additional consultations with the USFWS and the Texas Parks and Wildlife Department would be conducted, if appropriate, to ensure that impacts on any sensitive animal and plant species living in the vicinity of Zone 4 are negligible, and that appropriate mitigation actions are implemented as needed. Mitigative measures might include the avoidance of species and their habitats entirely or just during critical timeframes (e.g., during breeding season), or the relocation of sensitive species away from areas likely to be disturbed. Appropriate mitigations would be coordinated with regulatory agencies as part of the consultation process.

4.26.3.3.2 Operations

Nonsensitive Habitat. Noise disturbance would probably be the most significant impact of routine operation of the proposed facilities on local wildlife populations. Disturbed individual members of local populations could migrate to adjacent areas of similar habitat. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters would be used (UC 1998e, 1998h). Impacts on aquatic habitats should be limited because all liquid,

nonhazardous sanitary wastes would be sampled, treated, and disposed of in accordance with approved permits and procedures (UC 1998e, 1998h).

Sensitive Habitat. Operational impacts on wetlands or other sensitive habitats would be unlikely because airborne and aqueous effluents would be controlled and permitted. It is also unlikely that any federally listed threatened or endangered species would be affected, although Texas State–classified special-status species could be affected by noise or human activity during operations, as discussed for construction.

Radiological impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded than any doses incurred would be well below Federal, State, and local regulatory limits (see Sections 4.26.3.1.2 and 4.26.3.2.2). Due to the very conservative approach used in assessing radiological impacts on the public, this is deemed to bound any exposures via subsistence agriculture, hunting, and fishing. Appendixes F and J detail the assessment protocol and the conservative data assumptions, respectively.

4.26.3.4 Cultural and Paleontological Resources

Prehistoric, historic, Native American, and paleontological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. The land area required for construction activities is fairly small, however, and any such resource disturbance would be minimized by confinement of much of the construction to previously disturbed or developed areas. Impacts of operations would be negligible because facility operations and security would restrict access to nearby prehistoric, historic, Native American, and paleontological resources. Continued compliance monitoring, before and after construction, would also help to limit or preclude impacts on these resources.

4.26.3.4.1 Construction

Siting the pit conversion and MOX facilities in new buildings in Zone 4 West at Pantex would disturb about 16.9 ha (42 acres). Some of this area would be used only temporarily during the 5-year construction and startup phases for the MOX facility (5.7 ha [14 acres]) (UC 1998h). Previously disturbed areas in Zone 4 West would be used for construction laydown for the pit conversion facility (2.0 ha [4.9 acres]) (UC 1998e). Zone 4 West at Pantex contains enough land area to accommodate the new buildings.

Surveys for prehistoric and historic archaeological resources have covered about 50 percent of the Pantex land area. As a consequence, two sites have been determined eligible for nomination to the National Register of Historic Places by the Texas State Historic Preservation Officer and the Advisory Council on Historic Preservation. Neither is in the vicinity of the proposed construction area. Further, the Texas State Historic Preservation Officer and the Advisory Council have determined that additional surveys are not required at Pantex (M&H 1997:26-27). Thus, there should be no impact on archaeological resources associated with the proposed construction.

Historic building surveys and recordings have been completed for World War II Era facilities remaining at Pantex and similar surveys are under way for the Cold War Era. Under the terms of a programmatic agreement among DOE, the Texas State Historic Preservation Officer, and the Advisory Council, all potential impacts on modifications of Pantex structures having historic potential require internal review and mitigation by DOE. No direct impacts on historic structures would result from the proposed construction (DOE 1996c; M&H 1997:27).

No known Native American resources have been, or are likely to be, identified at Pantex. No paleontological resources have been identified in Zone 4 West; thus, there should also be no direct impacts on such resources.

Given the absence of significant cultural or paleontological resources in the construction area and its environs, there should be no indirect impacts associated with the proposed construction. Preliminary consultations with appropriate American Indian Tribal Governments have been performed and are documented in Appendix O. These consultations indicate that it is unlikely that significant resources of concern to Native Americans would be damaged. Inadvertent discoveries of cultural resources would be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects).

4.26.3.4.2 Operations

Given the absence of significant cultural or paleontological resources in the vicinity of the proposed facilities, there should be no direct or indirect impacts of plutonium disposition facility operations.

4.26.3.5 Land Use and Visual Resources

Land resources (land use and visual resources) could be affected by construction and operation of the proposed surplus plutonium disposition facilities. The land-use impact analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and land values, and other socioeconomic factors pertaining to land use. Land-use impacts would vary from site to site depending on existing facility land-use configurations, adjoining land uses, and other environmental and containment factors. The visual resource impact analysis emphasized changes in the existing landscape character that could result from the proposed action. The visual resource assessment was based on the VRM methodology.

4.26.3.5.1 Construction

Land area requirements at Pantex under Alternative 9 or 10 would include sufficient land for the construction of the pit conversion and MOX facilities in Zone 4 West (UC 1998e, 1998h). Table 4–173 provides an estimate of the total footprint area required, in terms of newly disturbed land, for construction and operation of the proposed facilities. The land required for the construction of facilities in Zone 4 West for any of the Pantex alternatives would be about 16.9 ha (42 acres). This includes 9.2 ha (23 acres) of new building footprints, new parking lots, and security areas that would remain in use throughout operations.

Table 4–173. Maximum New Facility and Construction Area Requirements at Pantex

Land Requirement	Pit Conversion (New)	MOX (New)
Construction area[a] (ha)	2.0	5.7
New operational area (ha)	3.0	6.2

[a] For uses such as construction laydown, construction worker parking, and waste storage.

Source: UC 1998e, 1998h.

The remaining 7.7 ha (19 acres) would be needed temporarily during construction for laydown, temporary storage, and parking. Construction areas would not be used after the facilities became operational. Land area requirements for Alternative 9 or 10 would not be major, and no permanent loss of land would result from construction and operation of the surplus plutonium disposition facilities at Pantex.

4.26.3.5.2 Operations

The pit conversion and MOX facilities would be new buildings in Zone 4 West at Pantex. Land within Zone 4 West is currently disturbed and designated as industrial to support existing pit disassembly operations. Operation of the pit conversion and MOX facilities would conform to existing and future land uses as described in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996c:4-24, 4-25). About 0.4 km (0.2 mi) to the east of Zone 4 is the Playa 1 Management Unit. Neither this protected land management area nor any other special-status lands at Pantex would be affected by facility operations. There would also be no impact on Native American Treaty land-use rights from any of the Pantex alternatives.

The appearance of the new facilities within Zone 4 West would remain consistent with the zone's industrialized landscape character and a VRM Class IV designation. The proposed facilities would be the tallest and largest facilities in Zone 4 West and would be visible from U.S. Route 60. Nevertheless, while a stack with a height of 35 m (115 ft) would be the tallest structure in Zone 4, it would not be the tallest structure at Pantex, as discussed in Section 3.4.10.2.1. For purposes of this SPD EIS, the pit conversion facility stack height at each of the four candidate sites was assumed to be 35 m (115 ft). However, the exact height of the ventilation stack would be determined as part of the detailed design for the facility and would take into account the actual meteorological conditions expected at the site location. Construction and operation of the facilities would not effect a significant change in any natural features of visual interest in the area. The nearest sensitive viewpoint is the intersection of U.S. Route 60 and FM Road 2373, 2.4 km (1.5 mi) away.

4.26.3.6 Infrastructure

4.26.3.6.1 Construction

Existing Pantex infrastructure would be capable of supporting the construction requirements for the proposed facilities under Alternative 9 or 10. Construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Only 5.1 km (3.2 mi) of road would be required for construction deliveries and access to new and temporary facilities (UC 1998e, 1998h); this would not have a major impact. The total requirement for fuel oil during construction might be higher than current available storage, but the majority of fuel oil usage would be connected to construction vehicle usage; therefore, storage would not be limiting. Table 4–174 reflects estimates of additional annual infrastructure requirements for construction of the proposed facilities. Site resource availability and possible additional resource requirements are also presented.

4.26.3.6.2 Operations

Resources needed for operations under Alternative 9 or 10 are well within Pantex capacity. The total fuel oil requirement for emergency generator testing during operations might be higher than current site storage, but shortfalls could be met through additional procurements by normal contractual means. Table 4–175 reflects estimates of additional annual resources required for operation of the proposed facilities. Available site resources and possible additional operational requirements are also presented.

Table 4–174. Maximum Annual Additional Site Infrastructure Requirements for Construction in Zone 4 at Pantex

Resource	Facility Requirement			Availability[a]	Additional Requirement
	Pit Conversion	MOX	Total		
Transportation					
Roads (km)	3.1	2.0	5.1	76	5.1
Railroads (km)	0	0	0	27	0
Electricity					
Energy consumption (MWh/yr)	1,700	1,900	3,600	338,634	0
Peak load (MW)	1.0	2.5	3.5	110.4	0
Fuel					
Natural gas (m^3/yr)	NA	NA	NA	235,181,309	0
Oil (l/yr)	330,000	350,000	680,000	NA[b]	0
Coal (t/yr)	NA	NA	NA	NA[b]	0
Water (l/yr)	12,000,000	23,000,000	35,000,000	2,933,000,000	0

[a] Capacity minus current usage, a calculation based on data provided in Sections 3.4.11.1 and 3.4.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: DOE 1999c; ORNL 1998; UC 1998e, 1998h.

Table 4–175. Maximum Annual Additional Site Infrastructure Requirements for Operations in Zone 4 at Pantex

Resource	Facility Requirement			Availability[a]	Additional Requirement
	Pit Conversion	MOX	Total		
Transportation					
Roads (km)	0	0	0	76	0
Railroads (km)	0	0	0	27	0
Electricity					
Energy consumption (MWh/yr)	16,000	30,000	46,000	338,634	0
Peak load (MW)	4.0	5.2	9.2	110.4	0
Fuel					
Natural gas (m^3/yr)	1,300,000	1,100,000	2,400,000	235,181,309	0
Oil (l/yr)	38,000	63,000	101,000	NA[b]	0
Coal (t/yr)	NA	NA	NA	NA[b]	0
Water (l/yr)	48,000,000	68,000,000	116,000,000	2,933,000,000	0

[a] Capacity minus current usage, a calculation based on data provided in Sections 3.4.11.1 and 3.4.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: DOE 1999c; UC 1998e, 1998h.

4.26.4 SRS

For SRS, the maximum impacts on environmental resources would be experienced if Alternative 3 were implemented. Under Alternative 3, all the proposed surplus plutonium disposition facilities would be located in newly constructed buildings on the site. This alternative would require the maximum ground disturbance,

thereby maximizing the potential impacts on related resources such as geology and soils, ecological, and cultural. [Text deleted.] All the other SRS alternatives evaluated in this SPD EIS would require less new ground to be broken and less utility usage, so none would result in greater impacts than those associated with Alternative 3.

4.26.4.1 Geology and Soils

4.26.4.1.1 Construction

Construction of all the facilities in new buildings at SRS would have a negligible impact on the geologic and soil resources. In the *Storage and Disposition PEIS*, hazards of the large-scale geologic conditions at SRS were analyzed in detail. The analysis determined that these conditions pose an acceptable risk to the proposed long-term storage facilities. Review of the data and analyses presented in the *Storage and Disposition PEIS* and the site-specific information in this SPD EIS indicates that large-scale geologic conditions would likewise not impact the proposed surplus plutonium disposition facilities. This is based on the relatively low seismic risk of the area to properly designed facilities and the extremely improbable occurrence of any volcanic activity during the lifetime of the proposed facilities. The potential for other nontectonic events to affect the facilities is also low. More detailed descriptions of impacts of the potential geologic hazards at SRS are included in the *Storage and Disposition PEIS* (DOE 1996a:4-309–4-311).

The soils at SRS are considered suitable for standard construction techniques. No economically viable geologic resources have been identified at SRS. No soils at SRS are currently classified as prime farmlands.

4.26.4.1.2 Operations

Operation of all the facilities in new buildings at SRS would have negligible impacts on the geologic and soil resources as no operational-related ground disturbance is anticipated. As discussed above for construction, site geologic conditions are not expected to affect surplus plutonium disposition facilities.

Occurrence of all proposed actions at SRS would result in a very small annual incremental dose to the local public from normal operations via the deposition of airborne radioactive particulates on agricultural products, fisheries, and water sources (i.e., the Savannah River). This dose, about 1.6 person-rem/yr, would only be 0.0007 percent of the annual dose of natural background radiation.

Ingestion doses at SRS were assessed for 11 consumable categories: leafy vegetables, root vegetables, fruits, grains, milk, meat, poultry, eggs, fish, shellfish, and drinking water. Public doses incurred from the uptake of these sources were determined to be well below Federal, State, and local regulatory limits; therefore, potential radiological impacts on local farmlands, fisheries, and irrigation sources would be essentially nonexistent.

4.26.4.2 Water Resources

4.26.4.2.1 Construction

Surface water would not be used in the construction of proposed facilities at SRS (UC 1998c, 1998d, 1999c, 1999d). Thus, there would be no impact on the surface water availability to downstream users.

All wastewater would be treated in the sitewide treatment system, which has sufficient hydraulic and organic capacity to treat the flows expected from these activities. No impacts on surface water quality would be expected from the discharge of these flows to the treatment system and to the receiving stream (Sessions 1997).

Proven construction techniques would be used to mitigate the impact of soil erosion on receiving streams. Because of the effectiveness of these techniques, no long-term impacts from soil erosion due to construction activities would be expected.

The maximum estimated annual average water usage for constructing all the proposed facilities at SRS would be 128 million l (33.8 million gal) (DOE 1999c; ORNL 1998; UC 1998c, 1998d, 1999c, 1999d). Current water usage in F-Area is 374 million l/yr (98.8 million gal/yr). The total construction requirement thus represents approximately 32 percent of the F-Area groundwater capacity of about 1.6 billion l/yr (423 million gal/yr) (see Section 3.5.11.2, Table 3–49). No impact on water availability would be anticipated.

Wastewater would not be directly discharged to the groundwater (Sessions 1997:11); it would be treated in the Central Sanitary Wastewater Treatment Facility and subsequently discharged to surface water. Thus, no adverse impacts on groundwater quality are anticipated.

4.26.4.2.2 Operations

Surface water would not be used in the operation of the proposed facilities at SRS (UC 1998c, 1998d, 1999c, 1999d). Therefore, no impact on surface water availability to downstream users would be expected. As detailed above in Section 4.26.4.1.2, there would be a very small annual incremental dose to the local public from normal operations via the food ingestion and drinking water pathways, from the deposition of minute quantities of airborne particulates, and from any potential wastewater releases. It has also been estimated that a small fraction of this dose (about 0.10 person-rem/yr) would be specifically due to the consumption of aquatic biota (fish or crustaceans) and drinking water (i.e., from the Savannah River). This estimation is based on historical characteristics of F-Area releases to Savannah River outfalls. Nevertheless, public doses incurred from these sources were determined to be well below Federal, State, and local regulatory limits. As described in Section 4.4.2.2, wastewater would not be directly discharged to surface water but would be treated in the Central Sanitary Wastewater Treatment Facility, which has sufficient capacity to treat the wastewater flows from these activities. Because the plant would be able to treat these flows adequately to meet NPDES permit limitations, negligible impacts on surface water quality would be expected.

The maximum annual average water usage for operating these facilities has been estimated at 216 million l (57.1 million gal) (DOE 1999c; UC 1998c, 1998d, 1999c, 1999d). The combination of this volume and the current water usage of 374 million l/yr (98.8 million gal/yr) represents about 37 percent of the F-Area groundwater capacity of about 1.6 billion l/yr (423 million gal/yr). The water treatment system has an approved capacity to service this volume of water. Therefore, no impacts on water availability would be expected. There would be no direct discharge of wastewater to the groundwater. Therefore, no impacts on groundwater quality would be expected.

4.26.4.3 Ecological Resources

Ecological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. However, habitat disturbance would be minimal; land area required for construction activities is small in relation to regionally available habitat, and construction would take place largely in previously disturbed or developed areas. Operational impacts would also be minimal because facility emissions to the environment would be processed in accordance with applicable permitting procedures. Therefore, impacts on nonsensitive and sensitive habitats, plant and animal species, and the overall biodiversity of the candidate site would be minimal.

4.26.4.3.1 Construction

Nonsensitive Habitat. Siting the three proposed facilities in new buildings at SRS would disturb a total of about 32 ha (79 acres) of land adjacent to APSF, if built (UC 1998c, 1998d, 1999c, 1999d). Some of this land (12.4 ha [31 acres]) would be used temporarily during the 3.5-year construction phase for the immobilization facility, and some (5.7 ha [14 acres]) during the 5-year construction and startup phases for the MOX facility (UC 1998d, 1999c, 1999d). Previously disturbed areas in F-Area would be used for construction laydown for the pit conversion facility (2.0 ha [4.9 acres]) (UC 1998c). There should be no direct impacts on nonsensitive aquatic habitats as best-management practices for soil erosion and sediment control would be used to prevent construction runoff to these habitats, and direct construction disturbance would be avoided. It is estimated that 11.9 ha (29 acres) of woodlands and other vegetation in the construction area would be lost as terrestrial habitat. The associated animal populations would be affected. Some of the less-mobile or established animals within the construction zone could perish during land-clearing activities and from increased vehicular traffic. Furthermore, activities and noise associated with construction could cause larger mammals and birds to relocate to similar habitat in the area. Also, animal species inhabiting areas surrounding F-Area could be disturbed by the increased noise associated with construction activities, and the additional vehicular traffic could result in higher mortality for individual members of local animal populations. Prior to construction, the proposed sites would be surveyed for nests of migratory birds in accordance with the Migratory Bird Treaty Act. There would be no impacts on aquatic habitat from surface water consumption because water required for construction would be drawn from groundwater sources (UC 1998c, 1998d, 1999c, 1999d).

Sensitive Habitat. Wetlands associated with floodplains, streams, and impoundments should not be directly impacted by construction activities. No critical habitat for any threatened or endangered species exists on SRS. However, the bald eagle, red-cockaded woodpecker, wood stork, American alligator, smooth purple coneflower, and Oconee azalea might occur near F-Area (DOE 1995c:3-37; 1996a:3-245). Consultations were initiated by DOE with the USFWS and the South Carolina Department of Natural Resources to request comments on potential impacts on animal and plant species and asking for any additional sensitive species information. The USFWS Charleston, South Carolina, field office provided a written response indicating that the proposed facilities at SRS do not appear to present a substantial risk to federally listed species or other species of concern. That office also provided additional information concerning listed species and species of concern occurring in the vicinity of SRS (EuDaly 1998). Preconstruction surveys and additional consultations with the USFWS and the South Carolina Department of Natural Resources would be conducted, if appropriate, to ensure that impacts on any sensitive animal and plant species living in the vicinity of F-Area are negligible, and that appropriate mitigation actions are implemented as needed. Mitigative measures might include the avoidance of species and their habitats entirely or just during critical timeframes (e.g., during breeding season), or the relocation of sensitive species away from areas likely to be disturbed. Appropriate mitigations would be coordinated with regulatory agencies as part of the consultation process.

4.26.4.3.2 Operations

Nonsensitive Habitat. Noise disturbance would probably be the most significant impact of routine operation of the three facilities on local wildlife populations. Disturbed individual members of local populations could migrate to adjacent areas of similar habitat. However, impacts associated with airborne releases of criteria pollutants, hazardous and toxic air pollutants, and radionuclides would be unlikely because scrubbers and filters would be used (UC 1998c, 1998d, 1999c, 1999d). Impacts on aquatic habitats should be limited because all liquid, nonhazardous sanitary wastes would be sampled, treated, and disposed of in accordance with approved permits and procedures (UC 1998c, 1998d, 1999c, 1999d).

Sensitive Habitat. Operational impacts on wetlands or other sensitive habitats would be unlikely because airborne and aqueous effluents would be controlled and permitted. It is also unlikely that any federally listed

threatened or endangered species would be affected, although South Carolina State–classified special-status species could be affected by noise or human activity during operations, as discussed for construction.

Radiological impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded than any doses incurred would be well below Federal, State, and local regulatory limits (see Sections 4.26.4.1.2 and 4.26.4.2.2). Due to the very conservative approach used in assessing radiological impacts on the public, this is deemed to bound any exposures via subsistence agriculture, hunting, and fishing. Appendixes F and J detail the assessment protocol and the conservative data assumptions, respectively.

4.26.4.4 Cultural and Paleontological Resources

Prehistoric, historic, Native American, and paleontological resources could be impacted by construction and operation of the proposed surplus plutonium disposition facilities. The land area required for construction activities is fairly small, however, and any such resource disturbance would be minimized as much of the construction would take place in previously disturbed or developed areas. Impacts of operations would be negligible because facility operations and security would restrict access to nearby prehistoric, historic, Native American, and paleontological resources. Continued compliance monitoring, before and after construction, would also help to limit or preclude impacts on these resources.

4.26.4.4.1 Construction

Siting all facilities in new buildings at SRS would disturb a total of about 32 ha (79 acres) of land adjacent to the area designated for APSF (UC 1998c, 1998d, 1999c, 1999d). Some of this land (12.4 ha [31 acres]) would be used temporarily during the 3.5-year construction phase for the immobilization facility, and some (5.7 ha [14 acres]) during the 5-year construction and startup phases for the MOX facility (UC 1998d, 1999c, 1999d). Previously disturbed areas in F-Area would be used for construction laydown for the pit conversion facility (2.0 ha [4.9 acres]) (UC 1998c).

Archaeological investigations near F-Area have discovered five sites that could be impacted by the construction of surplus plutonium disposition facilities. At least two of these sites have been recommended to the South Carolina State Historic Preservation Officer (SHPO) as eligible for nomination to the National Register of Historic Places. It appears that these sites were occupied during several different prehistoric periods, including the Late Woodland (A.D. 800–1000) and Mississippian (A.D. 1000–1600) Periods. These periods are poorly understood in the Central Savannah River Area. Therefore, these sites could contribute significantly to a better understanding of the Late Woodland and Mississippian Periods in this part of North America. Potential adverse impacts on these sites could be mitigated through either avoidance or data recovery (SRARP 1997:5; Stephenson and King 1999). DOE currently plans to mitigate impacts by avoiding these sites. All cultural resource compliance activities would be conducted in accordance with the *Programmatic Memorandum of Agreement for the Savannah River Site* (SRARP 1989:179–188).

There should be no direct impacts on historic resources associated with the Cold War Era. A historical review of SRS was initiated in 1996 and will continue for several years. An assessment of two buildings (Buildings 217–F and 701–5F) located within the proposed construction area indicates neither structure meets the age nor architectural uniqueness criteria for eligibility to the National Register (Reed 1997). No Native American cultural sites or paleontological sites are known to exist within the proposed construction area. In addition, no indirect impacts on prehistoric, historic, Native American, or paleontological resources are expected to occur under this alternative.

Preliminary consultations with appropriate American Indian Tribal Governments and the SHPO have been performed and are documented in Appendix O. The South Carolina SHPO response noted that if Alternative 3 (DOE's preferred alternative) is selected, further consultations would be required. In response to concerns about cultural resources present in the area proposed for the location of the disposition facilities, additional cultural resource surveys were performed as discussed above. The results of these surveys are being incorporated into a letter of recommendation to the South Carolina SHPO (Stephenson and King 1999). Consultations with Native American groups indicate that it is unlikely that significant Native American resources would be damaged. Inadvertent discoveries of cultural resources would be handled in accordance with 36 CFR 800.11 (historic properties) or 43 CFR 10.4 (Native American human remains, funerary objects, objects of cultural patrimony, and sacred objects).

4.26.4.4.2 Operations

There should be no direct impacts on prehistoric, historic, Native American, or paleontological resources associated with operation of the proposed facilities. Once the facilities were operational, no direct land disturbance or other action with impact potential would be conducted beyond the facility's perimeter fence.

There also should be no indirect impacts on prehistoric, historic, Native American, or paleontological resources associated with operation of the proposed facilities. Once the facilities were operational, access to, and the integrity of, resources beyond the direct impact area would not be affected.

4.26.4.5 Land Use and Visual Resources

Land resources (land use and visual resources) could be affected by construction and operation of the proposed surplus plutonium disposition facilities. The land-use impact analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends and land values, and other socioeconomic factors pertaining to land use. Land-use impacts would vary from site to site depending on existing facility land-use configurations, adjoining land uses, and other environmental and containment factors. The visual resource impact analysis emphasized changes in the existing landscape character that could result from the proposed action. The visual resource assessment was based on the VRM methodology.

4.26.4.5.1 Construction

SRS has sufficient land for the construction of the new facilities and APSF, if built, in F-Area, and the use of DWPF in S-Area (UC 1998c, 1998d, 1999c, 1999d). Table 4–176 provides an estimate for the total footprint area required, in terms of newly disturbed land, for construction and operation of the proposed facilities.

Table 4–176. Maximum New Facility and Construction Area Requirements at SRS

Land Requirement	Pit Conversion (New)	Immobilization (New)	MOX (New)
Construction area[a] (ha)	2.0	12.4	5.7
New operational area (ha)	3.0	2.7	6.2

[a] For uses such as construction laydown, construction worker parking, and waste storage.
Source: UC 1998c, 1998d, 1999c, 1999d.

The land required for the construction of facilities in F-Area for Alternative 3 would be about 32 ha (79 acres). This includes about 11.9 ha (29 acres) of new building footprints, new parking lots, and security areas that would remain in use throughout operations.

The remaining 20.1 ha (50 acres) would be needed temporarily during construction for laydown, temporary storage, and parking. Construction areas would not be used after the facilities became operational. A number of these construction areas exist within F-Area but are currently inactive. F-Area has ample space available for construction (UC 1998d). Land area requirements for Alternative 3 would not be major, and no permanent loss of land use would result from construction and operation of the proposed facilities at SRS.

4.26.4.5.2 Operations

All of the proposed facilities would be in new buildings adjacent to APSF, if built, in F-Area at SRS. Land in and around F-Area is currently disturbed and designated as industrial. Operation of the pit conversion, immobilization, and MOX facilities in and around F-Area, and use of DWPF in S-Area, would conform to existing heavy industrial land use and future land uses as described in the *Savannah River Site Future Use Project Report* (DOE 1996h:7–9). Because surplus plutonium disposition activities would be located in and around developed areas of the site, other SRS land uses or special-status lands would not be affected. Likewise, it is unlikely that there would be impacts on Native American Treaty land-use rights from any of the SRS alternatives.

The appearance of new facilities in and adjacent to F-Area would remain consistent with this area's industrialized landscape character and a VRM Class IV designation. In height and size, the proposed facilities would be similar to existing buildings in F-Area. Facilities are generally not visible off the site because views are limited by rolling terrain and heavy vegetation. Construction and operation of the surplus plutonium disposition facilities would not effect a major change in any natural features of visual interest in the area. The nearest sensitive viewpoints are those on State Route 125 and SRS Road 1, 7 km (4.3 mi) and 8.5 km (5.3 mi) away, respectively.

4.26.4.6 Infrastructure

4.26.4.6.1 Construction

[Text deleted.] Construction would require only a fraction of the available resources and thus would not jeopardize the resources required to operate the site. Only 4.4 km (2.7 mi) of road would be required for construction deliveries and access to new and temporary facilities (UC 1998c, 1998d, 1999c, 1999d); this would not have a major impact. Total construction requirements for fuel oil might be higher than currently available storage, but the majority of fuel oil usage would be connected to construction vehicle usage; therefore, storage would not be limiting. Table 4–177 reflects estimates of the additional annual infrastructure requirements for construction of the proposed facilities. Site resource availability and possible additional resource requirements are also presented.

4.26.4.6.2 Operations

[Text deleted.] The total fuel oil requirement for emergency generator testing during operations might be higher than current site storage, but shortfalls could be met through additional procurements by normal contractual means. Table 4–178 reflects estimates of additional annual resources required for operation of the proposed facilities. Available site resources and possible additional operational requirements are also presented.

Table 4–177. Maximum Annual Additional Site Infrastructure Requirements for Construction in F-Area at SRS

Resource	Facility Requirement				Availability[a]	Additional Requirement
	Pit Conversion	Immobilization	MOX	Total		
Transportation						
Roads (km)	1.8	0.6	2.0	4.4	230	4.4
Railroads (km)	0	0	0	0	103	0
Electricity						
Energy consumption (MWh/yr)	1,700	9,000	1,900	12,600	482,700	0
Peak load (MW)	1.0	2.7	2.1	5.8	49.5	0
Fuel						
Natural gas (m^3/yr)	NA	NA	NA	NA	NA	0
Oil (l/yr)	330,000	1,300,000	350,000	1,980,000	NA[b]	0
Coal (t/yr)	NA	510	NA	510	NA[b]	0
Water (l/yr)	12,000,000	93,000,000	23,000,000	128,000,000	1,216,000,000	0

[a] Capacity minus current usage, a calculation based on data provided in Sections 3.5.11.1 and 3.5.11.2.
[b] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: DOE 1999c; ORNL 1998; UC 1998c, 1998d, 1999c, 1999d.

Table 4–178. Maximum Annual Additional Site Infrastructure Requirements for Operations in F-Area at SRS

Resource	Facility Requirement				Availability[b]	Additional Requirement
	Pit Conversion	Immobilization[a]	MOX	Total		
Transportation						
Roads (km)	0	0	0	0	230	0
Railroads (km)	0	0	0	0	103	0
Electricity						
Energy consumption (MWh/yr)	16,000	23,000	30,000	69,000	482,700	0
Peak load (MW)	4.0	3.5	5.2	12.7	49.5	0
Fuel						
Natural gas (m^3/yr)	NA	NA	NA	NA	NA	0
Oil (l/yr)	38,000	69,000	63,000	170,000	NA[c]	0
Coal (t/yr)	2,400	1,200	890	4,490	NA[c]	0
Water (l/yr)	48,000,000	100,000,000	68,000,000	216,000,000	1,216,000,000	0

[a] Data reflect the higher of the requirements for ceramic and glass.
[b] Capacity minus current usage, a calculation based on data provided in Sections 3.5.11.1 and 3.5.11.2.
[c] Not applicable due to the ability to procure additional resources.
Key: NA, not applicable.
Source: DOE 1999c; UC 1998c, 1998d, 1999c, 1999d.

4.27 LEAD ASSEMBLYAND POSTIRRADIATION EXAMINATION ALTERNATIVES

Five sites have been proposed for domestic fabrication of lead assemblies. Those sites are LLNL, LANL, and three of the four candidate sites for the proposed surplus plutonium disposition activities: Hanford, INEEL (the ANL–W facilities are being considered), and SRS. Pantex was not included as a candidate site for lead assembly fabrication because it does not currently have any plutonium-processing facilities. After irradiation in a domestic, commercial reactor, the lead assemblies would be examined at a postirradiation examination facility at ANL–W or Oak Ridge National Laboratory (ORNL).

Impacts from lead assembly and postirradiation examination activities are based on the fabrication of 10 assemblies. If less than 10 lead assemblies were fabricated, most of the impacts would be lower than those presented in this SPD EIS. Impacts from facility modifications would not be expected to change because the facility modifications would be the same regardless of the number of assemblies produced. Impacts from routine operations such as resources used, personnel and public exposure, hazardous chemcial impacts, waste generation, and transportation would be expected to be reduced in proportion to the number of assemblies produced. The consequences of facility and transportation accidents would be expected to remain the same because the material at risk at any one time would likely not change. However, the risk of these accidents occurring would be reduced as the number of lead assemblies decreased.

4.27.1 ANL–W

4.27.1.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at ANL–W would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at ANL–W and would result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating the existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at ANL–W and INEEL. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly facility would be smaller than the levels shown in Table 4–104, and the concentrations at the site boundary would continue to meet ambient air quality standards. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less than 0.001 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAPs limit.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic associated with operating these facilities would be a small fraction of the existing traffic associated with activities at ANL–W and should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment would be similar to noise from existing ventilation equipment.

4.27.1.2 Waste Management

Table 4–179 compares the waste generated during modification of facilities for lead assembly fabrication at ANL–W with the existing treatment, storage, and disposal capacity for the various waste types. LLW would be generated during modification of contaminated areas of FMF and ZPPR, although no TRU, mixed, or hazardous waste is expected to be generated. Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at INEEL or at other DOE sites or commercial facilities. For this SPD EIS, it is assumed that waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–179. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at ANL–W

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
LLW	18	<1	<1	<1
Nonhazardous				
Liquid	37	NA	NA	1
Solid	11	NA	NA	<1

[a] See definitions in Appendix F.8.
[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.
Key: ANL–W, Argonne National Laboratory–West; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated and stored on the site).

LLW would be packaged, certified, and accumulated at the modification site before transfer for treatment and disposal in existing ANL–W and INEEL facilities. A total of 36 m^3 (47 yd^3) of LLW would be generated over the modification period. LLW generated during modification of facilities for lead assembly fabrication is estimated to be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) treatment capacity of WERF, less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity of RWMC, and less than 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of RWMC. Using the 6,264-m^3/ha (3,316-yd^3/acre) disposal land usage factor for RWMC published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 36-m^3 (47 yd^3) of waste would require less than 0.1 ha (0.25 acre) of disposal space. Therefore, impacts of the management of this additional LLW at ANL–W and INEEL should not be major.

Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication would be packaged in conformance with standard industrial practice and would be disposed of in the onsite Central Facilities Area landfill complex, or shipped to offsite facilities for recycling. Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication is estimated to be less than 1 percent of the 48,000-m^3 (62,800-yd^3) capacity of the Central Facilities Area landfill complex. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at ANL–W and INEEL.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be managed at the ANL–W sewage treatment facility. Nonhazardous liquid waste generated during modification of these facilities is estimated to be 1 percent of the 6,057-m^3/yr (7,923-yd^3/yr) capacity of the ANL–W sewage treatment facility. Therefore, management of these wastes at ANL–W should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–180 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from lead assembly fabrication at ANL–W. No HLW would be generated by lead assembly fabrication.

Table 4–180. Potential Waste Management Impacts of Operation of Lead Assembly Facility at ANL–W

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	1	<1	<1 of WIPP
LLW	200	<1	1	1
Mixed LLW	1	<1	<1	NA
Hazardous	<1	NA	<1	NA
Nonhazardous				
Liquid	1,600	NA	NA	26[d]
Solid	1,300	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation on an annual basis. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities would not generate remotely handled TRU waste.
[d] Percent of the capacity of the ANL–W sewage treatment facility.
Key: ANL–W, Argonne National Laboratory–West; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at INEEL or at other DOE sites or commerical facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored on the site until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated and disposed of at offsite commercial facilities. This SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at INEEL are described in the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final EIS* (DOE 1995a).

TRU wastes would be treated, packaged, and certified to WIPP waste acceptance criteria at the facilities for lead assembly fabrication. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned Waste Characterization Facility at INEEL.

TRU waste generated by lead assembly fabrication at ANL–W is estimated to be 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all the TRU waste were to be stored at INEEL, this would be less than 1 percent of the 177,300 m^3 (231,900 yd^3) storage capacity available at RWMC. Impacts of the management of additional quantities of TRU waste at ANL–W and INEEL should not be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d) and the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facility before transfer for treatment, storage, and disposal in existing ANL–W or INEEL facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated during the 3-year operation period. LLW generated during lead assembly fabrication is estimated to be less than 1 percent of the 49,610-m^3/yr (64,890-yd^3/yr) treatment capacity of WERF, 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity of RWMC, and 1 percent of the 37,700-m^3/yr (49,300-yd^3/yr) disposal capacity of RWMC. Using the 6,264-m^3/ha (3,316-yd^3/acre) disposal land usage factor for RWMC published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.11 ha (0.27 acre) of disposal space at RWMC. Therefore, impacts of the management of this additional LLW at ANL–W and INEEL should not be major.

Mixed LLW would be stabilized, packaged, and stored for treatment and disposal in a manner consistent with the site treatment plan. At INEEL, mixed LLW is currently treated on the site with some waste shipped to Envirocare of Utah for disposal. INEEL is planning a new facility for onsite disposal of mixed LLW. Mixed LLW generated by lead assembly fabrication is estimated to be less than 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) planned capacity of the Advanced Mixed Waste Treatment Project and less than 1 percent of the 112,400-m^3 (147,000-yd^3) storage capacity of RWMC. Therefore, the management of this additional waste at ANL–W and INEEL should not have a major impact on the mixed LLW management system.

Any hazardous waste generated during lead assembly fabrication at ANL–W would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. Hazardous waste generated by lead assembly fabrication is estimated to be less than 1 percent of the 1,600-m^3 (2,090-yd^3) capacity of the hazardous waste storage buildings. Therefore, the management of these additional hazardous wastes at ANL–W and INEEL should not have a major impact on the hazardous waste management system.

If all the TRU waste and mixed LLW generated by lead assembly fabrication at ANL–W is processed in the planned Advanced Mixed Waste Treatment Project, this additional waste would be 1 percent of the 6,500-m^3/yr (8,500-yd^3/yr) capacity of the facility. If all TRU waste, LLW, and mixed LLW generated by lead assembly fabrication is stored at RWMC, this additional waste would be 1 percent of the 112,400-m^3 (147,000-yd^3) capacity of the facility. If all LLW and hazardous waste generated by lead assembly fabrication is treated at WERF, this additional waste would be less than 1 percent of the 49,610-m^3 (64,890-yd^3) capacity of the facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent off the site for disposal in the Bonneville County Landfill. This additional waste load should not have a major impact on the nonhazardous solid waste management systems at ANL–W and INEEL.

Nonhazardous wastewater generated by lead assembly fabrication would be treated, if necessary, before being discharged to the ANL–W sewage treatment facility. Nonhazardous liquid waste generated by lead assembly fabrication is estimated to be 26 percent of the 6,057-m^3/yr (7,923-yd^3/yr) capacity of the ANL–W sewage treatment facility. Therefore, management of nonhazardous liquid waste at ANL–W should not have a major impact on the wastewater treatment system.

4.27.1.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification and operation of the facilities for the proposed lead assembly program. Proposed activities would use existing facilities, therefore, all required utility connections are in existence. See Table 3–51 for current infrastructure characteristics at ANL–W. To support the lead assembly fabrication, annual electricity requirements at ANL–W are estimated to increase by 720 MWh. Current annual electrical usage at ANL–W is 4,200 MWh, with a site capacity of 7,000 MWh. Additional annual fuel requirements are estimated to be 49,200 l (13,000 gal) of diesel fuel for heating and 4,600 l (1,215 gal) of diesel oil for emergency generators. Fuel is procured on the site on an as-needed basis. Annual total water usage for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). No surface water requirements are expected for the facility. Current annual water usage at ANL–W is 1.5 million l (396,000 gal), while the current capacity is 15 million l (4 million gal). Even though the amount of water needed at the site would effectively double, it would still be less than 25 percent of the water available. Thus, there would not be any major impacts on infrastructure should the decision be made to conduct the proposed lead assembly program at ANL–W (O'Connor et al. 1998a).

4.27.1.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at ANL–W. Moreover, doses to construction workers should not exceed the normally low levels attributable to routine occupancy. Nonetheless, construction workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

Table 4–181 reflects the potential radiological impacts of normal operations on three individual receptor groups at ANL–W: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–181. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at ANL–W

Population within 80 km for year 2005	
Dose (person-rem/yr)	0.011
Percent of natural background[a]	1.2×10^{-5}
Associated latent fatal cancers	5.5×10^{-6}
Maximally exposed individual	
Annual dose (mrem/yr)	9.4×10^{-4}
Percent of natural background[a]	2.6×10^{-4}
Associated latent fatal cancer risk	4.7×10^{-10}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	4.4×10^{-5}
Associated latent fatal cancer risk	2.2×10^{-11}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 90,600 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2005 (251,500).

Key: ANL–W, Argonne National Laboratory–West.

Source: Appendix J.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 0.011 person-rem. The corresponding number of LCFs in the population around ANL–W from annual operation of the facility would be 5.5×10^{-6}. The total dose to the maximally exposed member of the public from annual operation would be 9.4×10^{-4} mrem; this corresponds to an LCF risk of 4.7×10^{-10}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–182; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–182. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at ANL–W

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Key: ANL–W, Argonne National Laboratory–West.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998a.

Hazardous Chemical Impacts. No hazardous chemical releases would be expected as a result of modification and operation activities.

4.27.1.5 Facility Accidents

Given the estimated 1,517 person-days of construction labor and standard industrial accident rates, about 0.60 cases of nonfatal occupational injury or illness and 8.4×10^{-4} fatality would be expected. DOE-required industrial safety programs would be in place to reduce the risks.

The potential consequences of postulated bounding facility accidents from lead assembly fabrication activities at ANL–W are presented in Table 4–183. The most severe consequences of a design basis accident would be associated with a nuclear criticality. Radiological consequences of the criticality for the MEI would include a dose of 4.9×10^{-3} rem, corresponding to an LCF probability of 2.5×10^{-6}. Among the general population off the site, an estimated 1.7×10^{-4} LCF could occur as a result of a criticality. The frequency of this accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year. This accident would also be expected to be more severe than any accident associated with postirradiation examination activities that could be conducted at ANL–W (see Section 4.27.6.2).

Consistent with the analysis presented in the *Storage and Disposition PEIS*, the noninvolved worker is a hypothetical individual working on the site but not involved in the proposed action, and assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be

Table 4–183. Accident Impacts of Lead Assembly Fabrication at ANL–W

		Impacts on Noninvolved Worker		Impact at Site Boundary		Impacts on Population Within 80 km	
Accident	**Frequency (per year)**	**Dose (rem)[a]**	**Probability of Cancer Fatality[b]**	**Dose (rem)[a]**	**Probability of Cancer Fatality[b]**	**Dose (person-rem)[a]**	**Latent Cancer Fatalities[c]**
Criticality	Extremely unlikely	7.7×10^{-2}	3.1×10^{-5}	4.9×10^{-3}	2.5×10^{-6}	3.4×10^{-1}	1.7×10^{-4}
Design basis earthquake	Unlikely	1.7×10^{-4}	6.8×10^{-8}	7.7×10^{-6}	3.9×10^{-9}	2.7×10^{-3}	1.4×10^{-6}
Design basis fire	Unlikely	7.4×10^{-5}	2.9×10^{-8}	3.3×10^{-6}	1.7×10^{-9}	1.2×10^{-3}	5.9×10^{-7}
Design basis explosion	Extremely unlikely	1.2×10^{-3}	4.8×10^{-7}	5.4×10^{-5}	2.7×10^{-8}	1.9×10^{-2}	9.6×10^{-6}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	7.4×10^{1}	3.0×10^{-2}	2.8	1.4×10^{-3}	7.9×10^{2}	3.9×10^{-1}
Beyond-evaluation-basis fire	Beyond extremely unlikely	1.7×10^{-1}	6.6×10^{-5}	6.2×10^{-3}	3.1×10^{-6}	1.8	8.7×10^{-4}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

Key: ANL–W, Argonne National Laboratory–West.

the highest during the nuclear criticality. The consequences of such an accident would include an LCF probability of 3.1×10^{-5}.

Given total facility collapse as a result of the beyond-design-basis earthquake, the radiological effects from the proposed activities would be 3.9×10^{-1} LCF in the population residing within 80 km (50 mi) of ANL–W. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the

decisions made in the SPD EIS ROD, site emergency management programs would be modified as appropriate to consider any new accidents not in the current program.

4.27.1.6 Transportation

Plutonium dioxide would be shipped from LANL to lead assembly fabrication facilities at ANL–W. These facilities would also receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to the McGuire reactor for irradiation.[37] After irradiation, selected fuel rods would be shipped to the postirradiation examination site. Approximately 30 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 77,000 km (48,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.4 person-rem; the dose to the public, 9.6 person-rem. Accordingly, incident-free transportation of radioactive material would result in 5.6×10^{-4} LCF among transportation workers and 4.8×10^{-3} LCF in the total affected population over the duration of the transportation activities. (LCFs associated with radiological releases were estimated by multiplying the occupational [worker] dose by 4.0×10^{-4} cancer per person-rem of exposure, and the public accident and accident-free dose by 5.0×10^{-4} cancer per person-rem of exposure [ICRP 1991].) The estimated number of nonradiological fatalities from vehicular emissions would be 2.4×10^{-4}.

Impacts of Accidents During Transportation. Estimates of the total ground transportation accident risks follow: a radiological dose to the population of 5.4 person-rem, resulting in a total population risk of 2.7×10^{-3} LCF; and traffic accidents resulting in 1.8×10^{-3} traffic fatality.

4.27.1.7 Other Resource Areas

Other resource areas include geology and soils, water resources and floodplains, ecological resources (including threatened and endangered species, biodiversity, and wetlands), cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected on any of these resource areas. Impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. Potential radiological impacts on members of the public resulting from routine lead assembly fabrication activities and from facility accidents are assessed in the preceding sections. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded that doses incurred by members of the public during routine operations would not be expected to result in any additional LCFs. As for accidents, the longer-term effects of plutonium deposited on the ground and surface waters after the accident, including the resuspension and inhalation of plutonium and the ingestion of contaminated crops, have been studied and been found not to contribute as significantly to dosage as inhalation. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances (as much as two orders of magnitude at the 80 km [50 mi] limit). Due to the very conservative approach used in assessing radiological impacts on the public, this bounds (i.e., provides the maximum for) any

[37] Based on information provided by DCS, DOE has identified McGuire as its preference for irradiating lead assemblies.

exposures via subsistence agriculture, hunting, and fishing. Appendixes F, J, and K detail the assessment protocol and the conservative data assumptions, respectively.

4.27.1.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, routine operations associated with lead assembly fabrication at ANL–W would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of ANL–W would be 5.5×10^{-6}; thus, no additional LCFs would be expected (see Table 4–181). Transportation related to these activities would not be expected to result in any LCFs either (see Section 4.27.1.6). The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 2.7×10^{-3} due to radiological impacts, by 3.0×10^{-4} due to emissions, and by 1.8×10^{-3} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.1.6). Risks posed by the implementation of the ANL–W alternative for lead assembly fabrication would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at ANL–W would pose no significant risks to the public or to groups within the public, including the risk of disproportionately high and adverse effects on minority or low-income populations.

4.27.2 Hanford

4.27.2.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at Hanford would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary. However, occasional exceedances of the PM_{10} and total suspended particulate standards would likely continue from natural sources.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at Hanford and would result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating the existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at Hanford. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly facility would be smaller than the levels shown in Table 4–84, and the concentrations at the site boundary would continue to meet ambient air quality standards. However, occasional exceedances of the PM_{10} and total suspended particulate standards would likely continue from natural sources. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less than 0.001 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAPs limit.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic noise associated with operating these facilities would be a small fraction of the existing traffic associated with activities at Hanford and

should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment would be similar to noise from existing ventilation equipment.

4.27.2.2 Waste Management

Table 4–184 compares the waste generated during modification of facilities for lead assembly fabrication at Hanford with the existing treatment, storage, and disposal capacity for the various waste types. No TRU waste, LLW, mixed LLW, or hazardous waste would be generated during modification. This SPD EIS also assumes that nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–184. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Nonhazardous				
Liquid	15	<1	NA	<1
Solid	50	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.
Key: NA, not applicable (i.e., it is assumed that the majority of the nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at Hanford.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be discharged to the sewer system in the 400 Area. Nonhazardous liquid waste generated during modification of these facilities is estimated to be less than 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, less than 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the Energy Northwest (formerly WPPSS) Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the Energy Northwest Sewage Treatment Facility (Mecca 1997). Therefore, management of these wastes at Hanford should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–185 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from lead assembly fabrication activities at Hanford. No HLW would be generated during lead assembly fabrication.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at Hanford or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored on the site until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated and disposed of at offsite commercial facilities. This SPD EIS also assumes

Table 4–185. Potential Waste Management Impacts of Operation of Lead Assembly Facility at Hanford

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	2	1	<1 of WIPP
LLW	200	NA	NA	<1
Mixed LLW	1	<1	<1	<1
Hazardous	<1	NA	NA	NA
Nonhazardous				
Liquid	1,600	1[d]	NA	1[e]
Solid	1,300	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation annually. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities would not generate remotely handled TRU waste.
[d] Percent of capacity of the 400 Area sanitary sewer.
[e] Percent of capacity of the Energy Northwest (formerly Washington Public Power Supply System) Sewage Treatment Facility.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts on treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at Hanford will be evaluated in the *Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS*, which is being prepared by the DOE Richland Operations Office (DOE 1997b).

TRU wastes would be packaged and certified to WIPP waste acceptance criteria at the lead assembly fabrication facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Waste Receiving and Processing Facility at Hanford.

TRU waste generated by lead assembly fabrication is estimated to be 2 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all of the TRU waste had to be stored on the site, this would be 1 percent of the 17,000-m^3 (2,220-yd^3) storage capacity available at Hanford. Therefore, impacts of the management of additional quantities of TRU waste at Hanford should not be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d) and the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facility before transfer for disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generated by lead assembly fabrication is estimated to be less than 1 percent of the 1,740,000-m^3 (2,280,000-yd^3) capacity of the LLW Burial Grounds and less than 1 percent of the 230,000-m^3 (301,000-yd^3) capacity of the Grout Vaults. Using the 3,480-m^3/ha (1,842-yd^3/acre) disposal land usage factor for Hanford published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would

require 0.2 ha (0.49 acre) of disposal space at Hanford. Therefore, impacts of the management of this additional LLW at Hanford should not be major.

Mixed LLW would be packaged and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for Hanford. Mixed LLW generated by lead assembly fabrication is estimated to be less than 1 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the Waste Receiving and Processing Facility, less than 1 percent of the 16,800-m^3 (22,000-yd^3) storage capacity of the Central Waste Complex, and less than 1 percent of the 14,200-m^3 (18,600-yd^3) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, the management of this additional waste at Hanford should not have a major impact on the mixed LLW management system.

If all TRU waste and mixed LLW generated by lead assembly fabrication were processed in the Waste Receiving and Processing Facility, this additional waste would be 2 percent of the 1,820-m^3/yr (2,380-yd^3/yr) capacity of the facility, and therefore should not have a major impact on this facility.

The small quantity of hazardous waste generated during operations would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the operations period should not have a major impact on the Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent offsite for recycling. The remaining solid sanitary waste would be sent for disposal in the Richland Sanitary Landfill. This additional waste load should not have a major impact on the nonhazardous solid waste management system at Hanford.

To be conservative, it was assumed that all nonhazardous wastewater generated by lead assembly fabrication at Hanford would be managed in the 400 Area. Nonhazardous wastewater would be treated, if necessary, before being discharged to the 400 Area sanitary sewer system, which connects to the Energy Northwest (formerly WPPSS) Sewage Treatment Facility. Nonhazardous liquid waste generated by lead assembly fabrication is estimated to be 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the 400 Area sanitary sewer, 1 percent of the 235,000-m^3/yr (307,000-yd^3/yr) capacity of the Energy Northwest Sewage Treatment Facility, and within the 138,000-m^3/yr (181,000-yd^3/yr) excess capacity of the Energy Northwest Sewage Treatment Facility (Mecca 1997). Therefore, management of additional nonhazardous liquid waste at Hanford should not have a major impact on the wastewater treatment system.

4.27.2.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification and operation of the facilities for the proposed lead assembly program. Proposed activities would use the existing space at the Fuel Assembly Area, appended to FMEF, in Hanford's 400 Area; therefore, all utility connections are in existence. See Table 3–13 for additional information on the infrastructure characteristics at FMEF. To support lead assembly fabrication, annual electricity requirements are calculated to increase by 1,230 MWh; this includes 514 MWh for heating. Current annual electrical usage at FMEF is 7,300 MWh, with a capacity of 61,000 MWh. An estimated 4,600 l (1,215 gal) of diesel oil for emergency generators is also required. Fuel is procured on the site on an as-needed basis. Annual total water usage for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). Current water usage is 41.7 million l (11 million gal), while capacity is 400 million l (105 million gal). There would not be any major impacts on infrastructure should the decision be made to conduct the proposed lead assembly program at the Fuel Assembly Area at FMEF (Mecca 1997; O'Connor et al. 1998b:27).

4.27.2.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at Hanford. Moreover, doses to construction workers should not exceed the normally low levels attributable to routine occupancy (Antonio 1998). Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

Table 4–186 reflects the potential radiological impacts of normal operations on three individual receptor groups at Hanford: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–186. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at Hanford

Population within 80 km for year 2005	
Dose (person-rem/yr)	0.025
Percent of natural background[a]	2.3×10^{-5}
Associated latent fatal cancers	1.2×10^{-5}
Maximally exposed individual	
Annual dose (mrem/yr)	3.4×10^{-4}
Percent of natural background[a]	1.1×10^{-4}
Associated latent fatal cancer risk	1.7×10^{-10}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	7.0×10^{-5}
Associated latent fatal cancer risk	3.5×10^{-11}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 107,400 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2005 (358,100).
Source: Appendix J.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 0.025 person-rem. The corresponding number of LCFs in the population around Hanford from annual operation of the facility would be 1.2×10^{-5}. The total dose to the maximally exposed member of the public from annual operation would be 3.4×10^{-4} mrem; this corresponds to an LCF risk of 1.7×10^{-10}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–187; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. No hazardous chemical releases would be expected as a result of modification and operation activities.

Table 4–187. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at Hanford

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998b.

4.27.2.5 Facility Accidents

No major modifications would be required for any of the facilities proposed for lead assembly fabrication. The potential for accidents during construction would thus be minimal.

The potential consequences of postulated bounding facility accidents from lead assembly fabrication activities at Hanford is presented in Table 4–188. The source terms are identical to those for lead assembly activities at ANL–W; the different consequences are attributable to differences in stack height, meteorology, site boundary distance, and population.

The most severe consequences of a design basis accident would be associated with a nuclear criticality. Bounding radiological consequences for the MEI would result in a dose of 3.4×10^{-3} rem, corresponding to an LCF probability of 1.7×10^{-6}. Consequences of the criticality for the general population in the environs of Hanford would include an estimated 2.7×10^{-3} LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

Consistent with the analysis presented in the *Storage and Disposition PEIS*, the noninvolved worker is assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the criticality accident. The consequences of such an accident would include an LCF probability of 1.3×10^{-5}.

The radiological effects from total collapse of FMEF for lead assembly fabrication in the beyond-design-basis earthquake would be approximately 3.2 LCFs in the population residing within 80 km (50 mi) of Hanford. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly

depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design

Table 4–188. Accident Impacts of Lead Assembly Fabrication at Hanford

		Impacts on Noninvolved Worker		Impact at Site Boundary		Impacts on Population Within 80 km	
Accident	Frequency (per year)	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (person-rem)[a]	Latent Cancer Fatalities[c]
Criticality	Extremely unlikely	3.3×10^{-2}	1.3×10^{-5}	3.4×10^{-3}	1.7×10^{-6}	5.4	2.7×10^{-3}
Design basis earthquake	Unlikely	3.5×10^{-5}	1.4×10^{-8}	5.2×10^{-6}	2.6×10^{-9}	1.7×10^{-2}	8.5×10^{-6}
Design basis fire	Unlikely	1.5×10^{-5}	6.0×10^{-9}	2.3×10^{-6}	1.1×10^{-9}	7.4×10^{-3}	3.7×10^{-6}
Design basis explosion	Extremely unlikely	2.4×10^{-4}	9.8×10^{-8}	3.7×10^{-5}	1.8×10^{-8}	1.2×10^{-1}	5.9×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	7.1×10^{1}	2.8×10^{-2}	2.7	1.3×10^{-3}	6.5×10^{3}	3.2
Beyond-design-basis fire	Beyond extremely unlikely	1.6×10^{-1}	6.3×10^{-5}	5.9×10^{-3}	3.0×10^{-6}	1.4×10^{1}	7.2×10^{-3}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the decisions made in the SPD EIS ROD, site emergency management programs would be modified as appropriate to consider any new accidents not in the current program.

4.27.2.6 Transportation

Plutonium dioxide would be shipped from LANL to lead assembly fabrication facilities at Hanford. These facilities would also receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to the McGuire reactor for irradiation.[38] Approximately 30 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 89,000 km (55,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.4 person-rem; the dose to the public, 9.6 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.6×10^{-4} LCF among transportation workers and 4.8×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 2.5×10^{-4}.

[38] Based on information provided by DCS, DOE has identified McGuire as its preference for irradiating lead assemblies.

Impacts of Accidents During Transportation. Estimates of the total ground transportation accident follow: a radiological dose to the population of 5.6 person-rem, resulting in a total population risk of 2.8×10^{-3} LCF; and traffic accidents resulting in 1.9×10^{-3} fatality.

4.27.2.7 Other Resource Areas

Other resource areas include geology and soils, water resources and floodplains, ecological resources (including threatened and endangered species, biodiversity, and wetlands), cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected on any of these resource areas. Impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. Potential radiological impacts on members of the public resulting from routine lead assembly fabrication activities and from facility accidents are assessed in the preceding sections. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded that doses incurred by members of the public during routine operations would not be expected to result in any additional LCFs. As for accidents, the longer-term effects of plutonium deposited on the ground and surface waters after the accident, including the resuspension and inhalation of plutonium and the ingestion of contaminated crops, have been studied and been found not to contribute as significantly to dosage as inhalation. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances (as much as tow orders of magnitude at the 80 km [50 mi] limit). Due to the very conservative approach used in assessing radiological impacts on the public, this bounds (i.e., provides the maximum for) any exposures via subsistence agriculture, hunting, and fishing. Appendixes F, J, and K detail the assessment protocol and the conservative data assumptions, respectively.

4.27.2.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, routine operations associated with lead assembly fabrication at Hanford would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of Hanford would be 1.2×10^{-5}; thus, no additional LCFs would be expected (see Table 4–186). Transportation related to these activities would not be expected to result in any LCFs either. The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 2.8×10^{-3} due to radiological impacts, by 3.2×10^{-4} due to emissions, and by 1.9×10^{-3} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.2.6). Although a beyond-design-basis accident could result in LCFs, the risks (when the probability of occurrence is considered) posed by the implementation of the Hanford alternative for lead assembly fabrication would be very small regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at Hanford would pose no significant risks to the public or to groups within the public, including the risk of disproportionately high and adverse effects on minority or low-income populations.

4.27.3 LLNL

4.27.3.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at LLNL would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at LLNL and would result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating the existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at LLNL. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly facility would be small. Estimated maximum concentrations of criteria air pollutants at the site boundary from testing of the emergency generators are less than 0.2 percent of the applicable standards. [Text deleted.] The concentrations at the site boundary would continue to meet ambient air quality standards except possibly for ozone. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less that 0.1 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAPs limit.

Section 176(c) of the 1990 CAA amendments requires that all Federal actions conform with the applicable State implementation plan. EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. The area in which LLNL is located is currently designated as attainment for all criteria air pollutants (EPA 1998a); however, EPA has recently redesignated the San Francisco Bay Area as nonattainment for ozone (EPA 1998b). Therefore, proposed actions at this site may need to be evaluated for applicability of the conformity regulations. Total direct and indirect emissions from the No Action Alternative or the lead assembly fabrication alternative result in little or no change in emissions from LLNL. Therefore, the requirement for a conformity determination is not applicable to the No Action Alternative or the lead assembly fabrication alternative and no further analysis of conformity at LLNL is required related to alternatives considered in this SPD EIS.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic associated with operating these facilities would be a small fraction of the existing traffic associated with activities at LLNL and should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment should be similar to noise from existing ventilation equipment.

4.27.3.2 Waste Management

Table 4–189 compares the waste generated during modification of facilities for lead assembly fabrication at LLNL with the existing treatment, storage, and disposal capacity for the various waste types. No TRU waste, LLW, mixed LLW, or hazardous waste would be generated during modification. This SPD EIS also assumes that nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–189. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at LLNL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Nonhazardous				
Liquid	17	<1	NA	NA
Solid	12	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.
Key: LLNL, Lawrence Livermore National Laboratory; NA, not applicable (i.e., it is assumed that the majority of the nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication would be packaged in conformance with standard industrial practice and shipped to offsite facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the nonhazardous solid waste management system at LLNL.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be discharged to the LLNL sanitary sewer system. Nonhazardous liquid waste generated during modification of these facilities is estimated to be less than 1 percent of the 2,327,800-m^3/yr (3,044,762-yd^3/yr) capacity of the LLNL sanitary sewer. Therefore, management of these wastes at LLNL should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–190 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from the conduct of lead assembly fabrication activities at LLNL. No HLW would be generated during lead assembly fabrication.

Table 4–190. Potential Waste Management Impacts of the Conduct of Lead Assembly Fabrication Activities at LLNL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	NA	4	<1 of WIPP
LLW	200	26	13	<1 of NTS
Mixed LLW	1	<1	<1	NA
Hazardous	<1	NA	<1	NA
Nonhazardous				
Liquid	1,600	<1	NA	NA
Solid	1,300	NA	NA	NA

[a] See waste type definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation annually. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
Key: LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; NTS, Nevada Test Site; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at LLNL or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed that TRU waste would be stored on the site until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated and disposed of at offsite commercial facilities. This SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment and storage of radioactive, hazardous, and mixed wastes at LLNL are described in the *Final EIS and Environmental Impact Report for Continued Operation of LLNL and SNL-Livermore* (DOE 1992:vol. I).

TRU wastes would be packaged and certified to WIPP waste acceptance criteria at the lead assembly fabrication facilities. It is likely that drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned Decontamination and Waste Treatment Facility.

A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all of the TRU waste were stored on the site, this would be 51 percent of the 257 m^3 (336 yd^3) of contact-handled TRU waste currently in storage at LLNL and 4 percent of the 3,335 m^3 (4,362 yrd^3) of onsite storage capacity. Assuming that the waste were stored in 208-l (55-gal) drums that can be stacked two high and adding a 50 percent factor for aisle space, a storage area of about 189 m^2 (226 yd^2) would be required. Impacts of the storage of additional quantities of TRU waste on less than 0.1 ha (0.25 acre) of land at LLNL should not be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d) and the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facility before transfer for treatment and storage in existing onsite facilities. LLW generated during lead assembly fabrication is estimated to be 26 percent of the 771-m^3/yr (1,008-yd^3/yr) capacity of the LLW size reduction facility. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. This would be 13 percent of the 5,255 m^3 (6,874 yd^3) of onsite storage capacity, and would not require LLNL to build additional storage capacity, because this waste would be shipped to a disposal facility on a routine basis. If additional storage space were required, and assuming that the waste were stored in 208-l (55-gal) drums that can be stacked two high and adding a 50 percent factor for aisle space, a storage area of about 1,000 m^2 (1,196 yd^2) would be required. Impacts of the storage of additional quantities of LLW on 0.1 ha (0.25 acre) of land at LLNL should not be major.

LLW would be disposed of at NTS or a similar facility off the site. The additional LLW from lead assembly fabrication at LLNL would be 4 percent of the 20,000 m^3 (26,000 yd^3) of LLW disposed of at NTS in 1995 and less than 1 percent of the 500,000-m^3 (650,000-yd^3) disposal capacity at NTS. Using the 6,085-m^3/ha (3,221-yd^3/acre) disposal land usage factor for NTS published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.12 ha (0.30 acre) of disposal space at NTS or a similar facility. Therefore, impacts of the management of this additional LLW at the disposal site should not be major. Impacts of disposal of LLW at NTS are described in the *Final EIS for the NTS and Off-Site Locations in the State of Nevada* (DOE 1996d).

The small quantity of mixed LLW would be packaged and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for LLNL. Mixed LLW disposal would occur off the site. Mixed LLW generated for these activities is estimated to be less than 1 percent of the 2,012-m^3/yr (2,632-yd^3/yr) capacity of the Building 513 and 514 waste treatment facilities. Over the operating period of the lead assembly fabrication activities, the 4 m^3 (5.2 yd^3) of mixed LLW generated would be less than 1 percent of the 2,825 m^3 (3,695 yd^3) of onsite storage capacity. Therefore, the management of this additional waste at LLNL should not have a major impact on the mixed LLW management system.

The small quantity of hazardous waste generated during operations (<1 m^3/yr [<1.3 yd^3/yr]) would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. Hazardous waste generated by lead assembly fabrication activities is estimated to be less than 1 percent of the 2,825 m^3 (3,695 yd^3) of hazardous waste storage capacity. Because the additional waste load is very small, the waste generated during the operations period should not have a major impact on the LLNL hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent off the site for disposal in the Vasco Road Landfill. This additional waste load should not have a major impact on the nonhazardous solid waste management system at LLNL.

Nonhazardous wastewater would be treated, if necessary, before being discharged to the sanitary sewer system. After monitoring to ensure that the wastewater meets discharge limits, sanitary wastewaters from lead assembly fabrication, along with other sanitary wastewaters from LLNL and Sandia National Laboratories, Livermore (SNL-Livermore), would be routed to the city of Livermore Water Reclamation Plant. Nonhazardous liquid waste generated by these activities is estimated to be less than 1 percent of the existing annual site waste generation and less than 1 percent of the 2,327,800-m^3/yr (3,044,762-yd^3/yr) capacity of the LLNL sanitary sewer, and therefore should not have a major impact on the LLNL and city of Livermore sanitary wastewater treatment systems.

4.27.3.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification to and operation of the facilities for the proposed lead assembly program. Proposed activities would use existing facilities on the Livermore Site at LLNL; therefore, all required utility connections are in existence. See Table 3–57 for current infrastructure characteristics at the Livermore Site. To support lead assembly fabrication, annual electricity requirements are estimated to increase by 720 MWh. Current annual electrical usage at the Livermore Site is 296,000 MWh. Natural gas requirements for heating are 55,200 m^3/yr (72,200 yd^3/yr). Current natural gas usage for the Livermore Site is 13 million m^3/yr (17 million yd^3/yr) . An estimated 4,600 l (1,215 gal) of diesel oil for emergency generators is also required. Annual liquid fuel usage at the Livermore Site is 1.3 million l (343,000 gal). Annual total water usage for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). Current annual water usage is 873 million l (231 million gal). There would not be any major impacts on infrastructure should the decision be made to conduct the proposed lead assembly program at the Livermore Site at LLNL (DOE 1996a:4-333-337; O'Connor et al. 1998c:S-10, 31).

4.27.3.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at LLNL. Moreover, doses to construction workers should not exceed the normally low levels attributable to routine occupancy. Nonetheless, construction workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

Table 4–191 reflects the potential radiological impacts of normal operations on three individual receptor groups at LLNL: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–191. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at LLNL

Population within 80 km for year 2005	
Dose (person-rem/yr)	1.1
Percent of natural background[a]	4.7×10^{-5}
Associated latent fatal cancers	5.5×10^{-4}
Maximally exposed individual	
Annual dose (mrem/yr)	0.064
Percent of natural background[a]	0.021
Associated latent fatal cancer risk	3.2×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	1.4×10^{-4}
Associated latent fatal cancer risk	7.1×10^{-11}

[a] The annual natural background radiation level at LLNL is 300 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 2,323,000 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of LLNL in 2005 (7,742,000).

Key: LLNL, Lawrence Livermore National Laboratory.

Source: Appendix J.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 1.1 person-rem. The corresponding number of LCFs in the population around LLNL from annual operation of the facility would be 5.5×10^{-4}. The total dose to the maximally exposed member of the public from annual operation would be 0.064 mrem; this corresponds to an LCF risk of 3.2×10^{-8}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–192; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. Limited hazardous chemical releases would be expected as a result of modification and operation activities. However, concentrations would be within the regulated exposure limits.

4.27.3.5 Facility Accidents

Given the estimated 2,060 person-days of construction labor and standard industrial accident rates, about 0.82 cases of nonfatal occupational injury or illness and 1.1×10^{-3} fatality would be expected. DOE-required industrial safety programs would be in place to reduce the risks.

Table 4–192. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at LLNL

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Key: LLNL, Lawrence Livermore National Laboratory.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998c.

The potential consequences of postulated bounding facility accidents from lead assembly fabrication activities at LLNL are presented in Table 4–193. The source terms are identical to those for lead assembly activities at ANL–W; the different consequences are attributable to differences in stack height, meteorology, site boundary distance, and population.

Table 4–193. Accident Impacts of Lead Assembly Fabrication at LLNL

		Impacts on Noninvolved Worker		Impact at Site Boundary		Impacts on Population Within 80 km	
Accident	Frequency (per year)	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (person-rem)[a]	Latent Cancer Fatalities[c]
Criticality	Extremely unlikely	5.3×10^{-1}	2.1×10^{-4}	5.3×10^{-1}	2.7×10^{-4}	6.4×10^{1}	3.2×10^{-2}
Design basis earthquake	Unlikely	1.3×10^{-3}	5.3×10^{-7}	1.7×10^{-3}	8.5×10^{-7}	2.8×10^{-1}	1.4×10^{-4}
Design basis fire	Unlikely	5.7×10^{-4}	2.3×10^{-7}	7.4×10^{-4}	3.7×10^{-7}	1.2×10^{-1}	6.0×10^{-5}
Design basis explosion	Extremely unlikely	9.3×10^{-3}	3.7×10^{-6}	1.2×10^{-2}	6.0×10^{-6}	1.9	9.7×10^{-4}
Beyond-design-basis fire	Beyond extremely unlikely	1.1	4.3×10^{-4}	1.1	5.3×10^{-4}	1.7×10^{2}	8.7×10^{-2}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: LLNL, Lawrence Livermore National Laboratory.
Note: A beyond-design-basis earthquake scenario was not evaluated for Building 332 at LLNL because extensive analyses of the seismic hazard at the site and the response of the building to those hazards indicate that the scenario is beyond the range of "reasonably foreseeable." Current estimates are that the frequency of collapse is about 1×10^{-7} per year or less (Murray 1998).

The most severe consequences of a design basis accident would be associated with a nuclear criticality. Bounding radiological consequences for the MEI would result in a dose of 0.53 rem, corresponding to an LCF probability of 2.7×10^{-4}. Consequences of the criticality for the population in the environs of LLNL would include an estimated 3.2×10^{-2} LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

Consistent with the analysis presented in the *Storage and Disposition PEIS*, the noninvolved worker is assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and

downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the criticality accident. The consequences of such an accident would include an LCF probability of 2.1×10^{-4}.

Extensive analyses have been performed on the seismic hazard at the LLNL site and the response of the Plutonium Facility, Building 332, to those hazards. The geology and seismology studies have characterized the nature and magnitude of the seismic threat to LLNL and indicate there is no physiographic basis for postulating earthquake magnitudes or ground accelerations greater than Richter magnitude 6.9g or 1.1g, respectively. Building 332, Increment III, has been designed and/or evaluated against earthquakes and ground accelerations of these magnitudes and found to be adequate. Significantly greater magnitude events and ground acceleration levels would be required before any potential collapse of Increment III would be expected. Based on the current LLNL hazard curve and various estimates of the fragility curves for collapse of Increment III, the frequency of collapse is on the order of 1×10^{-7} per year or less (Murray 1998).

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the decisions made in the SPD EIS ROD, site emergency management programs would be modified as appropriate to consider any new accidents not in the current program.

4.27.3.6 Transportation

Plutonium dioxide would be shipped from LANL to lead assembly fabrication facilities at LLNL. These facilities would also receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to the McGuire reactor for irradiation.[39] Approximately 30 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 73,000 km (46,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.4 person-rem; the dose to the public, 9.7 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.6×10^{-4} LCF among transportation workers and 4.8×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 3.7×10^{-4}.

Impacts of Accidents During Transportation. Estimates of the total ground transportation accident risks are as follows: a radiological dose to the population of 5.9 person-rem, resulting in a total population risk of 3.0×10^{-3} LCF; and traffic accidents resulting in 1.8×10^{-3} fatality.

[39] Based on information provided by DCS, DOE has identified McGuire as its preference for irradiating lead assemblies.

4.27.3.7 Other Resource Areas

Other resource areas include geology and soils, water resources and floodplains, ecological resources (including threatened and endangered species, biodiversity, and wetlands), cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected on any of these resource areas. Impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. Potential radiological impacts on members of the public resulting from routine lead assembly fabrication activities and from facility accidents are assessed in the preceding sections. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded that doses incurred by members of the public during routine operations would not be expected to result in any additional LCFs. As for accidents, the longer-term effects of plutonium deposited on the ground and surface waters after the accident, including the resuspension and inhalation of plutonium and the ingestion of contaminated crops, have been studied and been found not to contribute as significantly to dosage as inhalation. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances (as much as two orders of magnitude at the 80-km [50-mi] limit). Due to the very conservative approach used in assessing radiological impacts on the public, this bounds (i.e., provides the maximum for) any exposures via subsistence agriculture, hunting, and fishing. Appendixes F, J, and K detail the assessment protocol and the conservative data assumptions, respectively.

4.27.3.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, routine operations associated with lead assembly fabrication at LLNL would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of LLNL would be 5.5×10^{-4}; thus, no additional LCFs would be expected (see Table 4–191). Transportation related to these activities would not be expected to result in any LCFs either. The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 3.0×10^{-3} due to radiological impacts, by 3.7×10^{-4} due to emissions, and by 1.8×10^{-3} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.3.6). Risks posed by the implementation of the LLNL alternative for lead assembly fabrication would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at LLNL would pose no significant risks to the public or to groups within the public, including the risk of disproportionately high and adverse effects on minority or low-income populations.

4.27.4 LANL

4.27.4.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at LANL would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at LANL and would result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating the existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at LANL. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly facility would be small. Estimated maximum concentrations of criteria air pollutants at the site boundary from testing of the emergency generators are less than 1 percent of the applicable standards. [Text deleted.] The concentrations at the site boundary would continue to meet ambient air quality standards. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less than 0.01 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAPs limit.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic associated with operating these facilities would be a small fraction of the existing traffic associated with activities at LANL and should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment would be similar to noise from existing ventilation equipment.

4.27.4.2 Waste Management

Table 4–194 compares the waste generated during modification of facilities for lead assembly fabrication at LANL with the existing treatment, storage, and disposal capacity for the various waste types. TRU waste and LLW would be generated during modification of contaminated areas of the glovebox line in Building PF–4, although no mixed waste or hazardous wastes would be generated.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at LLNL or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored on the site until 2016. This SPD EIS also assumes that LLW and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–194. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at LANL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU	3	<1	<1	<1 of WIPP
LLW	3	NA	1	<1
Nonhazardous, liquid	10	<1	NA	<1

[a] See definitions in Appendix F.8.

[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.

Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated or stored on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

TRU wastes would be packaged and certified to WIPP waste acceptance criteria at the modification site. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the Radioactive Materials Research, Operations and Demonstration (RAMROD) Facility and the Radioactive Assay and Nondestructive Test (RANT) Facility (DOE 1999b:2-108, 2-112, 2-113).

TRU waste generated during modification of Building PF–4 is estimated to be less than 1 percent of the 1,050-m^3/yr (1,373-yd^3/yr) TRU waste-processing capacity of the RAMROD and RANT facilities. A total of 5 m^3 (6.5 yd^3) of TRU waste would be generated over the modification period. If all of the TRU waste were to be stored on the site, this would be less than 1 percent of the 24,355-m^3 (31,856-yd^3) storage capacity available at LANL. Therefore, impacts of the management of additional quantities of TRU waste at LANL should not be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d) and the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

The TRU waste generated during modification of Building PF–4 would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

LLW generated during modification of Building PF–4 would be packaged, certified, and accumulated at the facility before transfer for treatment, storage, and disposal in existing onsite facilities. A total of 5 m^3 (6.5 yd^3) of LLW would be generated over the modification period. LLW generated by modification of facilities for lead assembly fabrication is estimated to be 1 percent of the 663-m^3 (867-yd^3) LLW storage capacity and less than 1 percent of the 252,500-m^3 (330,270-yd^3) capacity of the Technical Area–54 (TA–54) LLW disposal area. Using the 12,562-m^3/ha (6,649-yd^3/acre) disposal land usage factor for LANL published in the *Stockpile Stewardship and Management PEIS* (DOE 1996b:H-9), 5 m^3 (6.5 yd^3) of waste would require less than 0.1 ha (0.25 acre) of disposal space at LANL. Therefore, impacts of the management of this additional LLW at LANL should not be major.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be discharged to the LANL sanitary wastewater treatment plant. Nonhazardous liquid waste generated during modification of these facilities is estimated to be less than 1 percent of the 1,060,063-m^3/yr (1,386,562-yd^3/yr) capacity of the sanitary wastewater treatment plant and less than 1 percent of the 567,750-m^3/yr (742,617-d^3/yr) capacity of the sanitary drain fields. Therefore, management of these wastes at LANL should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–195 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from lead assembly fabrication activities at LANL. No HLW would be generated during lead assembly fabrication.

Table 4–195. Potential Waste Management Impacts of Operation of Lead Assembly Facility at LANL

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	4	1	<1 of WIPP
LLW	200	NA	106	<1
Mixed LLW	1	NA	1	NA
Hazardous	<1	NA	<1	NA
Nonhazardous				
Liquid	1,600	<1[d]	NA	<1[e]
Solid	1,300	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation annually. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of the capacity of sanitary wastewater treatment plant.
[e] Percent of the capacity of sanitary tile fields.
Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at LANL or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, it is assumed that TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored on the site until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated and disposed of at offsite commercial facilities. This SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of waste at LANL are evaluated in the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (DOE 1999b).

TRU wastes would be packaged and certified to WIPP waste acceptance criteria at the lead assembly fabrication facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at RAMROD and RANT facilities (DOE 1999b:2-108, 2-112, 2-113).

TRU waste generated by lead assembly fabrication is estimated to be 4 percent of the 1,050-m^3/yr (1,373 yd^3/yr) TRU waste-processing capacity of the RAMROD and RANT facilities. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all of the TRU waste were to be stored on the site, this would be 1 percent of the 24,355-m^3 (31,856-yd^3) storage capacity available at LANL. Therefore, impacts of the management of additional quantities of TRU waste at LANL should not be major.

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facility before transfer for disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generated by lead assembly fabrication is estimated to be 106 percent of the 663-m^3 (867-yd^3) LLW storage capacity and less than 1 percent of the 252,000-m^3 (329,600-yd^3) capacity of the TA–54 LLW disposal area. Because the waste would be sent for disposal on a regular basis, storage should not be a problem. Using the 12,562-m^3/ha (6,649-yd^3/acre) disposal land usage factor for LANL published in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM PEIS) (DOE 1996b:H-9), 700 m^3 (916 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at LANL. Thus, impacts of the management of this additional LLW at LANL should not be major.

The small quantity of mixed LLW would be packaged and stored on the site for treatment and disposal in a manner consistent with the site treatment plan for LANL. Mixed LLW generated at the lead assembly fabrication facility is estimated to be 1 percent of the 583-m^3 (763-yd^3) mixed LLW storage capacity. Therefore, the management of this additional waste at LANL should not have a major impact on the mixed LLW management system.

The small quantity of hazardous waste generated during operations would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. Hazardous waste generated by lead assembly fabrication facilities is estimated to be less than 1 percent of the 1,864 m^3 (2,438 yd^3) of hazardous waste storage capacity. The additional waste load generated during the operations period should not have a major impact on the LANL hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent for disposal in the Los Alamos County Landfill. This additional waste load should not have a major impact on the nonhazardous solid waste management system at LANL.

Nonhazardous wastewater would be treated, if necessary, before being discharged to the sanitary sewer system. Nonhazardous liquid waste generated by lead assembly fabrication is estimated to be less than 1 percent of the 1,060,063-m^3/yr (1,386,562-yd^3/yr) capacity of the sanitary wastewater treatment plant and less than 1 percent of the 567,750-m^3/yr (742,617-yd^3/yr) capacity of the sanitary drain fields. Therefore, management of additional nonhazardous liquid waste at LANL should not have a major impact on the wastewater treatment system.

4.27.4.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification and operation of the facilities for the proposed lead assembly program. Proposed activities would use existing facilities, therefore, utility connections are in existence. See Table 3–63 for additional information on the infrastructure characteristics at LANL. To support lead assembly fabrication, annual electricity requirements are calculated to increase by 720 MWh. Current annual electrical usage at LANL is approximately 372,000 MWh, with a site capacity of 500,000 MWh. Additional annual natural gas requirements for heating are 55,200 m^3/yr (72,200 yd^3/yr). Current natural gas usage at LANL is 43.4 million m^3/yr (56.8 million yd^3/yr), with a site capacity of 103.4 million m^3/yr (135.2 million yd^3/yr). An estimated 4,600 l (1,215 gal) of diesel oil for emergency generators is also required. Fuel is procured on the site on an as-needed basis. Annual total groundwater usage

for sanitary and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). Current annual water usage is about 5,500 million l (1,500 million gal) by all users, while the current capacity is 6,830 million l (1,800 million gal) (see Table 3–63). There would not be any other major impacts to infrastructure should the decision be made to conduct the proposed lead assembly program at LANL (DOE 1996a:3-308, 1999b:4-181, 4-182; O'Connor et al. 1998d).

4.27.4.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at LANL. As shown in Table 4–196, additional doses (above the normally low levels attributable to routine occupancy) to construction workers are expected from modification activities. Construction worker exposures would be limited to ensure that doses are maintained ALARA and would be monitored (badged) as appropriate.

Table 4–196. Potential Radiological Impacts on Construction Workers of Lead Assembly Facility at LANL

Number of badged workers	15
Annual total dose (person-rem/yr)	5.7
Associated latent fatal cancers[a]	2.3×10^{-3}
Annual average worker dose (mrem/yr)	383
Associated latent fatal cancer risk	1.5×10^{-4}

[a] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations, per ICRP 1991.

Key: LANL, Los Alamos National Laboratory.

Note: If the worker is a LANL radiation worker, the whole body dose limit is 5,000 mrem/yr (DOE 1995d), with a DOE administrative control level of 2,000 mrem/yr (DOE 1994a). If the worker is a contractor (i.e., LANL site "visitor"), the whole body dose limit is 100 mrem/yr (DOE 1993) because the worker would be considered a member of the public. In either case, an effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: ICRP 1991; NAS 1990; O'Connor et al. 1998d.

Table 4–197 reflects the potential radiological impacts of normal operations on three individual receptor groups at LANL: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 0.025 person-rem. The corresponding number of LCFs in the population around LANL from annual operation of the facility would be 1.2×10^{-5}. The total dose to the maximally exposed member of the public from annual operation would be 9.0×10^{-3} mrem; this corresponds to an LCF risk of 4.5×10^{-9}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–198; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–197. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at LANL

Population within 80 km for year 2005	
Dose (person-rem/yr)	0.025
Percent of natural background[a]	2.4×10^{-5}
Associated latent fatal cancers	1.2×10^{-5}
Maximally exposed individual	
Annual dose (mrem/yr)	9.0×10^{-3}
Percent of natural background[a]	2.6×10^{-3}
Associated latent fatal cancer risk	4.5×10^{-9}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	8.5×10^{-5}
Associated latent fatal cancer risk	4.3×10^{-11}

[a] The annual natural background radiation level at LANL is 349 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 102,200 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of LANL in 2005 (292,700).
Key: LANL, Los Alamos National Laboratory.
Source: Appendix J.

Table 4–198. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at LANL

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Key: LANL, Los Alamos National Laboratory.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved with operations will be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program will ensure that doses will be reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998d.

Hazardous Chemical Impacts. No hazardous chemical releases would be expected as a result of modification and operation activities.

4.27.4.5 Facility Accidents

The only change in employment resources that would be required for lead assembly fabrication at LANL would be increased labor hours to modify the existing glovebox line and related equipment. Given the estimated 594 person-days of construction labor and standard industrial accident rates, about 0.24 cases of nonfatal occupational injury or illness and 3.3×10^{-4} fatality would be expected.

The potential consequences of postulated bounding facility accidents from lead assembly operations at LANL are presented in Table 4–199. The source terms are identical to those for lead assembly operations at ANL–W; the different consequences are attributable to differences in stack height, meteorology, site boundary distance, and population.

The most severe consequences of a design basis accident would be associated with a nuclear criticality. Bounding radiological consequences for the MEI would result in a dose of 2.8×10^{-2} rem, corresponding to an

Table 4–199. Accident Impacts of Lead Assembly Fabrication at LANL

		Impacts on Noninvolved Worker		Impact at Site Boundary		Impacts on Population Within 80 km	
Accident	**Frequency (per year)**	**Dose (rem)[a]**	**Probability of Cancer Fatality[b]**	**Dose (rem)[a]**	**Probability of Cancer Fatality[b]**	**Dose (person-rem)[a]**	**Latent Cancer Fatalities[c]**
Criticality	Extremely unlikely	6.5×10^{-2}	2.6×10^{-5}	2.8×10^{-2}	1.4×10^{-5}	6.6	3.2×10^{-3}
Design basis earthquake	Unlikely	1.1×10^{-4}	4.3×10^{-8}	4.1×10^{-5}	2.1×10^{-8}	1.4×10^{-2}	6.8×10^{-6}
Design basis fire	Unlikely	4.7×10^{-5}	1.9×10^{-8}	1.8×10^{-5}	9.0×10^{-9}	5.9×10^{-3}	2.9×10^{-6}
Design basis explosion	Extremely unlikely	7.6×10^{-4}	3.0×10^{-7}	2.9×10^{-4}	1.5×10^{-7}	9.5×10^{-2}	4.8×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	5.1×10^{1}	2.1×10^{-2}	1.4×10^{1}	7.0×10^{-3}	4.2×10^{3}	2.1
Beyond-design-basis fire	Beyond extremely unlikely	1.1×10^{-1}	4.6×10^{-5}	3.1×10^{-2}	1.6×10^{-5}	9.2	4.6×10^{-3}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.
[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.
Key: LANL, Los Alamos National Laboratory.

LCF probability of 1.4×10^{-5}. Consequences of the criticality for the general population in the environs of LANL would include an estimated 3.2×10^{-3} LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

Consistent with the analysis presented in the *Storage and Disposition PEIS*, the noninvolved worker is assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the criticality accident. The consequences of such an accident would include an LCF probability of 2.6×10^{-5}.

The radiological effects from total collapse of the lead assembly fabrication facility at LANL in the beyond-design-basis earthquake would be approximately 2.1 LCFs in the population residing within 80 km (50 mi) of LANL. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly

depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the decisions made in the SPD EIS ROD, site emergency management programs would be modified as appropriate to consider any new accidents not in the current program.

4.27.4.6 Transportation

Plutonium dioxide would already be at LANL so no shipping would be required for this material. These facilities would receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to the McGuire reactor for irradiation.[40] Approximately 20 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 49,000 km (30,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.4 person-rem; the dose to the public, 9.6 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.5×10^{-4} LCF among transportation workers and 4.8×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 1.5×10^{-4}.

Impacts of Accidents During Transportation. Estimates of the total ground transportation accident risks follow: a radiological dose to the population of 5.4 person-rem, resulting in a total population risk of 2.7×10^{-3} LCF; and traffic accidents resulting in 1.5×10^{-3} fatality.

4.27.4.7 Other Resource Areas

Other resource areas include geology and soils, water resources and floodplains, ecological resources (including threatened and endangered species, biodiversity, and wetlands), cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected on any of these resource areas. Impacts on individuals subsisting on ecological resources (e.g., fish and wildlife) from operation of the proposed facilities would be negligible. Potential radiological impacts on members of the public resulting from routine lead assembly fabrication activities and from facility accidents are assessed in the preceding sections. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded that doses incurred by members of the public during routine operations would not be expected to result in any additional LCFs. As for accidents, the longer-term effects of plutonium deposited on the ground and surface waters after the accident, including the resuspension and inhalation of plutonium and the ingestion of contaminated crops, have been studied and been found not to contribute as significantly to dosage as inhalation. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for

[40] Based on information provided by DCS, DOE has identified McGuire as its preference for irradiating lead assemblies.

inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances (as much as two orders of magnitude at the 80-km [50-mi] limit). Due to the very conservative approach used in assessing radiological impacts on the public, this bounds (i.e., provides the maximum for) any exposures via subsistence agriculture, hunting, and fishing. Appendixes F, J, and K detail the assessment protocol and the conservative data assumptions, respectively.

4.27.4.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, routine operations associated with lead assembly fabrication at LANL would pose no significant health risks to the public. The expected number of LCFs as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of LANL would be 1.2×10^{-5}; thus, no additional LCFs would be expected (see Table 4–197). Transportation related to these activities would not be expected to result in any LCFs either. The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 2.7×10^{-3} due to radiological impacts, by 2.2×10^{-4} due to emissions, and by 1.6×10^{-3} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.4.6). Although a beyond-design-basis accident could result in LCFs, the risks (when the probability of occurrence is considered) posed by the implementation of the LANL alternative for lead assembly fabrication would be very small regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at LANL would pose no significant risks to the public or to groups within the public, including the risk of disproportionately high and adverse effects on minority or low-income populations.

4.27.5 SRS

4.27.5.1 Air Quality and Noise

Potential air quality impacts of modification of facilities for lead assembly fabrication at SRS would not be major. Emissions from modification would result from welding and vehicle emissions from moving employees, equipment, and wastes. All modification activities would be inside existing buildings. Air pollutant concentrations from these modification activities would result in little increase in air pollutant concentrations at the site boundary.

Outdoor noise sources during modification would be limited to employee vehicles and truck traffic. Traffic associated with modification of these facilities would be a small fraction of the existing traffic associated with activities at SRS and should result in little or no increase in traffic noise levels along roads to the site.

Operational air quality impacts would result from emissions from emergency diesel generators, employee vehicles, and trucks moving materials and wastes. Emissions from heating the existing buildings would not change. The change in vehicular traffic would be small because most of the operations employees are expected to be existing employees, and that number is small in comparison to current employment at SRS. Incremental air pollutant concentrations (e.g., carbon monoxide or nitrogen dioxide) for the site from operation of the lead assembly fabrication facility would be smaller than the levels shown in Table 4–73, and the concentrations at the site boundary would continue to meet ambient air quality standards. Radiological emissions are expected to be minor with the MEI receiving an additional dose of less than 0.0001 mrem/yr. The overall site would be expected to remain within the 10-mrem/yr NESHAPs limit.

Noise sources during operation would include employee vehicles and trucks and may include new ventilation equipment. Traffic noise associated with operating these facilities would occur on the site and along offsite local and regional transportation routes used to bring materials and workers to the site. Traffic associated with operating these facilities would be a small fraction of the existing traffic associated with activities at SRS and

should result in little or no increase in traffic noise levels along roads to the site. Noise from ventilation equipment should be similar to noise from existing ventilation equipment.

4.27.5.2 Waste Management

Table 4–200 compares the waste generated during modification of facilities for lead assembly fabrication at SRS with the existing treatment, storage, and disposal capacity for the various waste types. No TRU waste,LLW, or mixed LLW would be generated during modification. For this SPD EIS, it is assumed that hazardous and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices.

Table 4–200. Potential Waste Management Impacts of Modification of Facilities for Lead Assembly Fabrication at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
Hazardous	1	NA	NA	NA
Nonhazardous				
Liquid	2,400	2[c]	NA	<1[d]
Solid	19	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment, storage, and disposal capacities are compared with estimated additional waste generation assuming a 2-year modification period.
[c] Percent of the capacity of H-Area sanitary sewer.
[d] Percent of the capacity of Central Sanitary Wastewater Treatment Facility.
Key: NA, not applicable (i.e., it is assumed that the majority of the hazardous and nonhazardous solid waste would be treated and disposed of off the site by the construction contractor).

Hazardous waste generated during modification of facilities for lead assembly fabrication would be typical of those generated during construction of an industrial facility. Any hazardous waste generated during modification would be packaged in DOT-approved containers and shipped off the site to permitted commercial recycling, treatment, and disposal facilities. The additional waste load generated during the modification period should not have a major impact on the SRS hazardous waste management system.

Nonhazardous solid waste generated during modification of facilities for lead assembly fabrication would be packaged in conformance with standard industrial practice and shipped to commercial or municipal facilities for recycling or disposal. The additional waste load generated during the modification period should not have a major impact on the SRS nonhazardous solid waste management system.

To be conservative, it was assumed that all nonhazardous liquid waste generated during modification of facilities for lead assembly fabrication would be managed at the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated during modification of these facilities is estimated to be 2 percent of the 136,274-m^3/yr (178,246-yd^3/yr) capacity of the H-Area sanitary sewer, less than 1 percent of the 1,449,050-m^3/yr (1,895,357-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and within the 1,032,950-m^3/yr (1,351,099-yd^3/yr) excess capacity of the Central Sanitary Wastewater Treatment Facility (Sessions 1997). Therefore, management of these wastes at SRS should not have a major impact on the nonhazardous liquid waste treatment system during the modification period.

Table 4–201 compares the existing site treatment, storage, and disposal capacities with the expected waste generation rates from lead assembly fabrication at SRS. No HLW would be generated during lead assembly fabrication.

Table 4–201. Potential Waste Management Impacts of Operation of Lead Assembly Facility at SRS

Waste Type[a]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[b]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[c]	41	2	<1	<1 of WIPP
LLW	200	1	NA	2
Mixed LLW	1	<1	<1	NA
Hazardous	<1	<1	<1	NA
Nonhazardous				
Liquid	1,600	1[d]	NA	<1[e]
Solid	1,300	NA	NA	NA

[a] See definitions in Appendix F.8.
[b] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional waste generation annually. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 3-year operation period.
[c] Includes mixed TRU waste. Facilities are not expected to generate remotely handled TRU waste.
[d] Percent of the capacity of H-Area sanitary sewer.
[e] Percent of the capacity of Central Sanitary Wastewater Treatment Facility.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Depending in part on decisions in the RODs for the WM PEIS, wastes could be treated and disposed of at SRS or at other DOE sites or commercial facilities. According to the ROD for TRU waste issued on January 20, 1998, TRU and mixed TRU waste would be certified on the site to current WIPP waste acceptance criteria and shipped to WIPP for disposal. Current schedules for shipment of TRU waste to WIPP would accommodate the shipment of contact-handled TRU waste from surplus plutonium disposition facilities beginning in 2016 (DOE 1997c:17). Therefore, in order to be conservative, it is assumed the TRU waste would be stored on the site until 2016. Per the ROD for hazardous waste issued on August 5, 1998, nonwastewater hazardous waste would continue to be treated on the site in the Consolidated Incineration Facility and disposed of at offsite commercial facilities. This SPD EIS also assumes that LLW, mixed LLW, and nonhazardous waste would be treated, stored, and disposed of in accordance with current site practices. Impacts of treatment, storage, and disposal of radioactive, hazardous, and mixed wastes at SRS are described in the *SRS Waste Management Final EIS* (DOE 1995c).

TRU wastes would be treated, packaged and certified to WIPP waste acceptance criteria at the lead assembly fabrication facilities. Drum-gas testing, real-time radiography, and loading the TRUPACT for shipment to WIPP would occur at the planned TRU Waste Characterization and Certification Facility at SRS.

TRU waste generated by lead assembly fabrication is estimated to be 2 percent of the 1,720-m^3/yr (2,250-yd^3/yr) planned capacity of the TRU Waste Characterization and Certification Facility. A total of 132 m^3 (173 yd^3) of TRU waste would be generated over the 3-year operation period. If all of the TRU waste were stored on the site, this would be less than 1 percent of the 34,400 m^3 (45,000 yd^3) of storage capacity available at the TRU Waste Storage Pads. Therefore, impacts of the management of additional quantities of TRU waste at SRS should not be major. Impacts from the treatment of TRU waste to WIPP waste acceptance criteria are described in the WM PEIS (DOE 1997d) and the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

The 132 m^3 (173 yd^3) of TRU waste generated by these activities would be less than 1 percent of the 143,000 m^3 (187,000 yd^3) of contact-handled TRU waste that DOE plans to dispose of at WIPP and less than 1 percent of the current 168,500-m^3 (220,400-yd^3) limit for WIPP (DOE 1997e:3-3). Impacts of disposal of TRU waste at WIPP are described in the *WIPP Disposal Phase Final Supplemental EIS* (DOE 1997e).

LLW would be packaged, certified, and accumulated at the lead assembly fabrication facilities before transfer for treatment and disposal in existing onsite facilities. A total of 700 m^3 (916 yd^3) of LLW would be generated over the 3-year operation period. LLW generated by lead assembly fabrication is estimated to be 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility and 2 percent of the 30,500-m^3 (39,900-yd^3) capacity of the Low-Activity Waste Vaults. Using the 8,687-m^3/ha (4,598-yd^3/acre) disposal land usage factor for SRS published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 700 m^3 (916 yd^3) of waste would require 0.1 ha (0.25 acre) of disposal space at SRS. Therefore, impacts of the management of this additional LLW at SRS should not be major.

Mixed LLW would be stabilized, packaged, and stored on the site for treatment and offsite disposal in a manner consistent with the site treatment plan for SRS. Mixed LLW generated by lead assembly fabrication is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and less than 1 percent of the 1,900-m^3 (2,490-yd^3) capacity of the Mixed Waste Storage Buildings. Therefore, the management of this additional waste at SRS should not have a major impact on the mixed LLW management system.

Hazardous waste would be packaged at the generating facility for treatment and disposal at a combination of onsite and offsite facilities. Assuming that all hazardous waste is managed on the site, hazardous waste generated by lead assembly fabrication is estimated to be less than 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of the Consolidated Incineration Facility, and less than 1 percent of the 5,200-m^3 (6,800-yd^3) capacity of the hazardous waste storage buildings. The management of these additional hazardous wastes at SRS should not have a major impact on the hazardous waste management system. If all LLW, mixed LLW, and hazardous waste generated by lead assembly fabrication activities is treated in the Consolidated Incineration Facility, this additional waste would be only 1 percent of the 17,830-m^3/yr (23,320-yd^3/yr) capacity of that facility.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Recyclable solid wastes such as office paper, metal cans, and plastic and glass bottles would be sent off the site for recycling. The remaining solid sanitary waste would be sent to the Three Rivers Landfill (DOE 1998c:3-42). This additional waste load should not have a major impact on the nonhazardous solid waste management system at SRS.

To be conservative, it was assumed that all nonhazardous wastewater would be managed in H-Area. Nonhazardous wastewater would be treated, if necessary, before being discharged to the H-Area sanitary sewer system, which connects to the Central Sanitary Wastewater Treatment Facility. Nonhazardous liquid waste generated by lead assembly fabrication is estimated to be 1 percent of the 136,274-m^3/yr (178,246-yd^3/yr) capacity of the H-Area sanitary sewer, less than 1 percent of the 1,449,050-m^3/yr (1,895,357-yd^3/yr) capacity of the Central Sanitary Wastewater Treatment Facility, and within the 1,032,950-m^3/yr (1,351,099-yd^3/yr) excess capacity of the Central Sanitary Wastewater Treatment Facility (Sessions 1997). Therefore, management of nonhazardous liquid waste at SRS should not have a major impact on the wastewater treatment system.

4.27.5.3 Infrastructure

Site infrastructure includes those utilities and resources required to support modification and operation of the facilities for the proposed lead assembly program in Building 221–H. Proposed activities would use existing facilities, therefore, utility connections are in existence. See Table 3–64 for additional information on the infrastructure characteristics of Building 221–H. To support lead assembly fabrication, annual electricity requirements are estimated to increase by 720 MWh. Current annual electrical usage at Building 221–H is 120,000 MWh, with a current annual capacity is 500,000 MWh. An additional annual coal requirement for heating is estimated at 60 t (66 tons). An estimated 4,600 l (1,215 gal) of diesel oil for emergency generators is also required. Fuel is procured on the site on an as-needed basis. Annual total groundwater usage for sanitary

and nonsanitary needs are estimated to be 1.6 million l (423,000 gal). Current annual water usage is 380 million l (100 million gal), while the current capacity is 1.5 billion l (396 million gal). There would not be any major impacts to infrastructure should the decision be made to conduct the proposed lead assembly program in Building 221–H (O'Connor et al. 1998e:S-6).

4.27.5.4 Human Health Risk

Radiological Impacts. No radiological risk would be incurred by members of the public from modification of existing facilities for lead assembly fabrication at SRS. Moreover, doses to construction workers should not exceed normally low levels attributable to routine occupancy. Nonetheless, construction workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

Table 4–202 reflects potential radiological impacts of normal operations on three individual receptor groups at SRS: the population living within 80 km (50 mi) in the year 2005, the maximally exposed member of the public, and the average exposed member of the public. The table depicts the projected LCF risks to these groups from annual operation of the lead assembly facility. To put operational doses into perspective, comparisons with doses from natural background radiation are also provided in the table.

Table 4–202. Potential Radiological Impacts on the Public of Operation of Lead Assembly Facility at SRS

Population within 80 km for year 2005	
Dose (person-rem/yr)	6.6×10^{-3}
Percent of natural background[a]	3.0×10^{-6}
Associated latent fatal cancers	3.3×10^{-6}
Maximally exposed individual	
Annual dose (mrem/yr)	5.5×10^{-5}
Percent of natural background[a]	1.9×10^{-5}
Associated latent fatal cancer risk	2.8×10^{-11}
Average exposed individual within 80 km[b]	
Annual dose (mrem/yr)	8.8×10^{-6}
Associated latent fatal cancer risk	4.4×10^{-12}

[a] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2005 would receive 222,400 person-rem.

[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2005 (754,000).

Source: Appendix J.

Given incident-free operation of the lead assembly facility, the total population dose in the year 2005 would be 6.6×10^{-3} person-rem. The corresponding number of LCFs in the population around SRS from annual operation of the facility would be 3.3×10^{-6}. The total dose to the maximally exposed member of the public from annual operation would be 5.5×10^{-5} mrem; this corresponds to an LCF risk of 2.8×10^{-11}. The impacts on the average individual would be lower.

Doses to involved workers from normal operations are given in Table 4–203; these workers are defined as those directly associated with lead assembly fabrication activities. Under the proposed action, the annual average dose to lead assembly facility workers would be an estimated 500 mrem. The annual dose received by the total involved workforce for this facility would be 28 person-rem, which corresponds to 0.011 LCF.

Table 4–203. Potential Radiological Impacts on Involved Workers of Operation of Lead Assembly Facility at SRS

Number of badged workers	55
Annual total dose (person-rem/yr)	28
Associated latent fatal cancers	0.011
Annual average worker dose (mrem/yr)	500
Associated latent fatal cancer risk	2.0×10^{-4}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998e.

Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Hazardous Chemical Impacts. No hazardous chemical releases would be expected as a result of modification and operation activities.

4.27.5.5 Facility Accidents

The SRS lead assembly fabrication option would involve a total of 59,000 person-days of construction labor. Thus, given standard industrial accident rates, 23 cases of nonfatal occupational injury or illness and 0.033 fatality would be expected.

The potential consequences of postulated bounding facility accidents from lead assembly operations at SRS are presented in Table 4–204. The source terms are identical to those for lead assembly operations at ANL–W; the different consequences are attributable to differences in stack height, meteorology, site boundary distance, and population.

The most severe consequences of a design basis accident would be associated with a nuclear criticality. Bounding radiological consequences for the MEI would result in a dose of 9.3×10^{-4} rem, corresponding to an LCF probability of 4.6×10^{-7}. Consequences of the criticality for the general population in the environs of SRS would include an estimated 6.5×10^{-4} LCF. The frequency of such an accident is estimated to be between 1 in 10,000 and 1 in 1,000,000 per year.

Consistent with the analysis presented in the *Storage and Disposition PEIS*, the noninvolved worker is assumed to be 1,000 m (3,281 ft) from the location of the accident or at the site boundary, whichever is closer, and downwind from that location. For design basis accidents, the radiological consequences for this worker were estimated to be the highest for the criticality accident. The consequences of such an accident would include an LCF probability of 4.0×10^{-6}.

Table 4–204. Accident Impacts of Lead Assembly Fabrication at SRS

		Impacts on Noninvolved Worker		Impact at Site Boundary		Impacts on Population Within 80 km	
Accident	Frequency (per year)	Dose (rem)[a]	Probability of Cancer Fatality[b]	Dose (rem)[a]	Probabiity of Cancer Fatality[b]	Dose (person-rem)[a]	Latent Cancer Fatalities[c]
Criticality	Extremely unlikely	1.0×10^{-2}	4.0×10^{-6}	9.3×10^{-4}	4.6×10^{-7}	1.3	6.5×10^{-4}
Design basis earthquake	Unlikely	7.8×10^{-6}	3.1×10^{-9}	1.3×10^{-6}	6.7×10^{-10}	5.6×10^{-3}	2.8×10^{-6}
Design basis fire	Unlikely	3.4×10^{-6}	1.3×10^{-9}	5.8×10^{-7}	2.9×10^{-10}	2.4×10^{-3}	1.2×10^{-6}
Design basis explosion	Extremely unlikely	5.5×10^{-5}	2.2×10^{-8}	9.5×10^{-6}	4.7×10^{-9}	3.9×10^{-2}	2.0×10^{-5}
Beyond-design-basis earthquake	Extremely unlikely to beyond extremely unlikely	2.6×10^{1}	1.0×10^{-2}	8.8×10^{-1}	4.4×10^{-4}	2.2×10^{3}	1.1
Beyond-design-basis fire	Beyond extremely unlikely	5.8×10^{-2}	2.3×10^{-5}	2.0×10^{-3}	9.8×10^{-7}	4.9	2.4×10^{-3}

[a] For 95th percentile meteorological conditions. With the exception of doses due to criticality, the stated doses are from the inhalation of plutonium, and represent dose commitments that would be received over the lifetime of the impacted individual.

[b] Increased likelihood (or probability) of cancer fatality for a hypothetical individual (a single noninvolved worker at a distance of 1,000 m [3,281 ft] or at the site boundary, whichever is smaller, or for a hypothetical individual in the offsite population at the site boundary) if exposed to the indicated dose. The value assumes that the accident has occurred.

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose. The value assumes that the accident has occurred.

The radiological effects from total collapse of the lead assembly fabrication facility at SRS in the beyond-design-basis earthquake would be approximately 1.1 LCF in the population residing within 80 km (50 mi) of SRS. It should be emphasized that a seismic event of sufficient magnitude to collapse these facilities would likely cause the collapse of other DOE facilities, and would almost certainly cause widespread failure of homes, office buildings, and other structures in the surrounding area. The overall impact of such an event must therefore be seen in the context not only of the potential radiological impacts of these other facilities, but of hundreds, possibly thousands, of immediate fatalities from falling debris. The frequency of an earthquake of this magnitude is estimated to be between 1 in 100,000 and 1 in 10,000,000 per year.

No major consequences for the maximally exposed involved worker would be expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would not be affected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of plutonium and uranium particulates through inhalation. If a criticality occurred, workers within tens of meters could receive very high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distance from the criticality, and the amount of shielding provided by the structures and equipment between the workers and accident. The design basis and beyond-design-basis earthquakes would also have substantial consequences, ranging from workers being killed by debris from collapsing equipment and structures to high radiation exposures and uptakes of radionuclides. For most accidents, immediate emergency response actions should reduce the consequences to workers near the accident. As discussed in the Emergency Preparedness sections of Chapter 3, each candidate site has an established emergency management program that would be activated in the event of an accident. Based on the decisions made in the SPD EIS ROD, site emergency management programs would be modified as appropriate to consider any new accidents not in the current program.

4.27.5.6 Transportation

Plutonium dioxide would be shipped from LANL to lead assembly fabrication facilities at SRS. These facilities would also receive uranium dioxide and other material needed to assemble MOX fuel bundles from a nuclear fuel fabricator and would ship MOX fuel assemblies to the McGuire reactor for irradiation.[41] Approximately 30 shipments of radioactive materials would be carried out by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be about 67,000 km (42,000 mi).

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities under this lead assembly alternative has been estimated at 1.4 person-rem; the dose to the public, 9.5 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.5×10^{-4} LCF among transportation workers and 4.8×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 3.0×10^{-4}.

Impacts of Accidents DuringTransportation. Estimates of the total transportation accident risks follow: a radiological dose to the population of 5.7 person-rem, resulting in a total population risk of 2.9×10^{-3} LCF; and traffic accidents resulting in 1.5×10^{-3} fatality.

4.27.5.7 Other Resource Areas

Other resource areas include geology and soils, water resources and floodplains, ecological resources (including threatened and endangered species, biodiversity, and wetlands), cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the lead assembly fabrication in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected on any of these resource areas. Impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. Potential radiological impacts on members of the public resulting from routine lead assembly fabrication activities and from facility accidents are assessed in the preceding sections. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded that doses incurred by members of the public during routine operations would not be expected to result in any additional LCFs. As for accidents, the longer-term effects of plutonium deposited on the ground and surface waters after the accident, including the resuspension and inhalation of plutonium and the ingestion of contaminated crops, have been studied and been found not to contribute as significantly to dosage as inhalation. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances (as much as two orders of magnitude at the 80-km [50-mi] limit). Due to the very conservative approach used in assessing radiological impacts on the public, this bounds (i.e., provides the maximum for) any exposures via subsistence agriculture, hunting, and fishing. Appendixes F, J, and K detail the assessment protocol and the conservative data assumptions, respectively.

4.27.5.8 Environmental Justice

As demonstrated throughout the analyses presented in this section, routine operations associated with lead assembly fabrication at SRS would pose no significant health risks to the public. The expected number of LCFs

[41] Based on information provided by DCS, DOE has identified McGuire as its preference for irradiating lead assemblies.

as a result of the radiation released from these activities in the general population residing within 80 km (50 mi) of SRS would be 3.3×10^{-6}; thus, no additional LCFs would be expected (see Table 4–202). Transportation related to these activities would not be expected to result in any LCFs either. The number of transportation-related fatalities in the total population along the shipping routes would be expected to increase by 2.9×10^{-3} due to radiological impacts, by 4.1×10^{-4} due to emissions, and by 1.6×10^{-3} as a result of traffic accidents; thus, no transportation-related fatalities would be expected (see Section 4.27.5.6). Although a beyond-design-basis accident could result in LCFs, the risks (when the probability of occurrence is considered) posed by the implementation of the SRS alternative for lead assembly fabrication would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the lead assembly fabrication activities at SRS would pose no significant risks to the public or to groups within the public, including the risk of disproportionately high and adverse effects on minority or low-income populations.

4.27.6 Postirradiation Examination Activities

After the lead assemblies have been irradiated, they would be shipped to a postirradiation examination facility where they would be disassembled and examined. DOE facilities being considered for this work include ANL–W and ORNL. These two sites are currently the only DOE sites that possess the capability to conduct postirradiation examination activities without major modifications to facility and processing capabilities. The only facility modification that might be needed to perform the work is to increase the size of the hot cell to receive a full-size fuel assembly.

Any postirradiation examination activities and shipments of spent fuel remaining after postirradiation examination would comply with the Consent Order and Settlement Agreement in Public Service Company of Colorado v. Batt and all other applicable agreements and orders, including provisions concerning removal of the material from the applicable examination site and limits on the number of truck shipments to the site.

4.27.6.1 [Text deleted.]

4.27.6.2 ANL–W

Waste Management. It is expected that postirradiation examination could be performed at ANL–W without the need for facility modifications that would generate waste. Thus, there would be no construction waste that could impact the waste management infrastructure.

Table 4–205 compares the existing site treatment, storage, and disposal capacities with the expected waste generation by postirradiation examination at ANL–W. As indicated in the table, wastes generated by postirradiation examination activities would be no more than 6 percent of the applicable treatment, storage, and disposal capacities, and therefore should not have a major impact on the waste management infrastructure at ANL–W and INEEL. Details of this analysis are included in Appendix H.6.1.

Radiological Impacts. No radiological risk would be incurred by members of the public from the minor modification of the hot cell at the postirradiation examination facility at ANL–W. Moreover, doses to associated workers should not exceed the normally low levels attributable to routine occupancy. Nonetheless, workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

Table 4–205. Potential Waste Management Impacts of Postirradiation Examination at ANL–W [a]

Waste Type[b]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[c]		
		Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[d]	3	<1	<1	<1 of WIPP
LLW	35	<1	<1	<1
Mixed LLW	<1	<1	<1	NA
Hazardous	<1	NA	<1	NA
Nonhazardous				
Liquid	380	NA	NA	6
Solid	51	NA	NA	NA

[a] Information summarized from Appendix H.6.1.
[b] See definitions in Appendix F.8.
[c] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 4-year operations period.
[d] Includes mixed TRU waste and destructively tested spent fuel.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

It is not expected that any discernable radiological impacts on the public would be incurred from postirradiation examination activities at ANL–W because all the work would be accomplished in heavily shielded hot cells that are built specifically to contain radiation, thereby protecting workers and the public from potential radioactive emissions.

Doses to involved workers from normal operations are given in Table 4–206; these workers are defined as those directly associated with postirradiation examination facility activities. Under the proposed action, the annual average dose to postirradiation examination facility workers is estimated to be 177 mrem. The annual dose received by the total involved workforce for this facility would be 1.8 person-rem, which corresponds to 7.1×10^{-4} LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–206. Potential Radiological Impacts on Involved Workers of Operation of Postirradiation Examination Facility at ANL–W

Number of badged workers	10[a]
Total dose (person-rem/yr)	1.8
Associated latent fatal cancers	7.1×10^{-4}
Average worker dose (mrem/yr)	177
Associated latent fatal cancer risk	7.1×10^{-5}

[a] The maximum estimated dose to one of these workers is 347 mrem/yr.
Key: ANL–W, Argonne National Laboratory–West.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998a.

Hazardous Chemical Impacts. No hazardous chemical releases would be expected as a result of modification and examination activities.

Facility Accidents. The accident risks to the public, worker, and environment from postirradiation examination of spent light water reactor fuel rods have been analyzed at a number of existing DOE and commercial facilities (PNL 1997). Spent fuel rods or assemblies are shipped from the reactor site to a postirradiation examination facility in heavy shielded casks. Fuel rods are typically removed from the fuel assemblies or bundles in deep, water-filled fuel storage basins and transferred via heavy, shielded casks. The rods are transferred from the casks to heavily shielded hot cells designed to protect the operators from the intense gamma and neutron radiation. Accidents occurring in the hot cells due to fuel examination, including spills, fires, and handling accidents, would not result in unfiltered releases or serious worker exposures due to the multiple HEPA filters on the cell exhaust and the heavy construction and shielding of the cell. The most severe accident conceivable with these types of operations would be nuclear criticality. The amount of spent fuel necessary for an accident to be physically possible, however, would be at least one to two orders of magnitude greater than would normally be available during postirradiation examination. Such an accident could result in high, though probably not fatal, radiological exposures to hot cell workers. Noninvolved workers and members of the public would also be exposed to doses in the range of fractions of a millirem to a hundred millirem, depending on distance from the facility. For example, a criticality of 1×10^{19} fissions would result in increased probabilities of fatal cancer to the noninvolved worker and MEI of 3.1×10^{-5} and 2.5×10^{-6}, respectively. No LCFs would be expected in the general population as a result of the accident.

Transportation. In order to support these activities, the MOX spent fuel assemblies would be shipped from the McGuire reactor to the postirradiation examination facilities.[42] Approximately eight shipments of radioactive materials would be carried out by DOE. The maximum total distance traveled on public roads by trucks carrying radioactive materials would be 30,000 km (19,000 mi). The maximum transportation impacts for postirradiation examination have been included in the impacts presented in Sections 4.27.1 through 4.27.5. The very small amount of spent fuel remaining after postirradiation examination would be sent to storage at INEEL in accordance with the ROD for the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final EIS* (DOE 1995a). Transportation of spent fuel from INEEL to the potential geologic repository (if constructed) would be in accordance with the *Yucca Mountain Draft EIS* (DOE 1999d) and any subsequent ROD.

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities related to postirradiation examination has been estimated at 1.4 person-rem; the dose to the public, 9.5 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 5.5×10^{-4} LCF among transportation workers and 4.8×10^{-3} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 7.8×10^{-5}.

Impacts of Accidents During Transportation. The total ground transportation accident risks for shipping spent fuel assemblies to the postirradiation examination facility is estimated to be 0.0023 LCF from radiation and 1.2×10^{-3} traffic fatality.

Other Resource Areas. Other resource areas include geology and soils, water resources and floodplains, ecological resources (including threatened and endangered species, biodiversity, and wetlands), cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the postirradiation examination in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected on any of these resource areas. Impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be

[42] Based on information provided by DCS, DOE has identified McGuire as its preference for irradiating lead assemblies.

negligible. Potential radiological impacts on members of the public resulting from routine postirradiation examination activities and from facility accidents are assessed in the preceding sections. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded that doses incurred by members of the public during routine operations would not be expected to result in any additional LCFs. As for accidents, the longer-term effects of plutonium deposited on the ground and surface waters after the accident, including the resuspension and inhalation of plutonium and the ingestion of contaminated crops, have been studied and been found not to contribute as significantly to dosage as inhalation. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances (as much as two orders of magnitude at the 80-km [50-mi] limit). Due to the very conservative approach used in assessing radiological impacts on the public, this bounds (i.e., provides the maximum for) any exposures via subsistence agriculture, hunting, and fishing. Appendixes F, J, and K detail the assessment protocol and the conservative data assumptions, respectively.

Environmental Justice. As demonstrated throughout the analyses presented in this section, routine operations associated with postirradiation examination at ANL–W would pose no significant health risks to the public. Transportation related to these activities would not be expected to result in any LCFs or transportation-related fatalities (see Section 4.27.1.6). Risks posed by the implementation of the ANL–W alternative for postirradiation examination would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the postirradiation examination activities at ANL–W would pose no significant risks to the public or to groups within the public, including the risk of disproportionately high and adverse effects on minority or low-income populations.

4.27.6.3 ORNL

Waste Management. It is expected that postirradiation could be performed at ORNL without the need for facility modifications that would generate waste. Thus, there would be no construction waste that could impact the waste management infrastructure.

Table 4–207 compares the existing site treatment, storage, and disposal capacities with the expected waste generation by postirradiation examination at ORNL. As indicated in the table, wastes generated by postirradiation examination activities would be no more than 1 percent of the applicable treatment, storage, and disposal capacities, and therefore should not have a major impact on the waste management infrastructure at ORNL and ORR. Details of this analysis are included in Appendix H.6.2. Irradiated fuel rods sent to the postirradiation examination facility that are not destroyed in testing would be managed at the postirradiation examination site as spent fuel, in accordance with the site's spent fuel program. This spent fuel from the lead assembly program may be stored at the postirradiation examination site until transported to INEEL, where it would remain in storage pending disposition at a potential geologic repository pursuant to the NWPA.[43]

Radiological Impacts. No radiological risk would be incurred by members of the public from the minor modification of the hot cell at the postirradiation examination facility at ORNL. Moreover, doses to associated workers should not exceed the normally low levels attributable to routine occupancy. Nonetheless, workers would be monitored (badged) as appropriate, to help ensure that doses are maintained as low as is reasonably achievable.

[43] Transportation and storage at INEEL would be in accordance with decisions made in the ROD for the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement.*

Table 4–207. Potential Waste Management Impacts of Postirradiation Examination at ORNL [a]

Waste Type[b]	Estimated Additional Waste Generation (m^3/yr)	Estimated Additional Waste Generation as a Percent of[c] Characterization or Treatment Capacity	Storage Capacity	Disposal Capacity
TRU[d]	3	<1	1	<1 of WIPP
LLW	35	<1	<1	<1 of NTS
Mixed LLW	<1	<1	<1	NA
Hazardous	<1	<1	<1	NA
Nonhazardous				
Liquid	380	NA	NA	<1
Solid	51	NA	NA	<1

[a] Information summarized from Appendix H.6.2.
[b] See definitions in Appendix F.8.
[c] Treatment capacities, and the disposal capacity for nonhazardous liquid waste, are compared with estimated additional annual waste generation. All other storage and disposal capacities are compared with total estimated additional waste generation assuming a 4-year operations period.
[d] Includes mixed TRU waste and destructively tested spent fuel.
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on the site); NTS, Nevada Test Site; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

It is not expected that any discernable radiological impacts on the public would be incurred from postirradiation examination activities at ORNL because all the work would be accomplished in heavily shielded hot cells that are built specifically to contain radiation, thereby protecting workers and the public from potential radioactive emissions.

Doses to involved workers from normal operations are given in Table 4–208; these workers are defined as those directly associated with postirradiation examination facility activities. Under the proposed action, the annual average dose to postirradiation examination facility workers is estimated to be 177 mrem. The annual dose received by the total involved workforce for this facility would be 1.8 person-rem, which corresponds to 7.1×10^{-4} LCF. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–208. Potential Radiological Impacts on Involved Workers of Operation of Postirradiation Examination Facility at ORNL

Number of badged workers	10[a]
Total dose (person-rem/yr)	1.8
Associated latent fatal cancers	7.1×10^{-4}
Average worker dose (mrem/yr)	177
Associated latent fatal cancer risk	7.1×10^{-5}

[a] The maximum estimated dose to one of these workers is 347 mrem/yr.
Key: ORNL, Oak Ridge National Laboratory.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995d). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994a). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: O'Connor et al. 1998a.

Hazardous Chemical Impacts. No hazardous chemical releases would be expected as a result of modification and examination activities.

Facility Accidents. The accident risks to the public, worker, and environment from postirradiation examination of spent light water reactor fuel rods have been analyzed at a number of existing DOE and commercial facilities (PNL 1997). Spent fuel rods or assemblies are shipped from the reactor site to a postirradiation examination facility in heavy shielded casks. Fuel rods are typically removed from the fuel assemblies or bundles in deep, water-filled fuel storage basins and transferred via heavy, shielded casks. The rods are transferred from the casks to heavily shielded hot cells designed to protect the operators from the intense gamma and neutron radiation. Accidents occurring in the hot cells due to fuel examination, including spills, fires, and handling accidents, would not result in unfiltered releases or serious worker exposures due to the multiple HEPA filters on the cell exhaust and the heavy construction and shielding of the cell. The most severe accident conceivable with these types of operations would be nuclear criticality. The amount of spent fuel necessary for an accident to be physically possible, however, would be at least one to two orders of magnitude greater than would normally be available during postirradiation examination. Such an accident could result in high, though probably not fatal, radiological exposures to hot cell workers. Noninvolved workers and members of the public would also be exposed to doses in the range of fractions of a millirem to a hundred millirem, depending on distance from the facility.

Transportation. In order to support these activities, the MOX spent fuel assemblies would be shipped from the McGuire reactor to the postirradiation examination facilities.[44] Approximately eight shipments of radioactive materials would be carried out by DOE. The maximum total distance traveled on public roads by trucks carrying radioactive materials would be 4,000 km (2,500 mi). The maximum transportation impacts for postirradiation examination at ORNL would be less than those shown for ANL–W in Section 4.27.6.2 because the distance from McGuire to ORNL is much less. The very small amount of spent fuel remaining after postirradiation examination would be sent to storage at INEEL in accordance with the ROD for the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final EIS* (DOE 1995a). Transportation of spent fuel from INEEL to the potential geologic repository (if constructed) would be in accordance with the *Yucca Mountain Draft EIS* (DOE 1999d) and any subsequent ROD.

Impacts of Incident-Free Transportation. The dose to transportation workers from all transportation activities related to postirradiation examination has been estimated at 0.2 person-rem; the dose to the public, 1.2 person-rem. Accordingly, the incident-free transportation of radioactive material would result in 6.7×10^{-5} LCF among transportation workers and 5.9×10^{-4} LCF in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions would be 3.7×10^{-6}.

Impacts of Accidents During Transportation. The total ground transportation accident risks for shipping spent fuel assemblies to the postirradiation examination facility is estimated to be 1.2×10^{-4} LCF from radiation and 1.4×10^{-4} traffic fatality.

Other Resource Areas. Other resource areas include geology and soils, water resources and floodplains, ecological resources (including threatened and endangered species, biodiversity, and wetlands), cultural and paleontological resources, land use and visual resources, and socioeconomics. Impacts on these resource areas are primarily related to the construction of new buildings and the number of persons employed to support the activities. Because a relatively small number of largely existing personnel are expected to perform the postirradiation examination in existing buildings (i.e., no new buildings would be constructed and no additional land disturbed), little or no impacts are expected on any of these resource areas. Impacts on individuals subsisting on ecological resources (e.g., fish, shellfish, and wildlife) from operation of the proposed facilities would be negligible. Potential radiological impacts on members of the public resulting from routine postirradiation examination activities and from facility accidents are assessed in the preceding sections. The human health risk assessment included the evaluation of radiation exposures via the ingestion pathway for foodstuffs (e.g., food

[44] Based on information provided by DCS, DOE has identified McGuire as its preference for irradiating lead assemblies.

crops and contaminated animal products) and drinking water, as applicable at each site. This assessment concluded that doses incurred by members of the public during routine operations would not be expected to result in any additional LCFs. As for accidents, the longer-term effects of plutonium deposited on the ground and surface waters after the accident, including the resuspension and inhalation of plutonium and the ingestion of contaminated crops, have been studied and been found not to contribute as significantly to dosage as inhalation. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances (as much as two orders of magnitude at the 80-km [50-mi] limit). Due to the very conservative approach used in assessing radiological impacts on the public, this bounds (i.e., provides the maximum for) any exposures via subsistence agriculture, hunting, and fishing. Appendixes F, J, and K detail the assessment protocol and the conservative data assumptions, respectively.

Environmental Justice. As demonstrated throughout the analyses presented in this section, routine operations associated with postirradiation examination at ORNL would pose no significant health risks to the public. Transportation related to these activities would not be expected to result in any LCFs or transportation-related fatalities. Risks posed by the implementation of the ORNL alternative for postirradiation examination would be negligible regardless of the racial or ethnic composition, or the economic status of the population. Therefore, the postirradiation examination activities at ORNL would pose no significant risks to the public or to groups within the public, including the risk of disproportionately high and adverse effects on minority or low-income populations.

4.28 IMPACTS OF IRRADIATING MOX FUEL AT REACTOR SITES

[Text deleted.]

The environmental impacts described in the following sections are based on using a partial MOX core (i.e., up to 40 percent MOX fuel) instead of an LEU core in existing, commercial light water reactors. As discussed in Section 3.7, the proposed sites are the Catawba Nuclear Station near York, South Carolina; the McGuire Nuclear Station near Huntersville, North Carolina; and the North Anna Power Station near Mineral, Virginia. Each of the proposed sites has two operating reactors that would be used to irradiate MOX fuel assemblies. All of these sites have been operating safely for a number of years. Table 4–209 indicates operating statistics for each of the proposed reactors.

Table 4–209. Reactor Operating Information

Reactor	Operator	Capacity (net MWe)	Date of First Operation (mo/yr)
Catawba 1	Duke Power	1,129	1/85
Catawba 2	Duke Power	1,129	5/86
McGuire 1	Duke Power	1,129	7/81
McGuire 2	Duke Power	1,129	5/83
North Anna 1	Virginia Power	900	4/78
North Anna 2	Virginia Power	887	8/80

Source: DOE 1996i.

In the plant performance reviews announced in March 1999 (Table 4–210), NRC found that overall safety performance at Catawba, McGuire, and North Anna remains acceptable. Plant performance reviews are being used by NRC as an interim measure to monitor nuclear power plant safety until a new reactor oversight and assessment program is implemented. The new assessment program will provide quarterly performance reports based on a number of performance indicators and on inspection findings. A description of the new program is available on the NRC Web site at http://www.nrc.gov/OPA/primer.htm (NRC 1999b).

Table 4–210. Results of Plant Performance Reviews

Assessment Category[a]	Catawba	McGuire	North Anna
Overall	Acceptable	Acceptable	Acceptable
Operations	Consistent	Improved	Consistent
Maintenance	Consistent	Improved	Consistent
Engineering	Declined	Consistent	Consistent
Plant support	Consistent	Improved	Consistent

[a] Assessments based on most recent 6 months' performance when compared to previous 6-month period. "Consistent" indicates there has been no change in an acceptable performance for a given category. Similarly, "Declined" and "Improved" indicate a directional change in performance in the most recent 6 months.

Source: Haag 1999a, 1999b; Ogle 1999.

In accordance with the alternatives presented under the hybrid approach (i.e., Alternatives 2 through 10 in this SPD EIS), all of these reactors would use MOX fuel to partially fuel their reactor cores. Up to 33 t (36 tons) of surplus plutonium could be used in MOX fuel at these reactors from 2007–2022. In March 1999, DOE awarded a contract to Duke Engineering & Services, COGEMA Inc., and Stone & Webster (known as DCS) to provide MOX fuel fabrication and reactor irradiation services contingent on the selection (in the SPD EIS ROD) of the hybrid approach described in Chapter 2 of the SPD Draft EIS.

The analyses prepared for this section are based on information provided by DCS and verified by DOE. Data was also developed independently to support these analyses. This included projecting the population around the proposed reactor sites to 2015[45] and compiling information related to the topography surrounding the proposed reactor sites for evaluating air dispersal patterns. Information to support accident analysis was also provided by ORNL. Based on information provided by DCS, ORNL developed expected ratios of radionuclide activities in MOX fuel versus that in LEU fuel as it would be used in the reactors. Standard models for estimating radiation doses from normal operations and accident scenarios, and estimating air pollutant concentrations at the proposed reactor sites were run using this new information. Human health risk and accident analyses were performed for a maximum use of a 40 percent MOX core, which is a conservative estimate of the amount of MOX fuel that would be used in each of the reactors.

Under the MOX approach, both MOX and LEU fuel assemblies would be loaded into the reactor. The MOX assemblies would remain in the core for two 18-month cycles and the LEU assemblies for either two or three 18-month cycles, in accordance with the plant's current operating schedule. When the MOX fuel completes a normal cycle, it would be withdrawn from the reactor in accordance with the plant's standard refueling procedures and placed in the plant's spent fuel pool for cooling alongside other spent fuel. No changes are expected in the plant's spent fuel storage plans to accommodate the MOX spent fuel. Although the amount of fissile material would be higher in MOX spent fuel rods than in LEU spent fuel rods, rod numbers and spacing in the spent fuel pool and dry storage casks could be adjusted as necessary to maintain safety margins. Eventually the spent fuel would be shipped to a potential geologic repository for permanent disposal.

4.28.1 Construction Impacts

The proposed reactor sites have indicated that little or no new construction would be needed to support the irradiation of MOX fuel at the sites. As a result, land use; visual, cultural, and paleontological resources; geology and soils; and site infrastructure would not be affected by any new construction or other activities related to MOX fuel use. Nor would there be any effect on air quality and noise, ecological and water resources, or socioeconomics.

4.28.2 Operational Impacts

4.28.2.1 Air Quality and Noise

Continued operation of the proposed reactor sites would result in a small amount of nonradiological air pollutants being released to the atmosphere mainly due to the requirement to periodically test diesel generators. As shown in Section 3.7, all of the proposed reactors are operated within Federal, State, and local air quality regulations or guidelines. The estimated air pollutants resulting from operation of the proposed reactors would not be expected to increase due to the use of MOX fuel in these reactors. (See Tables 3–71, 3–76, and 3–81 in Section 3.7 for projected concentrations at the proposed reactor sites.)

There would also not be any increase in the noise levels expected from the operation of these reactors due to the use of MOX fuel.

[45] Population projections for the area encompassed in a 80-km (50-mi) radius around the proposed reactor sites were projected to 2015 to approximate the midpoint of the irradiation services program. By 2015, the MOX program would be firmly established at all of the proposed reactor sites and would be expected to remain stable through the end of the program. Using 1990 census data as the base year and state-provided population increase factors for all counties included in this analysis, the population around the sites was projected for 2015. Baseline projections were needed for the Catawba and McGuire reactor sites because the population information available was based on 1970 census data. Recent (i.e., 1990) census data were available for the North Anna site and projected by the offeror to the years 2010 and 2020. From these data points, 2015 projections were interpolated.

4.28.2.2 Waste Management

The proposed reactors would be expected to continue to produce low-level waste (LLW), mixed LLW, hazardous waste, and nonhazardous waste as part of their normal operations. The volume of waste generated is not expected to increase as a result of the reactors using MOX fuel. This is consistent with information presented in the *Storage and Disposition PEIS* that stated the use of MOX fuel is not expected to increase the amount or change the content of the waste being generated (DOE 1996a:4-734). (The amount of spent fuel generated would increase somewhat, as discussed in Section 4.28.2.8.)

As shown in Section 3.7, the estimated LLW generation for each of the proposed reactors is less than the amount estimated in the *Storage and Disposition PEIS* (DOE 1996a:4-734). (See Tables 3–72, 3–77, and 3–82 in Section 3.7.) None of these waste estimates are expected to impact the proposed reactor sites in terms of their ability to handle these wastes. The wastes would continue to be handled in the same manner as they are today with no change required due to the use of MOX fuel at the reactors.

4.28.2.3 Socioeconomics

The proposed reactor sites would not need to employ any additional workers to support the use of MOX fuel in the reactors. This is consistent with information presented in the *Storage and Disposition PEIS* which concluded that the use of MOX fuel could result in small increases in the worker population at the reactor sites (between 40 and 105), but that any increase would be filled from the area's existing workforce (DOE 1996a:4-727).

4.28.2.4 Human Health Risk From Normal Operations

There should be no change in the radiation dose to the public from normal operation of the reactors with a partial MOX fuel core versus a full LEU fuel core. This is consistent with findings in the *Storage and Disposition PEIS* that showed a very small range in the expected difference: -1.1×10^{-2} to 2×10^{-2} person-rem (DOE 1996a:4-729). Therefore, the doses would be approximately the same for either core. The annual estimated radiological releases from normal operation of the proposed reactors to the environment are shown in Table 4–211.

Table 4–211. Expected Radiological Releases From Continued Operation of the Proposed Reactors (Ci)

Reactor	Atmospheric Releases	Liquid Release	Total Estimated Release
Catawba	349.6	591.4	941.0
McGuire	165.2	626.1	791.3
North Anna	132.5	1,036.0	1,168.5

Table 4–212 shows the projected radiological doses that would be received by the maximally exposed offsite individual (MEI) and the general population based on the releases shown in Table 4–211. As shown in Table 4–212, the average individual living within 80 km (50 mi) of one of the proposed reactor sites could expect to receive an annual dose of between 2.5×10^{-3} to 9.9×10^{-3} mrem/yr from normal operation of these reactors regardless of whether the reactors were using MOX fuel or LEU fuel. This is a small dose compared with the average annual dose an individual would receive from natural background radiation near these sites (about 325 mrem).

Table 4–212. Estimated Dose to the Public From Continued Operation of the Proposed Reactors in the Year 2015 (Partial MOX or LEU Core)

Impact	Catawba[a]	McGuire[b]	North Anna[c]	S&D PEIS
Population within 80 km for year 2015				
Dose (person-rem)	5.7	10.7	20.3	2.0
Percent of natural background	7.7×10^{-4}	1.3×10^{-3}	3.0×10^{-3}	2.6×10^{-4}
Latent fatal cancers	2.9×10^{-3}	5.4×10^{-3}	1.0×10^{-2}	1.0×10^{-3}
Maximally exposed individual (mrem/yr)				
Annual dose (mrem)	0.73	0.31	0.37	0.17
Percent of natural background	0.22	0.095	0.11	0.052
Latent fatal cancer risk	3.7×10^{-7}	1.6×10^{-7}	1.9×10^{-7}	8.5×10^{-8}
Average exposed individual within 80 km				
Annual dose (mrem)	2.5×10^{-3}	4.2×10^{-3}	9.9×10^{-3}	7.8×10^{-4}
Latent fatal cancer risk	1.3×10^{-9}	2.1×10^{-9}	4.9×10^{-9}	3.9×10^{-10}

[a] The population for the year 2015 is estimated to be 2,265,000.
[b] The population for the year 2015 is estimated to be 2,575,000.
[c] The population for the year 2015 is estimated to be 2,042,000.
Key: LEU, low-enriched uranium; S&D PEIS, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement.*

The average radiation worker at the proposed reactor sites could expect to receive an annual dose of between 46 and 123 mrem/yr from normal operations with a partial MOX core. (See Tables 3–75, 3–80, and 3–85 in Section 3.7.) As discussed in Section 3.7 and Appendix P, this is the same amount of radiation dose that would be received if the reactors continued to use only LEU fuel. This is because the MOX fuel would be shipped in SST/SGTs and moved remotely or in shielded vehicles to the reactor's fuel staging area and finally into and out of the reactor core. The projection that the use of MOX fuel would not change the estimated worker dose is consistent with data presented in the *Storage and Disposition PEIS*, which showed an incremental increase in worker dose of less than 1.0 percent due to the use of MOX fuel (DOE 1996a:4-730).

4.28.2.5 Reactor Accident Analysis

The reactor accident analysis includes an assessment of postulated design basis and beyond-design-basis accidents at each reactor site. The accidents presented were selected because of their potential to release substantial amounts of radioactive material to the environment. A detailed discussion of the accident analysis methodology is provided in Appendix K.

There are differences in the expected risk of reactor accidents from the use of MOX fuel. Risk is determined by multiplying two factors. The first factor is the probability or frequency of the accident occurring. In the case of the reactor accidents evaluated in this SPD EIS, no change has been made in the estimated frequency of the accident based on the presence of MOX fuel. The frequencies used in the analysis are the same as those used in each reactor's probabilistic risk assessment (PRA), which was prepared for NRC for the reactor's current LEU core. Although it has been suggested that the frequency of these accidents would be higher with MOX fuel present, no empirical data is available to support this. Further, the National Academy of Sciences has stated that "We believe, further, that under these circumstances no important overall adverse impact of MOX use on the accident probabilities of the LWRs [light water reactors] involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather

than LEU fuel" (NAS 1995). The second factor in the risk equation is an estimate of what the consequences would be should the accident occur. Depending on the accident being analyzed, the presence of MOX fuel would decrease or increase the consequences of the accident because it would result in a different amount of radiation being released during the accident due to different isotopics and amounts of radioactive isotopes and noble gases being generated.

The change in consequences to the surrounding population due to the use of MOX fuel is estimated to range from 9.0×10^{-4} fewer to 6.0×10^{-2} additional LCFs for design basis accidents evaluated in this SPD EIS, to 7.0 fewer to 1,300 additional LCFs for beyond-design-basis accidents (16,900 versus 15,600 LCFs in the worst accident). Also, some of the beyond-design-basis accidents could result in prompt fatalities should they occur. The estimated increase in prompt fatalities due to MOX fuel being used during one of these accidents would range from no change to 28 additional fatalities (843 versus 815 prompt fatalities in the worst accident). As a result of these changes in projected consequences, there would be a change in the risk to the public associated with these accidents. The change in risk (in terms of an LCF or prompt fatality) to the surrounding population within 80 km (50 mi) of the proposed reactors is projected to range from a decrease of 6 percent to an increase of 3 percent in the risk of additional LCFs from design basis accidents, and from a decrease of 4 percent to an increase of 14 percent in the risk of additional prompt fatalities and LCFs from beyond-design-basis accidents.

The risk to the MEI would also change with the use of MOX fuel. The change in risk to the MEI of an LCF as a result of using MOX fuel during one of the design basis accidents evaluated is expected to range from a decrease of 10 percent to an increase of 3 percent. The change in risk to the MEI of a prompt fatality or LCF as a result of using MOX fuel during one of the beyond-design-basis accidents evaluated is expected to range from a 1 percent increase to a 22 percent increase. In the most severe accident evaluated, an ISLOCA, it is projected that the MEI would receive a fatal dose of radiation regardless of whether the reactor was using MOX fuel or LEU fuel at all of the proposed sites. It should be noted that the probability or estimated frequency of this accident occurring is very low; an average of 1 chance in 3.2 million per year of reactor operation.

Beyond-design-basis accidents, if they were to occur, would be expected to result in major impacts to the reactors and the surrounding communities and environment regardless of whether the reactor were using an LEU or partial MOX core. However, the probability of a beyond-design-basis accident actually happening is extremely unlikely, so the risk to an individual living within 80 km (50 mi) of the proposed reactors from these accidents is estimated to be low.

[Text deleted.] NRC-accepted models were used to estimate impacts associated with normal operations, design basis, and beyond-design-basis accidents. The methodology used is consistent with DOE and industry practice. The results are determined by the methodology and the assumptions. As indicated in this section, DOE's assumptions are based on its current planning, for example, 40 percent MOX cores rather than full cores as used in the *Storage and Disposition PEIS,* as well as site-specific meteorology and population data—all factors that influence the results.

4.28.2.5.1 Design Basis Accident Analysis

Design basis events are not expected to take place, but are postulated because their consequences would include the potential for the release of substantial amounts of radioactive material. They are the most drastic events that must be designed against and represent limiting design cases. The design basis accidents evaluated in this SPD EIS include a large-break loss-of-coolant accident (LOCA) and a fuel-handling accident.

The large-break LOCA is defined as a break equivalent in size to a double-ended rupture of the largest pipe of the reactor coolant system. Following this rupture of a reactor coolant pipe, the emergency core cooling system keeps cladding temperatures well below melting, ensuring that the core remains intact and in a coolable geometry.

The increase in cladding temperature and rapid depressurization of the core, however, may cause some cladding failure in the hottest regions of the core. Thus, a fraction of the fission products accumulated in the pellet-cladding gap may be released to the reactor coolant system and thereby to the containment. Although no core melting would occur during this LOCA, a gross release of fission products is evaluated consistent with NRC methodology. For a gross release of fission products to occur, a number of simultaneous and extended failures in the engineered safety feature systems would be required.

The fuel-handling accident is defined as dropping of a spent fuel assembly resulting in breaching of the fuel rod cladding. This breach would release a portion of the volatile fission gases from the damaged fuel rods. Although this fuelhandling accident would realistically result in only a fraction of the fuel rods being damaged, all the fuel rods in the assembly are assumed to be damaged consistent with NRC methodology.

No major increase in estimated impacts would be expected from design basis accidents at the proposed reactor sites due to the use of MOX fuel. In fact, the risk from the postulated fuel-handling accident at all three sites would slightly decrease as a result of using MOX fuel. The fuel-handling accident doses are driven by the noble gases, primarily krypton. The percentage of the dose attributable to krypton is 58 percent at Catawba, 56 percent at McGuire, and 54 percent at North Anna. With the 40 percent MOX core, the MOX/LEU ratios for the krypton isotopes range from 0.78–0.89 indicating that there is less krypton present in a partial MOX core. The combination of the low MOX/LEU ratio and the large percentage of dose contribution associated with krypton results in a lower dose for this accident with a 40 percent MOX core.

The doses to the surrounding population within 80 km (50 mi) from a LOCA are expected to be about 3 percent higher for a partial MOX core versus a full LEU core. The LOCA doses are driven by radioactive isotopes of iodine. The percentage of dose attributable to iodine in a LOCA is approximately 97 percent at each reactor site. Because the iodine MOX/LEU ratios average slightly over one, indicating that there is more iodine present in a partial MOX core, the dose also rises slightly for this accident.

Catawba Design Basis Accident Analysis

Table 4–213 presents the results of this analysis for design basis accidents at Catawba. (To derive the increase or decrease in risk associated with the use of MOX fuel at any of the proposed reactors, subtract the risk associated with the full LEU core from the same risk for a partial MOX core for any of the accidents presented in Tables 4–213 through 4–215 and 4–218 through 4–220. For example, the risk to the MEI at the site boundary from a LOCA at Catawba, as shown in Table 4–213, is calculated by subtracting 8.64×10^{-8} from 8.88×10^{-8} for an increase in risk of 2.4×10^{-9}. All risks have been rounded to two significant figures, so, in cases where the difference is only one digit, the numbers have been extended to two significant figures using model results.)

The results indicate that the highest risk increase to the surrounding population for a design basis accident with a partial MOX core configuration instead of a full LEU core is 3.3 percent from the LOCA. The increased risk, in terms of a fatality, from the use of MOX fuel to the noninvolved worker[46] is 1 in 200 million (5.0×10^{-9}) per

[46] During a design basis accident at a commercial reactor, the involved workers are defined, for the purposes of this SPD EIS, as control room operators. Control rooms at commercial reactors are designed so that during a design basis accident, the doses to control room operators are mitigated by emergency systems. These systems include isolation dampers, emergency ventilation systems, bottled air supplies, and HEPA filtration to lower the doses to control room operators. Control room operator doses are predominantly from noble gases and iodine because the HEPA filtration removes almost all of the particulates. Therefore, the assumption is made that an unprotected noninvolved worker (i.e., all workers except those in the control room at the time of the accident) would most likely receive a larger dose. Because the objective of the analysis is to determine the maximum increased risk from a partial MOX core versus an LEU core, the noninvolved worker was chosen as the onsite receptor.

16-year campaign[47]; the MEI, 1 in 420 million (2.4×10^{-9}) per 16-year campaign; and the general population, 1 in 140,000 (7.0×10^{-6}) per 16-year campaign.

McGuire Design Basis Accident Analysis

Table 4–214 presents the results of this analysis for design basis accidents at McGuire. The results indicate that the highest risk increase to the surrounding population for a design basis accident with a partial MOX core configuration instead of a full LEU core is approximately 3.0 percent from the LOCA. The increased risk, in terms of a fatality, from the use of MOX fuel to the noninvolved worker is 1 in 67 million (1.5×10^{-8}) per 16-year campaign; the MEI, 1 in 120 million (8.0×10^{-9}) per 16-year campaign; and the general population, 1 in 83,000 (1.2×10^{-5}) per 16-year campaign.

North Anna Design Basis Accident Analysis

Table 4–215 presents the results of this analysis for design basis accidents at North Anna. The results indicate that the highest risk increase to the surrounding population for a design basis accident with a partial MOX core configuration instead of a full LEU core is approximately 2.5 percent from the LOCA. The increased risk, in terms of a fatality, from the use of MOX fuel to the noninvolved worker is 1 in 5.0 billion (2.0×10^{-10}) per 16-year campaign; the MEI, 1 in 25 billion (4.0×10^{-11}) per 16-year campaign; and the general population, 1 in 6.2 million (1.6×10^{-7}) per 16-year campaign.

[47] If MOX fuel is used in the proposed reactors, it is estimated that it will take approximately 16 years to irradiate all of the surplus plutonium currently considered for use in MOX fuel.

Table 4–213. Design Basis Accident Impacts for Catawba With LEU and MOX Fuels

Accident	Frequency (per year)	LEU or MOX Core	Impacts on Noninvolved Worker: Dose (rem)	Impacts on Noninvolved Worker: Probability of Latent Cancer Fatality[a]	Impacts on Noninvolved Worker: Risk of Latent Cancer Fatality (over campaign)[b]	Impacts at Site Boundary: Dose (rem)	Impacts at Site Boundary: Probability of Latent Cancer Fatality[a]	Impacts at Site Boundary: Risk of Latent Cancer Fatality (over campaign)[b]	Impacts on Population Within 80 km: Dose (person-rem)	Impacts on Population Within 80 km: Latent Cancer Fatalities[c]	Impacts on Population Within 80 km: Risk of Latent Cancer Fatalities (over campaign)[d]
Loss-of-coolant accident	7.50×10^{-6}	LEU	3.78	1.51×10^{-3}	1.81×10^{-7}	1.44	7.20×10^{-4}	8.64×10^{-8}	3.64×10^{3}	1.82	2.19×10^{-4}
		MOX	3.85	1.54×10^{-3}	1.86×10^{-7}	1.48	7.40×10^{-4}	8.88×10^{-8}	3.75×10^{3}	1.88	2.26×10^{-4}
Spent-fuel-handling accident[e]	1.00×10^{-4}	LEU	0.27	1.10×10^{-4}	1.78×10^{-7}	0.14	6.90×10^{-5}	1.10×10^{-7}	1.12×10^{2}	5.61×10^{-2}	8.98×10^{-5}
		MOX	0.26	1.05×10^{-4}	1.68×10^{-7}	0.13	6.55×10^{-5}	1.05×10^{-7}	1.10×10^{2}	5.48×10^{-2}	8.77×10^{-5}

[a] Likelihood (or probability) of cancer fatality to a hypothetical individual—a noninvolved worker at a distance of 640 m (2,100 ft) or the maximally exposed offsite individual at the site boundary (762 m [2,500 ft])—given exposure to the indicated dose.

[b] Risk of cancer fatality over the estimated 16-year campaign to a hypothetical individual—a noninvolved worker at a distance of 640 m (2,100 ft) or the maximally exposed offsite individual at the site boundary (762 m [2,500 ft]).

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose.

[d] Risk of cancer fatalities over the estimated 16-year campaign in the entire offsite population out to a distance of 80 km (50 mi).

[e] Postulated design basis accidents at commercial reactors are considered extremely unlikely events. They are estimated to have a frequency of between 1.0×10^{-4} and 1.0×10^{-6} per year. Because a spent-fuel-handling accident does not have a calculated frequency associated with it, it has been estimated to have the highest frequency for the purposes of this analysis.

Key: LEU, low-enriched uranium.

Table 4–214. Design Basis Accident Impacts for McGuire With LEU and MOX Fuels

			Impacts on Noninvolved Worker			Impacts at Site Boundary			Impacts on Population Within 80 km		
Accident	Frequency (per year)	LEU or MOX Core	Dose (rem)	Probability of Latent Cancer Fatality[a]	Risk of Latent Cancer Fatality (over campaign)[b]	Dose (rem)	Probability of Latent Cancer Fatality[a]	Risk of Latent Cancer Fatality (over campaign)[b]	Dose (person-rem)	Latent Cancer Fatalities[c]	Risk of Latent Cancer Fatalities (over campaign)[d]
Loss-of-coolant accident	1.50×10^{-5}	LEU	5.31	2.12×10^{-3}	5.10×10^{-7}	2.28	1.14×10^{-3}	2.74×10^{-7}	3.37×10^{3}	1.69	4.06×10^{-4}
		MOX	5.46	2.18×10^{-3}	5.25×10^{-7}	2.34	1.17×10^{-3}	2.82×10^{-7}	3.47×10^{3}	1.74	4.18×10^{-4}
Spent-fuel-handling accident[e]	1.00×10^{-4}	LEU	0.392	1.57×10^{-4}	2.51×10^{-7}	0.212	1.06×10^{-4}	1.70×10^{-7}	99.1	4.96×10^{-2}	7.94×10^{-5}
		MOX	0.373	1.49×10^{-4}	2.38×10^{-7}	0.201	1.01×10^{-4}	1.62×10^{-7}	97.3	4.87×10^{-2}	7.79×10^{-5}

[a] Likelihood (or probability) of cancer fatality to a hypothetical individual—a noninvolved worker at a distance of 640 m (2,100 ft) or the maximally exposed offsite individual at the site boundary (762 m [2,500 ft])—given exposure to the indicated dose.

[b] Risk of cancer fatality over the estimated 16-year campaign to a hypothetical individual—a noninvolved worker at a distance of 640 m (2,100 ft) or the maximally exposed offsite individual at the site boundary (762 m [2,500 ft]).

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose.

[d] Risk of cancer fatalities over the estimated 16-year campaign in the entire offsite population out to a distance of 80 km (50 mi).

[e] Postulated design basis accidents at commercial reactors are considered extremely unlikely events. They are estimated to have a frequency of between 1.0×10^{-4} and 1.0×10^{-6} per year. Because a spent-fuel-handling accident does not have a calculated frequency associated with it, it has been estimated to have the highest frequency for the purposes of this analysis.

Key: LEU, low-enriched uranium.

Table 4–215. Design Basis Accident Impacts for North Anna With LEU and MOX Fuels

			Impacts on Noninvolved Worker			Impacts at Site Boundary			Impacts on Population Within 80 km		
Accident	Frequency (per year)	LEU or MOX Core	Dose (rem)	Probability of Latent Cancer Fatality[a]	Risk of Latent Cancer Fatality (over campaign)[b]	Dose (rem)	Probability of Latent Cancer Fatality[a]	Risk of Latent Cancer Fatality (over campaign)[b]	Dose (person-rem)	Latent Cancer Fatalities[c]	Risk of Latent Cancer Fatalities (over campaign)[d]
Loss-of-coolant accident	2.10×10^{-5}	LEU	0.114	4.56×10^{-5}	1.53×10^{-8}	3.18×10^{-2}	1.59×10^{-5}	5.34×10^{-9}	39.4	1.97×10^{-2}	6.62×10^{-6}
		MOX	0.115	4.60×10^{-5}	1.55×10^{-8}	3.20×10^{-2}	1.60×10^{-5}	5.38×10^{-9}	40.3	2.02×10^{-2}	6.78×10^{-6}
Spent-fuel-handling accident[e]	1.00×10^{-4}	LEU	0.261	1.04×10^{-4}	1.66×10^{-7}	9.54×10^{-2}	4.77×10^{-5}	7.63×10^{-8}	29.4	1.47×10^{-2}	2.35×10^{-5}
		MOX	0.239	9.56×10^{-5}	1.53×10^{-7}	8.61×10^{-2}	4.31×10^{-5}	6.90×10^{-8}	27.5	1.38×10^{-2}	2.21×10^{-5}

[a] Likelihood (or probability) of cancer fatality to a hypothetical individual—a noninvolved worker at a distance of 640 m (2,100 ft) or the maximally exposed offsite individual at the site boundary (1,349 m [4,426 ft])—given exposure to the indicated dose.

[b] Risk of cancer fatality over the estimated 16-year campaign to a hypothetical individual—a noninvolved worker at a distance of 640 m (2,100 ft) or the maximally exposed offsite individual at the site boundary (1,349 m [4,426 ft]).

[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose.

[d] Risk of cancer fatalities over the estimated 16-year campaign in the entire offsite population out to a distance of 80 km (50 mi).

[e] Postulated design basis accidents at commercial reactors are considered extremely unlikely events. They are estimated to have a frequency of between 1.0×10^{-4} and 1.0×10^{-6} per year. Because a spent-fuel-handling accident does not have a calculated frequency associated with it, it has been estimated to have the highest frequency for the purposes of this analysis.

Key: LEU, low-enriched uranium.

4.28.2.5.2 Beyond-Design-Basis Accident Analysis

Only beyond-design-basis accident scenarios that lead to containment bypass or failure were evaluated because these are the accidents with the greatest potential consequences. The public health and environmental consequences would be significantly less for accident scenarios that do not lead to containment bypass or failure. A steam generator tube rupture, early containment failure, late containment failure, and an ISLOCA were chosen as the representative set of beyond-design-basis accidents.

Commercial reactors, licensed by NRC, are required to complete Individual Plant Examinations (IPEs) to assess plant vulnerabilities to severe accidents. An acceptable method of completing the IPEs is to perform a PRA. A PRA evaluates, in full detail (quantitatively), the consequences of all potential events caused by the operating disturbances (known as internal initiating events) within each plant. The PRA uses realistic criteria and assumptions in evaluating the accident progression and the systems required to mitigate each accident. The PRAs for the proposed reactors provided the required data to evaluate beyond-design-basis accidents.

A beyond-design-basis steam generator tube rupture induced by high temperatures represents a containment bypass event. Analyses have indicated a potential for very high gas temperatures in the reactor coolant system during accidents involving core damage with the primary system at high pressure. The high temperature could fail the steam generator tubes long before the core begins to relocate. As a result of the tube rupture, the secondary (nonradioactive) side may be exposed to high pressure. This pressure would likely cause relief valves to open. If these valves failed to reclose, an open pathway from the vessel to the environment would result.

An early containment failure is defined as the failure of containment prior to or very soon (within a few hours) after breach of the reactor vessel. A variety of mechanisms can cause failure such as direct contact of core debris with the containment, rapid pressure and temperature loads, hydrogen combustion, and fuel-coolant interactions. Early containment failure can be important because it tends to result in shorter warning times for initiating public protective measures and because radionuclide releases would generally be more severe than if the containment were to fail late.

A late containment failure involves failure of the containment several hours after breach of the reactor vessel. A variety of mechanisms can cause late containment failure such as gradual pressure and temperature increase, hydrogen combustion, and basemat melt-through by core debris.

An ISLOCA refers to a class of accidents in which the reactor coolant system pressure boundary interfacing with a supporting system of lower design pressure is breached. If this occurs, the low-pressure system would be overpressurized and could rupture outside the containment. This failure would establish a flow path directly to the environment or, sometimes, to another building of small-pressure capacity.

Each of these accidents has a warning time and a release time associated with it. The warning time is the time at which notification is given to offsite emergency response officials to initiate protective measures for the surrounding population. The release time is when the release to the environment begins. The minimum time between the warning time and the release time is one-half hour; enough time to evacuate onsite personnel. This also conservatively assumes that an onsite emergency has not been declared prior to initiating an offsite notification. Intact containment severe accident scenarios, which were not analyzed because of their insubstantial offsite consequences, take place on an even longer timeframe.

For severe accident scenarios that postulate large abrupt releases, there exists a possibility for prompt fatalities. Prompt fatalities may occur if the radiation dose is sufficiently high. Table 4–216 shows the number of prompt fatalities in the offsite population estimated from a postulated beyond-design-basis steam generator tube

Table 4–216. Estimated Prompt Fatalities in the Public From Beyond-Design-Basis Reactor Accidents

Reactor	LEU Core	Partial MOX Core
Steam generator tube rupture		
Catawba	1	1
McGuire	1	1
North Anna	0	0
Interfacing systems loss-of-coolant accident		
Catawba	815	843
McGuire	398	421
North Anna	54	60

rupture and ISLOCA. None of the other accidents evaluated in this SPD EIS is expected to result in prompt fatalities.

Table 4–217 shows the difference in accident consequences for reactors using MOX fuel versus LEU fuel. For beyond-design-basis accidents, the consequences would be expected to be higher, with the largest increase associated with an ISLOCA. This is because the MOX fuel would release a higher actinide inventory in a severe accident. The increased impacts of an ISLOCA range from 7 to 14 percent and are estimated, on average, to be about 9 percent greater to the general population living within 80 km (50 mi) of the reactor with a partial MOX core instead of an LEU core. It should be noted that this accident has a very low estimated frequency of occurrence, an average of 1 chance in 3.2 million per year of reactor operation for the reactors being proposed to irradiate MOX fuel.

Table 4–217. Ratio of Accident Impacts for MOX-Fueled and Uranium-Fueled Reactors (MOX Impacts/LEU Impacts)

	Catawba		McGuire		North Anna		S&D PEIS[a]	
Accident	MEI	Population	MEI	Population	MEI	Population	MEI	Population
Design basis accidents								
LOCA[b]	1.03	1.03	1.03	1.03	1.01	1.03	NA	NA
Fuel-handling accident[b]	0.95	0.98	0.95	0.98	0.90	0.94	NA	NA
Beyond-design-basis accidents								
SG tube rupture	1.06	1.04	1.06	1.04	1.16	1.09	0.94	0.94
Early containment failure	1.01	1.05	1.03	1.02	1.10	1.02	0.96	0.97
Late containment failure	1.07	0.96	1.01	0.97	1.03	1.09	1.07	1.08
ISLOCA	1.14	1.08	1.12	1.07	1.22	1.14	0.92	0.93

[a] Accidents presented in the *Storage and Disposition PEIS* assumed a full MOX core rather than the 40 percent MOX core evaluated in this SPD EIS.

[b] No design basis accidents were analyzed in the *Storage and Disposition PEIS.*

Key: ISLOCA, interfacing systems loss-of-coolant accident; LEU, low-enriched uranium; LOCA, loss-of-coolant accident; MEI, maximally exposed individual; NA, not applicable; S&D PEIS, *Storage and Disposition of Weapons-Usable Fissile Material Final Programmatic Environmental Impact Statement*; SG, steam generator.

CATAWBA BEYOND-DESIGN-BASIS ACCIDENTS

Table 4–218 shows the risks of LCFs associated with all of the evaluated Catawba beyond-design-basis accidents.

Table 4–218. Beyond-Design-Basis Accident Impacts for Catawba With LEU and MOX Fuels

			Impacts at Site Boundary			Impacts on Population Within 80 km		
Accident	Frequency (per year)	LEU or MOX Core	Dose (rem)	Probability of Latent Cancer Fatality[a]	Risk of Latent Cancer Fatality (over campaign)[b]	Dose (person-rem)	Latent Cancer Fatalities[c]	Risk of Latent Cancer Fatalities (over campaign)[d]
SG tube rupture[e]	6.31×10^{-10}	LEU	3.46×10^{2}	0.346	3.49×10^{-9}	5.71×10^{6}	5.20×10^{3}	5.25×10^{-5}
		MOX	3.67×10^{2}	0.367	3.71×10^{-9}	5.93×10^{6}	5.42×10^{3}	5.47×10^{-5}
Early containment failure	3.42×10^{-8}	LEU	5.97	2.99×10^{-3}	1.63×10^{-9}	7.70×10^{5}	4.62×10^{2}	2.53×10^{-4}
		MOX	6.01	3.01×10^{-3}	1.65×10^{-9}	8.07×10^{5}	4.84×10^{2}	2.66×10^{-4}
Late containment failure	1.21×10^{-5}	LEU	3.25	1.63×10^{-3}	3.15×10^{-7}	3.93×10^{5}	1.97×10^{2}	3.81×10^{-2}
		MOX	3.48	1.74×10^{-3}	3.38×10^{-7}	3.78×10^{5}	1.90×10^{2}	3.68×10^{-2}
ISLOCA	6.90×10^{-8}	LEU	1.40×10^{4}	1	1.10×10^{-6}	2.64×10^{7}	1.56×10^{4}	1.73×10^{-2}
		MOX	1.60×10^{4}	1	1.10×10^{-6}	2.96×10^{7}	1.69×10^{4}	1.87×10^{-2}

[a] Likelihood (or probability) of cancer fatality to a hypothetical individual—the maximally exposed offsite individual at the site boundary (762 m [2,500 ft])—given exposure to the indicated dose.
[b] Risk of cancer fatality over the estimated 16-year campaign to a hypothetical individual—the maximally exposed offsite individual at the site boundary (762 m [2,500 ft]).
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose.
[d] Risk of cancer fatalities over the estimated 16-year campaign in the entire offsite population out to a distance of 80 km (50 mi).
[e] McGuire timing and release fractions were used to compare like scenarios.
Key: ISLOCA, interfacing systems loss-of-coolant accident; LEU, low-enriched uranium; SG, steam generator.

At Catawba, the greatest increase in risk of LCFs from the use of a partial MOX core to the surrounding population within 80 km (50 mi) for a beyond-design-basis accident is from an ISLOCA. If this accident were to occur, the consequences, in terms of LCFs and prompt fatalities in the general population within 80 km (50 mi), would be approximately 8 percent greater than those from an ISLOCA with an LEU core. It would be expected to result in approximately 16,400 fatalities with an LEU core and 17,700 fatalities with a partial MOX core. The increased risk, in terms of an LCF, in the surrounding population associated with the use of MOX fuel would be 1 in 710 (1.4×10^{-3}) per 16-year campaign. The increased risk, in terms of a prompt fatality, is 1 in 32,000 (3.1×10^{-5}) per 16-year campaign. No increase in risk to the MEI would be expected due to the severity of this accident. The MEI would be expected to receive a fatal dose regardless of whether the core was partially fueled with MOX fuel or not, so the risk of a fatality is estimated to be the same in either case, 1 in 910,000 (1.1×10^{-6}) per 16-year campaign.

At Catawba, the highest risk from a beyond-design-basis accident to the surrounding population within 80 km (50 mi) is from a late containment failure regardless of core type. If this accident were to occur with a partial MOX core, the consequences, in terms of LCFs, would be approximately 3.6 percent lower than those from the same accident with an LEU core. This accident would be expected to result in 197 LCFs with an LEU core and 190 LCFs with a partial MOX core. The decreased risk, in terms of an LCF, to the population associated with the use of MOX fuel would be 1 in 770 (1.3×10^{-3}) per 16-year campaign. No prompt fatalities would be expected

to result from this accident. However, the risk to the MEI would be expected to increase by approximately 7 percent if a partial MOX core were being used.[48] The increased risk of an LCF to the MEI from this accident with a partial MOX core is estimated to be 1 in 43 million (2.3×10^{-8}) per 16-year campaign.

McGuire Beyond-Design-Basis Accidents

Table 4–219 shows the risks of LCFs associated with all of the evaluated McGuire beyond-design-basis accidents.

Table 4–219. Beyond-Design-Basis Accident Impacts for McGuire With LEU and MOX Fuels

			Impacts at Site Boundary			Impacts on Population Within 80 km		
Accident	Frequency (per year)	LEU or MOX Core	Dose (rem)	Probability of Latent Cancer Fatality[a]	Risk of Latent Cancer Fatality (over campaign)[b]	Dose (person-rem)	Latent Cancer Fatalities[c]	Risk of Latent Cancer Fatalities (over campaign)[d]
SG tube rupture[e]	5.81×10^{-9}	LEU	6.10×10^{2}	0.610	5.66×10^{-8}	5.08×10^{6}	4.65×10^{3}	4.32×10^{-4}
		MOX	6.47×10^{2}	0.647	6.02×10^{-8}	5.28×10^{6}	4.85×10^{3}	4.51×10^{-4}
Early containment failure	9.89×10^{-8}	LEU	12.2	6.10×10^{-3}	9.65×10^{-9}	7.90×10^{5}	4.57×10^{2}	7.23×10^{-4}
		MOX	12.6	6.30×10^{-3}	9.97×10^{-9}	8.04×10^{5}	4.67×10^{2}	7.39×10^{-4}
Late containment failure	7.21×10^{-6}	LEU	2.18	1.09×10^{-3}	1.26×10^{-7}	3.04×10^{5}	1.52×10^{2}	1.76×10^{-2}
		MOX	2.21	1.11×10^{-3}	1.28×10^{-7}	2.96×10^{5}	1.48×10^{2}	1.71×10^{-2}
ISLOCA	6.35×10^{-7}	LEU	1.95×10^{4}	1	1.02×10^{-5}	1.79×10^{7}	1.19×10^{4}	0.121
		MOX	2.19×10^{4}	1	1.02×10^{-5}	1.97×10^{7}	1.27×10^{4}	0.129

a Likelihood (or probability) of cancer fatality to a hypothetical individual—the maximally exposed offsite individual at the site boundary (762 m [2,500 ft])—given exposure to the indicated dose.
b Risk of cancer fatality over the estimated 16-year campaign to a hypothetical individual—the maximally exposed offsite individual at the site boundary (762 m [2,500 ft]).
c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose.
d Risk of cancer fatalities over the estimated 16-year campaign in the entire offsite population out to a distance of 80 km (50 mi).
e McGuire timing and release fractions were used to compare like scenarios.
Key: ISLOCA, interfacing systems loss-of-coolant accident; LEU, low-enriched uranium; SG, steam generator.

At McGuire, the greatest increase in risk from the use of a partial MOX core and the highest risk regardless of core type to the surrounding population within 80 km (50 mi) for a beyond-design-basis accident is from an ISLOCA. If this accident were to occur, the consequences, in terms of LCFs and prompt fatalities, in the general population within 80 km (50 mi) would be approximately 7 percent greater than those from an ISLOCA with an LEU core. It would be expected to result in approximately 12,300 fatalities with an LEU core and 13,100 fatalities with a partial MOX core. The increased risk, in terms of an LCF, in the surrounding population would

48 For the late containment failure scenario at Catawba and McGuire, the MEI dose increases while the population dose decreases. The MEI dose increases because 96 percent of the MEI dose is from direct exposure during the initial plume passage. With a 40 percent MOX core, there is approximately double the actinide inventory. Because the actinide isotopes contribute greatly to the inhalation dose, the MEI dose increases. The majority of the population dose (78 percent) is from long-term effects, primarily groundshine. With a 40 percent MOX core, the majority of the fission products decrease, resulting in a lower groundshine dose. Therefore, the population dose decreases.

be 1 in 120 (8.0×10^{-3}) per 16-year campaign. The increased risk, in terms of a prompt fatality, would be 1 in 4,300 (2.3×10^{-4}) per 16-year campaign. For the same reasons as discussed above for Catawba, no increase in risk to the MEI would be expected due to the severity of this accident. The risk to the MEI of a fatality is estimated to be the same in either case, 1 in 98,000 (1.0×10^{-5}) per 16-year campaign.

NORTH ANNA BEYOND-DESIGN-BASIS ACCIDENTS

Table 4–220 shows the risks of LCFs associated with all of the evaluated North Anna beyond-design-basis accidents.

Table 4–220. Beyond-Design-Basis Accident Impacts for North Anna With LEU and MOX Fuels

			Impacts on Site Boundary			Impacts on Population Within 80 km		
Accident	Frequency (per year)	LEU or MOX Core	Dose (rem)	Probability of Latent Cancer Fatality[a]	Risk of Latent Cancer Fatality (over campaign)[b]	Dose (person-rem)	Latent Cancer Fatalities[c]	Risk of Latent Cancer Fatalities (over campaign)[d]
SG tube rupture[e]	7.38×10^{-6}	LEU	2.09×10^{2}	0.209	2.46×10^{-5}	1.73×10^{6}	1.22×10^{3}	0.144
		MOX	2.43×10^{2}	0.243	2.86×10^{-5}	1.84×10^{6}	1.33×10^{3}	0.157
Early containment failure[e]	1.60×10^{-7}	LEU	19.6	1.96×10^{-2}	5.02×10^{-8}	8.33×10^{5}	4.52×10^{2}	1.16×10^{-3}
		MOX	21.6	2.16×10^{-2}	5.54×10^{-8}	8.42×10^{5}	4.61×10^{2}	1.18×10^{-3}
Late containment failure[e]	2.46×10^{-6}	LEU	1.12	5.60×10^{-4}	2.21×10^{-8}	4.04×10^{4}	20.2	7.95×10^{-4}
		MOX	1.15	5.75×10^{-4}	2.26×10^{-8}	4.43×10^{4}	22.1	8.70×10^{-4}
ISLOCA[e]	2.40×10^{-7}	LEU	1.00×10^{4}	1	3.84×10^{-6}	4.68×10^{6}	2.98×10^{3}	1.14×10^{-2}
		MOX	1.22×10^{4}	1	3.84×10^{-6}	5.41×10^{6}	3.39×10^{3}	1.30×10^{-2}

[a] Likelihood (or probability) of cancer fatality to a hypothetical individual—the maximally exposed offsite individual at the site boundary (1,349 m [4,426 ft])—given exposure to the indicated dose.
[b] Risk of cancer fatality over the estimated 16-year campaign to a hypothetical individual—the maximally exposed offsite individual at the site boundary (1,349 m [4,426 ft]).
[c] Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km (50 mi) given exposure to the indicated dose.
[d] Risk of cancer fatalities over the estimated 16-year campaign in the entire offsite population out to a distance of 80 km (50 mi).
[e] McGuire release durations and warning times were used in lieu of site specific data.
Key: ISLOCA, interfacing systems loss-of-coolant accident; LEU, low-enriched uranium; SG, steam generator.

At North Anna, the greatest increase in risk from the use of a partial MOX core to the surrounding population within 80 km (50 mi) for a beyond-design-basis accident is from an ISLOCA. If this accident were to occur, the consequences, in terms of LCFs and prompt fatalities, in the general population within 80 km (50 mi) would be approximately 14 percent greater than those from an ISLOCA with an LEU core. It would be expected to result in approximately 3,000 fatalities with an LEU core and 3,400 fatalities with a partial MOX core. The increased risk, in terms of an LCF, to the surrounding population, would be 1 in 620 (1.6×10^{-3}) per 16-year campaign. The increased risk, in terms of a prompt fatality, is 1 in 43,000 (2.3×10^{-5}) per 16-year campaign. For the same reasons as discussed above for Catawba, no increase in risk to the MEI would be expected due to the severity of this accident. The risk to the MEI of a fatality is estimated to be the same in either case, 1 in 260,000 (3.8×10^{-6}) per 16-year campaign.

At North Anna, the highest risk from a beyond-design-basis accident to the surrounding population within 80 km (50 mi) is from a steam generator tube rupture regardless of core type. If this accident were to occur with a partial MOX core, the consequences, in terms of LCFs, would be approximately 9 percent greater than those from the same accident with an LEU core. It would be expected to result in approximately 1,200 LCFs with an LEU core and 1,300 LCFs with a partial MOX core. The increased risk, in terms of an LCF, to the surrounding population would be 1 in 77 (1.3×10^{-2}) per 16-year campaign. No prompt fatalities would be expected to result from this accident. The risk to the MEI would be expected to increase by approximately 16 percent if a partial MOX core were being used. The increased risk to the MEI of a fatal dose from this accident with a partial MOX core is estimated to be 1 in 250,000 (4.0×10^{-6}) per 16-year campaign.

4.28.2.6 Transportation

Transportation required under the MOX approach would include shipments of MOX fuel from the proposed MOX facility to the proposed reactor sites for irradiation. It is estimated that approximately 830 shipments of fresh MOX fuel would be shipped to the proposed reactor sites in DOE-provided SST/SGTs. While these shipments would likely replace similar shipments of fresh LEU fuel to the reactor sites, thereby reducing the transportation risks associated with this fuel, this SPD EIS analyzes the shipments on a stand-alone basis to estimate the maximum risk to the public. (The shipment of spent fuel is being considered the *Yucca Mountain Draft EIS* for a potential geologic repository that includes in its inventory the MOX fuel that would be generated from the surplus weapons-usable plutonium disposition program.)

The highest dose for these transportation activities would be associated with those alternatives that include locating the MOX facility at Hanford because it is the candidate site farthest from the proposed reactor sites. Similarly, the lowest dose would be associated with alternatives considering placing the MOX facility at SRS because this is the candidate site closest to the proposed reactors.

The estimated dose to the transportation crew from the incident-free transportation activities of fresh MOX fuel to the proposed reactors is estimated to range from 0.036 rem to 0.19 rem depending on the location of the MOX facility. In terms of the number of LCFs in the crew from this transportation, the number would range from 1.4×10^{-5} to 7.8×10^{-5}. The estimated dose to the public from the incident-free transportation of this material is estimated to range from 0.019 rem to 0.092 rem. In terms of the number of LCFs in the public from this transportation, the number would range from 9.3×10^{-6} to 4.6×10^{-5}. The estimated number of LCFs from emissions associated with this transportation would range from 9.0×10^{-4} to 1.4×10^{-2}. Thus, no fatalities would be expected as a result of incident-free transportation of this material.

The number of LCFs expected from transportation accidents is also projected to be small. The estimated dose from accidents involving this MOX fuel is projected to range from 0.15 rem to 0.46 rem. These doses range from 7.5×10^{-5} to 2.3×10^{-4} LCFs in the public. In terms of a fatality from traffic accidents, it is estimated that this transportation would result in between 5.6×10^{-3} and 3.0×10^{-2} fatalities. Thus, no fatalities would be expected as a result of accidents associated with this transportation.

4.28.2.7 Environmental Justice

[Text deleted.]

In the event of an ISLOCA at North Anna (see Table 4–220), the risk of an LCF (over the 16-year campaign) with an LEU core is 1.14×10^{-2}, and the corresponding risk with a MOX core is 1.3×10^{-2}; thus, the increase in risk at North Anna is 1.6×10^{-3} ($1.3\times10^{-2} - 1.14\times10^{-2}$). If this accident were to occur, approximately 28 percent of the fatalities due to the use of MOX fuel would be expected to be minority residents. As indicated in Table M–8, minorities compose approximately 36 percent of the population residing in the affected area surrounding the

North Anna site. It should be noted that this accident has a very low estimated frequency of occurrence, an average of 1 chance in 4.2 million per year of reactor operation. Thus, the consequences of an ISLOCA would not disproportionately impact minority residents residing in the affected area.

As demonstrated throughout the analyses presented in Section 4.28, normal irradiation of MOX fuel in existing, commercial reactors would pose no significant health risks to the public. As shown in Section 4.28.2.4, the expected number of LCFs would not increase as a result of radiation released during normal operations for the irradiation of this fuel because there would be essentially no increase in radiation received by the general population from the use of MOX fuel.

Some of the reactor accidents would be expected to result in LCFs and prompt fatalities among the public regardless of whether the reactor was fueled with MOX fuel or LEU fuel. However, it is unlikely that any of these accidents would occur. The consequences associated with use of MOX fuel would range from 7 less fatalities expected from a late containment failure at Catawba to 1,328 additional fatalities from an ISLOCA at Catawba. However, because these accidents have a very small frequency, the risk to the general population only changes by a small amount. The greatest percentage increase in risk to the general population of an LCF from a severe reactor accident using MOX fuel corresponds to an increase in risk of 1 in 77 (1.3×10^{-2}) over the 16-year MOX campaign. The greatest increase in risk of a prompt fatality from an accident due to the use of MOX fuel would be 1 in 43,000 (2.3×10^{-5}) over the 16-year MOX campaign. Thus, the use of MOX fuel in the proposed reactors would not pose significant risks or increases in risks to the general population, regardless of income or race residing within the area potentially affected by radiological contamination.

As shown in Section 4.28.2.6, no radiological or nonradiological fatalities would be expected to result from the incident-free transportation of MOX fuel to the proposed reactors. Nor would radiological or nonradiological fatalities be expected to result from transportation accidents.

The implementation of the MOX fuel irradiation program at any of the proposed reactor sites would not pose significant risks (when probability is considered) to the public, nor would implementation of this program pose significant risks to groups within the public, including the risk of disproportionately high and adverse effects on minority and low-income populations. [Text deleted.]

4.28.2.8 Spent Fuel

As shown in Table 4–221, it is likely that some additional LEU spent fuel would be generated by using a partial MOX core in the reactors. The amount of additional spent nuclear fuel generated is estimated to range from approximately 2 to 16 percent of the total amount of spent fuel that would be generated by the proposed reactors during the time period MOX fuel would be used. The reactor sites intend to manage the MOX spent fuel the same as LEU spent fuel, by storing it in the reactor's spent fuel pool or placing it in dry storage. The amount of additional spent fuel is not expected to impact spent fuel management at the reactor sites.

For the four units at Catawba and McGuire, all of the additional spent nuclear fuel assemblies would be generated during the transition cycles from LEU to MOX fuel. Additional assemblies help to maintain peaking below design and regulatory limits, and compensate for the greater end-of-cycle reactivity. For Catawba and McGuire, once equilibrium is reached in the partial MOX core, additional fuel assemblies would not be required.

Table 4–221. Total Additional Spent Fuel Assemblies Generated by MOX Fuel Irradiation

Reactor	Number of Spent Fuel Assemblies Generated With No MOX Fuel	Number of Additional Spent Fuel Assemblies With MOX Fuel	Percent Increase
Catawba 1	672	12	1.8
Catawba 2	672	12	1.8
McGuire 1	756	12	1.6
McGuire 2	672	12	1.8
North Anna 1	420	67	16.0
North Anna 2	540	84	15.6
Total	3,732	199	5.3

Like McGuire and Catawba, the North Anna units are expected to require additional LEU assemblies during the first transition cores. However, additional assemblies will also be required during equilibrium cycles because of operational considerations of the smaller North Anna cores (157 fuel assemblies compared to 193 each for the McGuire and Catawba units).

As core designs are finalized and optimized for MOX fuel, it may be possible to reduce MOX fuel assembly peaking and thereby reduce the number of additional assemblies required (and spent fuel generated) at the proposed reactors. As it currently stands, the North Anna site could generate approximately 16 percent more spent fuel by using MOX fuel than if the plants continued to use LEU fuel. The total amount of additional spent fuel generated by all six proposed reactors is estimated to be approximately 92 t (101 tons) of heavy metal. However, such MOX fuel is included in the inventory for the potential geologic repository considered in the *Yucca Mountain Draft EIS*.

4.28.2.9 Geology and Soils

No ground-disturbing activities related exclusively to the use of MOX fuel are proposed at any of the reactor sites. Therefore, there would be no impact on the reactor site's geology or soils resulting from the use of MOX fuel.

4.28.2.10 Water Resources

There would be no change in water usage or discharge of nonradiological pollutants resulting from use of MOX fuel in the proposed reactors. Each of the reactor sites discharges nonradiological wastewater in accordance with a National Pollutant Discharge Elimination System permit, or an analogous State-issued permit. Permitted outfalls discharge conventional and priority pollutants from the reactor and ancillary processes that are similar to discharges from most reactor sites. Monitoring, analyses, and toxicity testing are also consistent with the types of discharges. Discharge Monitoring Reports for North Anna (May 1994 through April 1998) and Catawba (calendar years 1995 through 1997) showed that, for the most part, there were only occasional noncompliances with permit limitations, only one of which occurred at an outfall receiving reactor process discharges. The effluent from outfall 001 at Catawba failed a quarterly chronic toxicity test in March 1996. However, a followup sample collected after receiving these results passed the test. During the period reviewed, Catawba experienced four noncompliances, two in 1995 and two in early 1996. North Anna exceeded the chlorine limitation at its sewage treatment facility, but this would neither affect, nor be affected by, the use of MOX fuel.

The use of MOX fuel in the proposed reactors would not be impacted by floods. Appendix A to 10 CFR 50 (*General Design Criteria for Nuclear Power Plants*) stipulates that the design basis for nuclear power plant systems, structures, and components reflect appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area. Subsequently, the conditions resulting from the worst site-related flood probable at a nuclear plant (e.g., probable maximum flood, seismically

induced flood, hurricane, seiche surge, heavy local precipitation) with attendant wind-generated wave activity constitute the design basis flood conditions that safety-related structures must be designed to withstand and retain capability for cold shutdown and maintenance thereof.

4.28.2.11 Ecological Resources

The use of MOX fuel in existing reactors would not be expected to result in any impacts on ecological resources at the proposed sites. There would be no new construction, and emissions of effluents from the reactors would not be expected to change.

4.28.2.12 Cultural and Paleontological Resources

No ground-disturbing activities are proposed at the sites related exclusively to the use of MOX fuel. Therefore, the use of MOX fuel in existing reactors is not expected to affect cultural and paleontological resources at the proposed sites. Similarly, no impacts on Native American resources in the areas surrounding the reactor sites are expected.

4.28.2.13 Land Use

The proposed reactor sites would not require any additional land to support the use of MOX fuel in their reactors. This statement is consistent with information presented in the *Storage and Disposition PEIS* (DOE 1996a:4-720). Nor would the use of MOX fuel in an existing reactor affect the use of other onsite lands (e.g., buffer zones and undeveloped land areas would not be impacted). Prime farmland would not be affected and, because the use of MOX fuel would not result in an in-migration of workers, as discussed in Section 4.28.2.3, no indirect impacts on offsite lands would be expected.

4.28.2.14 Infrastructure

Existing site infrastructure would continue to serve the sites proposed to irradiate MOX fuel. Each site is equipped with water and an existing power distribution system that would adequately support the demands of the reactors should MOX fuel be used. Therefore, the proposed reactor sites would not require any additional infrastructure to support the use of MOX fuel in the reactors. This is consistent with information presented in the *Storage and Disposition PEIS* (DOE 1996a:4-721).

4.28.3 Avoided Environmental Impacts Associated With Using MOX Fuel From Surplus Plutonium in Commercial Reactors Versus LEU Fuel

Using MOX fuel in commercial nuclear reactors would preclude that part of the nuclear fuel cycle associated with mining, possibly milling,[49] converting, and enriching uranium, for the LEU that would be displaced by plutonium as the fissile material needed to maintain a nuclear reaction.

A typical uranium enrichment for fresh light water reactor fuel is between 4.0 and 4.5 percent uranium 235. In order to create 1 t (1.1 tons) of enriched uranium at these enrichment levels, it is necessary to mine between 9 and 10 t (10 and 11 tons) of natural uranium depending on the enrichment level sought. (The higher the enrichment level sought, the more natural uranium is required.) The use of up to 33 t (36 tons) of plutonium in MOX fuel

[49] Milling refers to the step where uranium ore is processed to concentrate the uranium in a powder form. Uranium mills are used during conventional mining operations. Nearly all of the uranium produced in the United States is now produced through in situ processes whereby uranium is dissolved underground and pumped to the surface in a slurry that is separated to concentrate the uranium. This process does not require the use of a mill.

as proposed in the hybrid approach of this SPD EIS would displace between 733 and 825 t (808 and 909 tons) of LEU fuel at the same enrichment levels. Therefore, the use of MOX fuel as proposed in this SPD EIS could eliminate the need to mine and enrich between 6,600 and 8,250 t (7,275 and 9,094 tons) of natural uranium.

The mining and enrichment of uranium results in increased radiological emissions to workers and the public. While increased radiological emissions would also be associated with the fabrication of MOX fuel, as discussed in earlier sections of Chapter 4, these emissions would be expected to be lower than those associated with creating LEU fuel. About 0.25 LCF would be expected among the public living within 80 km (50 mi) of the uranium mining, conversion, and enrichment facilities involved with the uranium fuel cycle over a 10-year operating period; 1.3×10^{-4} to 1.5×10^{-3} LCF could be associated with normal operation of the MOX facility for a like period. A similar reduction could be expected in adverse impacts on involved workers. The expected LCFs for involved uranium workers would range between 8.3 and 9.4 over a 10-year operating period, versus 0.088 for involved workers at the MOX facility over the same period.[50]

A significant amount of energy would be needed to support the processing and enrichment of a quantity of LEU equivalent to the MOX fuel produced each year in the MOX facility. As described in Appendix E of this SPD EIS, MOX facility operations would require an estimated 30,000 to 46,000 MWh/yr of electricity in addition to either 890 t (981 tons) to 2,100 t (2,315 tons) of coal or 1,100,000 m^3 (38,846,500 ft^3) of natural gas, depending on the candidate site. The output of the proposed MOX facility is estimated to be between 73 and 83 t/yr (80 and 91 tons/yr). To produce an equivalent amount of LEU, it is estimated that the uranium fuel cycle would require up to 893,000 MWh/yr of electricity, or the equivalent of 326,000 t (359,350 tons) of coal.[51] Ambient air quality is affected by emissions of chemical pollutants from the uranium fuel cycle. These pollutants are released in processing the uranium and also from the fossil fuel plants used to supply electricity for uranium enrichment. It is estimated that LEU processing and enrichment would result in the release of an estimated 720 t (794 tons) to 820 t (904 tons) of carbon monoxide over 10 years; operation of the MOX facility, up to 52 t (57 tons). Over the same period, nitrogen dioxide emissions would be expected to decrease from between 29,000 t (31,967 tons) and 33,000 t (36,376 tons) over 10 years to less than 138 t (151 tons); sulfur dioxide emissions, from between 107,000 t (117,946 tons) and 122,000 t (134,481 tons) to less than 728 t (802 tons); and particulate matter, from between 28,000 t (30,864 tons) and 32,000 t (35,274 tons) to less than 8 t (9 tons).

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[50] Estimates of LCFs and other environmental impacts presented in this section are based on information contained in the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE 1996d:4-142–4-146). The impacts presented in that EIS were based on an annual production rate of 150 t (165 tons) of enriched uranium and an estimated production rate of the MOX facility of between 73 t and 83 t/yr (80 and 91 tons/yr) at an enrichment value of 4.0 to 4.5 percent. Accordingly, the impacts have been factored by a ratio of 73/150 to 83/150 to support a consistent comparison with expected MOX facility throughputs.

[51] The figures in 10 CFR 51, *Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,* Table S–3, are based on the production of about 30 t/yr (33 tons/yr) of LEU fuel. The MOX facility is expected to produce between 73 and 83 t/yr (80 and 91 tons/yr) of MOX fuel.

4.29 COMPARISON OF IMMOBILIZATION TECHNOLOGY IMPACTS

In order to provide a basis for evaluating alternative immobilization forms and technologies, the environmental impacts associated with operating the ceramic and glass can-in-canister immobilization facilities evaluated in this SPD EIS were compared with the corresponding environmental impacts associated with operating the homogenous ceramic immobilization and vitrification facilities evaluated in the *Storage and Disposition PEIS* (DOE 1996a).

Tables 4–222 through 4–230 present the comparable impacts for key environmental resources (e.g., air quality, waste management, human health risk, and resource requirements) at Hanford and SRS for the homogenous ceramic immobilization and vitrification facilities and the can-in-canister immobilization facilities. The impacts associated with facility accidents, intersite transportation, and environmental justice are also discussed.

The comparison of impacts is based on immobilizing the full 50 t (55 tons) of surplus plutonium. The *Storage and Disposition PEIS* impact analyses are based on operating facilities that would convert the plutonium to an oxide in one new facility and immobilize it in a homogenous ceramic or glass form in another new facility. Impacts for a plutonium conversion facility are evaluated and itemized separately from the impacts for a ceramic immobilization or vitrification facility. In contrast, this SPD EIS considers the use of both new and existing facilities and is based on evaluating a collocated plutonium conversion and immobilization capability. To compare impacts, it was therefore necessary to combine the separate *Storage and Disposition PEIS* impact values, as appropriate, to establish a suitable standard of comparison.

4.29.1 Air Quality

Tables 4–222 and 4–223 present the potential emissions of federally regulated criteria pollutants for both the homogenous ceramic immobilization and vitrification facilities and the can-in-canister immobilization facilities. With the exception of sulfur dioxide in the ceramic can-in-canister process, all criteria pollutant concentrations associated with either can-in-canister technology would range from being the same to being much lower. Pollutant levels would not be expected to differ between the ceramic and glass can-in-canister processes.

Table 4–222. Estimated Concentrations of Air Pollutants (g/m^3) of Immobilization Facilities During Operation at Hanford

		PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]	
Criteria Pollutant	**Averaging Period**	**Ceramic Immobilization[a]**	**Vitrification[b]**	**Ceramic**	**Glass**
Carbon monoxide	8 hours	40	12	0.27	0.27
	1 hour	320	96	1.8	1.8
Nitrogen dioxide	Annual	3.8	0.44	0.038	0.038
Ozone[d]	1 hour	NA	NA	NA	NA
PM_{10}	Annual	<0.01	<0.01	0.0027	0.0027
	24 hours	0.04	0.03	0.03	0.03
Sulfur dioxide	3 hours	0.03	0.77	0.19	0.19

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix G.
[d] Ozone is not directly emitted or monitored by the sites.
Key: NA, not applicable; PEIS, *Storage and Disposition PEIS*.
Source: DOE 1996a:4-436, 4-568, 4-614.

Table 4–223. Estimated Concentrations of Air Pollutants (g/m^3) of Immobilization Facilities During Operation at SRS

		PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]	
Criteria Pollutant	**Averaging Period**	**Ceramic Immobilization[a]**	**Vitrification[b]**	**Ceramic**	**Glass**
Carbon monoxide	8 hours	344	103	0.15	0.15
	1 hour	1,620	485	0.66	0.66
Nitrogen dioxide	Annual	16	1.9	0.024	0.024
Ozone[d]	1 hour	NA	NA	NA	NA
PM_{10}	Annual	0.02	0.01	0.0018	0.0018
	24 hours	0.38	0.28	0.032	0.032
Sulfur dioxide	3 hours	0.24	5.7	1.6	1.6

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix G.
[d] Ozone is not directly emitted or monitored by the sites.
Key: NA, not applicable; PEIS, *Storage and Disposition PEIS.*
Source: DOE 1996a:4-436, 4-568, 4-614.

4.29.2 Waste Management

As shown in Table 4–224, potential volumes of most waste types resulting from operation of the ceramic or glass can-in-canister technology would be considerably less than the waste volumes expected from either homogenous ceramic immobilization or vitrification technology evaluated in the *Storage and Disposition PEIS.* For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in TRU waste volumes of 126 m^3/yr (165 yd^3/yr), compared with the 647 m^3/yr (846 yd^3/yr) of TRU waste estimated in the *Storage and Disposition PEIS* from operation of the homogenous ceramic immobilization facility. Factors contributing to the reduced waste levels associated with the can-in-canister facility would include the use of dry-feed preparation techniques, coordination with existing HLW vitrification operations, and the need for a smaller operating workforce. Waste volumes would not be expected to differ appreciably between the ceramic and glass can-in-canister processes.

4.29.3 Human Health Risk

Radiological Impacts. Tables 4–225 and 4–226 present the potential radiological exposure and cancer risk to the public from normal operation of the immobilization facilities. The potential risks to the public associated with either can-in-canister technology would be slightly higher than the homogenous technologies at Hanford, but lower at SRS. For example, operation of a can-in-canister facility using the ceramic process at Hanford or SRS is estimated to result in population doses of 1.6×10^{-2} or 5.8×10^{-3} person-rem/yr, respectively, compared with the population doses of 8.4×10^{-3} (at Hanford) or 6.6×10^{-2} (at SRS) person-rem/yr resulting from operation of the homogenous ceramic immobilization facility evaluated in the *Storage and Disposition PEIS.* These variations may be attributable to the incorporation of updated source terms, meteorology, population distribution, and other modeling variables in the analysis of the can-in-canister technologies. A comparison between the ceramic and glass can-in-canister technologies indicates operation of the ceramic process would result in slightly higher potential offsite impacts, regardless of whether it is at Hanford or SRS. For example, the dose associated with operation of the can-in-canister facility at Hanford would result in a population dose of 1.6×10^{-2} person-rem/yr using the ceramic process and 1.5×10^{-2} person-rem/yr using the glass process; the same facility at SRS would result in a population dose of

Table 4–224. Estimated Waste Volumes (m^3/yr) of Immobilization Facilities During Operation at Hanford and SRS

	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]			
			Hanford[d]		SRS	
Waste Type	Ceramic Immobilization[a]	Vitrification[b]	Ceramic	Glass	Ceramic	Glass
TRU	647	573	126	126	126	126
LLW	1,820	1,820	108	108	108	108
Mixed LLW	191	191	1	1	1	1
Hazardous	70	51	75	75	89	89
Nonhazardous[e]						
Liquid	219,056	318,056	49,000	49,000	57,000	57,000
Solid	2,995	2,995	340	340	850	850

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix H.
[d] Values presented for Hanford reflect the largest possible waste volumes resulting from immobilization facilities supporting 50-t (55-ton) immobilization alternatives, whether configured alone or collocated in FMEF with the pit conversion facility.
[e] Includes sanitary and other nonhazardous waste.
Key: FMEF, Fuels and Materials Examination Facility; LLW, low-level waste; PEIS, *Storage and Disposition PEIS*; TRU, transuranic.
Source: DOE 1996a:4-471, 4-472, 4-603, 4-654, 4-655.

Table 4–225. Potential Radiological Impacts on the Public of Operations for Immobilization Facilities at Hanford

	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]	
Impact	Ceramic Immobilization[a]	Vitrification[b]	Ceramic	Glass
Population dose (person-rem/yr)	8.4×10^{-3}	9.2×10^{-3}	1.6×10^{-2}	1.5×10^{-2}
10-year latent fatal cancers	4.2×10^{-5}	4.6×10^{-5}	8.0×10^{-5}	7.5×10^{-5}
Maximally exposed individual (mrem/yr)	1.8×10^{-4}	1.9×10^{-4}	2.2×10^{-4}	2.0×10^{-4}
10-year latent fatal cancer risk	9.0×10^{-10}	9.7×10^{-10}	1.1×10^{-9}	1.0×10^{-9}
Average exposed individual (mrem/yr)	1.4×10^{-5}	1.5×10^{-5}	4.1×10^{-5}	3.9×10^{-5}
10-year latent fatal cancer risk	6.8×10^{-11}	7.4×10^{-11}	2.1×10^{-10}	2.0×10^{-10}

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix J.
Key: PEIS, *Storage and Disposition PEIS.*
Source: DOE 1996a:4-459, 4-460, 4-590, 4-591, 4-636, 4-637.

5.8×10^{-3} person-rem/yr using the ceramic process, and a dose of 5.3×10^{-3} person-rem/yr using the glass process.

Table 4–227 presents the potential radiological exposure and cancer risk to involved workers at the homogenous ceramic immobilization and vitrification facilities evaluated in the *Storage and Disposition PEIS* and the can-in-canister immobilization facilities. The estimated average worker dose and associated cancer risk for the can-in-canister technologies are slightly higher than estimated in the *Storage and Disposition PEIS* for the homogenous technologies. In all cases, however, the average worker dose would be within the DOE design objective of 1,000 mrem/yr (DOE 1995d). [Text deleted.] Potential radiological impacts on involved workers are not expected to differ appreciably between the ceramic and glass can-in-canister processes.

Table 4–226. Potential Radiological Impacts on the Public of Operations for Immobilization Facilities at SRS

	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]	
Impact	**Ceramic Immobilization[a]**	**Vitrification[b]**	**Ceramic**	**Glass**
Population dose (person-rem/yr)	6.6×10^{-2}	7.1×10^{-2}	5.8×10^{-3}	5.3×10^{-3}
10-year latent fatal cancers	3.3×10^{-4}	3.6×10^{-4}	2.9×10^{-5}	2.7×10^{-5}
Maximally exposed individual (mrem/yr)	1.0×10^{-3}	1.1×10^{-3}	5.8×10^{-5}	5.3×10^{-5}
10-year latent fatal cancer risk	5.0×10^{-9}	5.4×10^{-9}	2.9×10^{-10}	2.7×10^{-10}
Average exposed individual (mrem/yr)	7.4×10^{-5}	8.0×10^{-5}	7.4×10^{-6}	6.7×10^{-6}
10-year latent fatal cancer risk	3.7×10^{-10}	4.0×10^{-10}	3.7×10^{-11}	3.4×10^{-11}

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix J.
Key: PEIS, *Storage and Disposition PEIS.*
Source: DOE 1996a:4-459, 4-460, 4-590, 4-591, 4-636, 4-637.

Table 4–227. Potential Radiological Impacts on Involved Workers of Operations for Immobilization Facilities at Hanford and SRS

	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c] Hanford[d]		Can-in-Canister Immobilization Facilities[c] SRS	
Impact	**Ceramic Immobilization[a]**	**Vitrification[b]**	**Ceramic**	**Glass**	**Ceramic**	**Glass**
Average worker dose (mrem/yr)	512	433	750	750	750	750
10-year latent fatal cancer risk	0.002	0.002	0.003	0.003	0.003	0.003
Total dose (person-rem/yr)	253	243	298	298	254	254
10-year latent fatal cancers	0.99	0.97	1.2	1.2	1.0	1.0

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Appendix J.
[d] Values presented for Hanford reflect the largest possible numbers of involved workers associated with immobilization facilities supporting 50-t (55-ton) immobilization alternatives, whether configured alone or collocated in FMEF with the pit conversion facility.
Key: FMEF, Fuels and Materials Examination Facility; PEIS, *Storage and Disposition PEIS.*
Source: DOE 1996a:4-461, 4-593, 4-638, 4-639.

Hazardous Chemical Impacts. Tables 4–228 and 4–229 present the potential hazardous chemical impacts resulting from operation of the homogenous ceramic immobilization and vitrification facilities and can-in-canister immobilization facilities. Although some potential hazardous chemical impacts were determined for the homogenous technologies evaluated in the *Storage and Disposition PEIS*, none are expected for either the ceramic or glass can-in-canister technology because no hazardous chemical emissions would occur from operations.

Table 4–228. Potential Hazardous Chemical Impacts on Public and Workers of Operations for Immobilization Facilities at Hanford

Impact	PEIS Homogenous Facilities: Ceramic Immobilization[a]	PEIS Homogenous Facilities: Vitrification[b]	Can-in-Canister Immobilization Facilities[c]: Ceramic	Can-in-Canister Immobilization Facilities[c]: Glass
Maximally exposed individual (public)				
Hazard Index	2.6×10^{-3}	7.0×10^{-4}	0	0
Cancer risk	3.2×10^{-8}	3.2×10^{-8}	0	0
Worker onsite				
Hazard Index	1.6×10^{-1}	4.0×10^{-2}	0	0
Cancer risk	1.4×10^{-5}	1.4×10^{-5}	0	0

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] No hazardous or carcinogenic chemicals are expected to be released from operation of the can-in-canister immobilization facilities.
Key: PEIS, *Storage and Disposition PEIS.*
Source: DOE 1996a:4-463, 4-594, 4-640.

Table 4–229. Potential Hazardous Chemical Impacts on Public and Workers of Operations for Immobilization Facilities at SRS

Impact	PEIS Homogenous Facilities: Ceramic Immobilization[a]	PEIS Homogenous Facilities: Vitrification[b]	Can-in-Canister Immobilization Facilities[c]: Ceramic	Can-in-Canister Immobilization Facilities[c]: Glass
Maximally exposed individual (public)				
Hazard index	7.2×10^{-4}	1.9×10^{-4}	0	0
Cancer risk	8.7×10^{-9}	8.7×10^{-9}	0	0
Worker onsite				
Hazard index	1.4×10^{-1}	3.5×10^{-2}	0	0
Cancer risk	1.3×10^{-5}	1.3×10^{-5}	0	0

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] No hazardous or carcinogenic chemicals are expected to be released from operation of the can-in-canister immobilization facilities.
Key: PEIS, *Storage and Disposition PEIS.*
Source: DOE 1996a:4-463, 4-594, 4-640.

4.29.4 Facility Accidents

Because of substantial differences between the *Storage and Disposition PEIS* and this SPD EIS in terms of the specific accident scenarios and supporting assumptions used in the determination of facility accident impacts, a standard basis for comparing between homogenous technology and can-in-canister technology accidents is not available. For example, a design basis earthquake scenario was not evaluated in the *Storage and Disposition PEIS* for the plutonium conversion facility, nor were any other design basis accidents evaluated for that facility that could be incorporated with like impacts to the ceramic immobilization or vitrification facility for direct comparison to the accident scenarios presented in this SPD EIS. A design basis earthquake associated with the homogenous technologies at Hanford would result in 5.8×10^{-8} and 3.2×10^{-6} LCF in the general population for ceramic immobilization and vitrification, respectively; a design basis earthquake affecting the same facilities at SRS would result in 6.2×10^{-8} and 3.4×10^{-6} LCF, respectively. As discussed above, these values do not reflect the impact of such accidents on a plutonium conversion facility, and are therefore not directly comparable with the results shown for the can-in-canister approach in this SPD EIS. Comparison between the ceramic and glass

can-in-canister processes indicates slightly higher impacts would be associated with the ceramic process. For example, a design basis earthquake at Hanford would result in 9.6×10^{-5} LCF in the general population using the ceramic process, and 8.4×10^{-5} LCF using the glass process. Similarly, a design basis earthquake at SRS would result in 3.6×10^{-5} LCF in the general population using a ceramic process, and 3.1×10^{-5} LCF using a glass process.

4.29.5 Resource Requirements

As shown in Table 4–230, operation of the can-in-canister immobilization technologies would require lower amounts of electricity, fuel, land area, and water than would the ceramic immobilization and vitrification technologies evaluated in the *Storage and Disposition PEIS*. Fewer workers would be required to operate the can-in-canister technologies, which in turn would result in lower socioeconomic impacts. Resource requirements would differ between the ceramic and glass can-in-canister processes in that electricity requirements would be greater to support the ceramic process at either site (i.e., the ceramic process would require 29,000 or 24,000 MWh/yr at Hanford or SRS, respectively, compared with the 28,500 or 23,000 MWh/yr, respectively, required for the glass process).

Table 4–230. Estimated Resource Requirements for Operations at Hanford and SRS

	PEIS Homogenous Facilities		Can-in-Canister Immobilization Facilities[c]			
			Hanford[d]		SRS	
Resource	**Ceramic Immobilization[a]**	**Vitrification[b]**	**Ceramic**	**Glass**	**Ceramic**	**Glass**
Electricity (MWh/yr)	46,000	33,000	29,000	28,500	24,000	23,000
Peak load (MW)	8	8	5.4	5.2	3.9	3.7
Fuel						
Oil (l/yr)	229,750	418,250	100,000	100,000	69,000	69,000
Natural gas (m^3/yr)	4,361,000	3,936,100	0	0	0	0
Coal (t/yr)	0	0	0	0	1,200	1,200
Land use						
Construction area (ha)	16	20	7.2	7.2	12	12
New operation area (ha)	40	40	1.1	1.1	2.7	2.7
Water (million l/yr)	330	330	72	72	110	110
Total workers	1,743	1,651	412	412	351	351

[a] Represents the combined impacts of the plutonium conversion facility and the ceramic immobilization facility.
[b] Represents the combined impacts of the plutonium conversion facility and the vitrification facility.
[c] Electricity/Peak load derived from UC 1999 sources. All other can-in-canister values are as presented in Appendix E.
[d] Values presented for Hanford reflect the largest possible resource requirements needed for immobilization facilities supporting 50-t (55-ton) immobilization alternatives, whether configured alone or collocated in FMEF with the pit conversion facility.
Key: FMEF, Fuels and Materials Examination Facility; PEIS, *Storage and Disposition PEIS*.
Source: DOE 1996a:4-427, 4-432, 4-561, 4-566, 4-605, 4-610; UC 1999a, 1999b, 1999c, 1999d.

4.29.6 Intersite Transportation

The *Storage and Disposition PEIS* analysis assumes that canisters of plutonium immobilized with radionuclides would be transported to a Federal geologic repository via rail. Several canisters would be included in each shipment, and up to 64 shipments would be required from the homogenous ceramic immobilization or vitrification facility to the repository. Total potential fatalities were calculated based on both radiological and nonradiological risks to the public and workers for both routine and accident conditions. Intersite transportation associated with a homogenous ceramic immobilization or vitrification facility at Hanford were estimated to result

in 0.96 and 0.98 total potential fatalities, respectively. Intersite transportation associated with those same facilities at SRS were estimated to result in 1.40 and 1.43 total potential fatalities, respectively.

This SPD EIS analysis is consistent with the methodology used in the WM PEIS, which assumes that the immobilized canisters would be shipped by truck from the immobilization site to the repository. It also conservatively assumes that only one canister would be transported per truck shipment. The ceramic or glass can-in-canister facilities would require the production of an additional 272 or 395 canisters, respectively, over that otherwise expected for the DOE HLW vitrification program. Intersite transportation would result in 0.13 total potential fatalities in association with a glass can-in-canister facility at Hanford, and 0.23 total potential fatalities in association with a glass can-in-canister facility at SRS. Because the ceramic process would produce fewer canisters, it would correspondingly result in somewhat lower transportation impacts.[52]

4.29.7 Environmental Justice

Evaluations of both the homogenous ceramic immobilization and vitrification technologies and can-in-canister technologies included routine facility operations and transportation as well as accidents. No significant risk to the general population would be expected to occur for normal operations or in the event of a design basis accident. [Text deleted.] Similarly, implementation of these technologies would not result in a significant risk of disproportionately high and adverse impacts on minority or low-income groups within the general population.

[52] Consistent with the *Storage and Disposition PEIS* and the WM PEIS, the DWPF HLW canister has been used as the reference canister design for the surplus plutonium immobilization program. Although DOE is considering the possibility of using a larger canister for the Hanford HLW vitrification program, the analyses in this SPD EIS also assume that a DWPF-type canister would be used at Hanford.

4.30 INCREMENTAL IMPACTS

Under the hybrid alternatives (Alternatives 2 through 10), it is possible that a small amount of the 33 t (36 tons) of surplus plutonium considered for disposition as MOX fuel would not meet fuel specifications, and thus would have to be added to the 17 t (19 tons) of surplus plutonium apportioned for immobilization. Because the immobilization and MOX facilities would be designed and constructed to process as much as 50 t (55 tons) and 35 t (38 tons), respectively, reapportionment of a small amount of material would not affect construction activities or schedules. However, such a shift in the material throughputs of each facility could slightly change their respective operating parameters. Thus, an analysis was conducted to evaluate the influence (per metric ton) of this shift on the environmental impacts presented for the hybrid alternatives in this SPD EIS—specifically, any operational incremental reduction of impacts attributable to the MOX facility and, conversely, the incremental increase in impacts attributable to the immobilization facility. In addition, a qualitative discussion of the incremental impacts of extending or shortening the operating period of the surplus plutonium disposition facilities is provided in Section 4.30.2, and incremental impacts associated with uranium conversion operations supporting the hybrid alternatives are provided in Section 4.30.3.

4.30.1 Incremental Impacts of Reapportioning Materials in the Hybrid Approach

4.30.1.1 Air Quality

Air emissions resulting from operating the immobilization or MOX facilities would be attributed solely to the production of power for heating and cooling these facilities; no process emissions would be associated with operating either facility. Therefore, the reapportionment of surplus plutonium from MOX fuel fabrication to immobilization would not result in any changes in annual nonradiological air pollutant emissions. Further, the pollutants associated with heating and cooling the facilities would not be affected because both facilities would continue to operate albeit at slightly higher or lower levels. See Appendix G for more details on the effects of these operations on air quality.

[Table deleted.]

4.30.1.2 Waste Management

Table 4–231 presents the incremental changes in annual operating waste volumes that would result from each metric ton of surplus plutonium reapportioned from MOX fuel fabrication to immobilization. This would result in annual reductions in the generation of TRU, LLW, mixed LLW, and hazardous wastes at the MOX facility. Although there would be associated slight increases in the generation of TRU and LLW at the immobilization facility, the incremental change from reapportioning each metric ton of plutonium would be a small net reduction in waste generation. However, such modifications in process throughput would not affect either facility's generation of nonhazardous wastes, which is primarily a function of nonprocess activities such as facility air conditioning and sanitary systems.

4.30.1.3 Socioeconomics

Slight adjustments in the surplus plutonium material throughputs apportioned to either the MOX facility or immobilization facility would not be expected to affect the number of personnel needed to operate the facilities. Therefore, no change in socioeconomic impacts would be expected.

Table 4–231. Potential Incremental Changes in Waste Generated (m^3/t) From Facility Operations

Waste Type[a]	Incremental Reduction in MOX Facility Impacts	Incremental Increase in Immobilization Facility Impacts	Total Incremental Change
TRU	20.6	9.4	(11.2)
LLW	28.5	8.5	(20.0)
Mixed LLW	0.91	0	(0.91)
Hazardous	0.91	0	(0.91)
Nonhazardous	NA[b]	NA[b]	NA[b]

[a] See definitions in Appendix F.8.
[b] Generation of nonhazardous wastes (e.g., sanitary sewer, trash) are not considered a function of facility throughput.
Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.
Note: Values are per metric ton of surplus plutonium reapportioned from MOX fuel fabrication to immobilization.
Source: Appendix H.

4.30.1.4 Human Health Risk

Table 4–232 presents the potential incremental radiological impacts on the public of reapportioning plutonium from the MOX facility to the immobilization facility. Because estimated radiological impacts would vary somewhat between sites and between the use of new or existing facilities, the analysis of a new MOX facility and a new immobilization facility at SRS is presented as a representative example of potential incremental changes to human health risk. In this example, the data clearly reflect the sensitivity of potential impacts to changes in material throughput. Each reapportioned metric ton of surplus plutonium would result in slight reductions in the doses and LCFs associated with normal operation of the MOX facility, and in contrasting increases in the doses and LCFs associated with normal operation of the immobilization facility. However, the total incremental change would equate to a net reduction in radiological impacts on the public.

Table 4–232. Potential Incremental Changes in Radiological Impacts on the Public From Normal Operations[a]

Impact	Incremental Reduction in MOX Facility Impacts	Incremental Increase in Immobilization Facility Impacts[b]	Total Incremental Change
Population within 80 km for year 2010			
Dose (person-rem)	5.5×10^{-3}	9.1×10^{-4}	(4.6×10^{-3})
10-year latent fatal cancers	2.8×10^{-5}	4.5×10^{-7}	(2.7×10^{-5})
Maximally exposed individual			
Annual dose (mrem)	1.1×10^{-3}	9.1×10^{-6}	(1.1×10^{-3})
10-year latent fatal cancer risk	5.8×10^{-10}	4.5×10^{-12}	(5.7×10^{-10})
Average exposed individual within 80 km[c]			
Annual dose (mrem)	7.0×10^{-5}	1.2×10^{-6}	(6.9×10^{-5})
10-year latent fatal cancer risk	3.6×10^{-11}	5.8×10^{-13}	(3.6×10^{-11})

[a] SRS is presented as a representative site for purposes of analysis.
[b] Values are for the ceramic form of can-in-canister immobilization in a new facility.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2010 (about 790,000).
Note: Values are per metric ton of surplus plutonium reapportioned from MOX fuel fabrication to immobilization.
Source: Appendix J.

4.30.1.5 Facility Accidents

Adjusting the amount of plutonium to be immobilized could influence accident impacts in two ways. One, increased throughput would increase the number of times a process would need to be repeated, therefore potentially increasing the chance of an accident occurring. Two, in some accident scenarios an increased amount of material at risk could increase the consequences. However, because the 50-t (55-ton) case was used to bound the accident analyses, the accident impacts reported under the individual immobilization alternatives would bound any incremental changes discussed here. See Appendix K for a more detailed description of assumptions and specific accident scenarios.

4.30.1.6 Transportation

The reapportionment of surplus plutonium from MOX fuel fabrication to immobilization would result in a slight decrease in the number of trips needed to transport uranium dioxide and MOX fuel rods from the MOX facility to a domestic commercial reactor. Conversely, it would increase the number of trips needed to transport additional canisters of immobilized plutonium from the HLW vitrification facility to the potential geologic repository. The incremental impacts of these changes would vary by site and SPD EIS collocation alternative because of the different travel routes and distances involved. Under any scenario, the radiological impacts from normal transportation of immobilized plutonium would not exceed those associated with Alternative 12A. This alternative entails the greatest distance for the transport of canisters given the disposition of all surplus plutonium through immobilization.

As more plutonium is sent to immobilization, the risks associated with radiological transportation accidents would generally become lower because there are fewer transportation requirements associated with immobilization. Any reduction in the amount of plutonium being sent to the MOX facility means there would be less depleted uranium required by the facility and less MOX fuel rods that would be shipped to a reactor for irradiation. Nonradiological transportation accident risks would range from 0.045 to 0.081 fatalities for the immobilization-only alternatives versus 0.043 to 0.091 for the hybrid alternatives. It needs to be recognized that the risks associated with transporting these materials to and from either disposition facility under any of the alternatives would be low.

4.30.1.7 Environmental Justice

Analysis in connection with this SPD EIS indicates that minority or low-income populations residing in the vicinity of the candidate sites would experience no significant impacts from either the MOX or immobilization facility during routine operations under any of the disposition alternatives. Therefore, no significant impacts would be expected to result from the reapportionment of plutonium throughputs during routine operations. Facility accidents would similarly not be expected to pose a significant risk (when probability is considered) to the general population, nor would they be expected to result in a significant risk of disproportionately high and adverse impacts to minority or low-income groups within the general population.

4.30.1.8 Other Resource Areas

Several resource areas (i.e., geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and infrastructure) were determined to have minimal or no impacts from the disposition alternatives being considered, as discussed in Section 4.26. The reapportionment of plutonium throughputs from the MOX facility to the immobilization facility would not change the impacts on these resource areas.

4.30.2 Incremental Impacts of Extending or Shortening the Operating Period of Surplus Plutonium Disposition Facilities

Each of the disposition facilities is proposed to operate for only about 10 years. However, the operating life of the facilities may vary somewhat, depending on facility startup experiences and negotiations with other countries (e.g., Russia) regarding the pace of disposition. Slightly more or less material could be processed in any given year, potentially extending or shortening the operating period of any of the disposition facilities.

Some impacts occur only during surplus plutonium materials processing. For these resources, total impacts would not change even if the processing schedule was extended or shortened. This includes impacts to air quality for hazardous air pollutants, hazardous and radioactive waste management, human health risk, facility accidents during material processing, transportation impacts from material transport, and environmental justice. For example, if the operating period was extended by 1 year, the total dose and LCFs for the worker and the public would be expected to remain unchanged, even though the annual dose would be expected to decrease.

For other resources, impacts occur whenever the facility is operational regardless of whether material processing is occurring. These types of impacts are associated with activities, such as building heating, sanitary water use, and nonhazardous solid waste generation that would take place independent of the materials processing schedule. These include impacts to air quality for criteria air pollutants, nonhazardous waste management, socioeconomics, facility accidents not associated with material processing, transportation impacts from employee trips, and infrastructure. For example, air quality impacts from criteria pollutant emissions associated with building heating would continue as long as the facility is occupied. Likewise, impacts from nonhazardous waste management and impacts to infrastructure would occur as long as personnel continue to use potable water and generate nonhazardous waste. The impacts on these resource areas from extending or shortening the operating period are presented in Chapter 4 because this chapter largely presents impacts for these resources on an annual basis. Extending operations by 1 year would mean that impacts would continue at the level described in Chapter 4 for 1 year longer. Shortening operations by 1 year would mean that impacts would cease 1 year earlier.

4.30.3 Incremental Impacts Associated With Uranium Conversion

As discussed in Chapter 2, the ceramic immobilization and MOX fuel fabrication processes require the use of depleted uranium dioxide (UO_2) as a feed material should any of the hybrid alternatives (Alternatives 2 through 10) be chosen. UO_2 can be derived from either natural or depleted uranium hexafluoride (DUF_6). DOE currently has a large excess inventory of DUF_6 equivalent to approximately 385,000 t (424,270 tons) of UO_2 (White1997:1, 2, 23). This SPD EIS analyzes the conversion of some of that inventory (about 137 t/yr [151 tons/yr]) to produce approximately 100 t/yr (110 tons/yr) of UO_2 to support the hybrid alternatives. Less UO_2 (approximately 8.3 t/yr [9.2 tons/yr]), would be needed to support alternatives for immobilization in the ceramic form of all 50 t (55 tons) of surplus plutonium. No additional UO_2 would be required to support 50-t (55-ton) immobilization alternatives using the glass form.

DUF_6 is a byproduct of the uranium enrichment process. The vast majority of DOE's inventory of this material is stored at the Oak Ridge, Paducah, and Portsmouth gaseous diffusion sites. The dry conversion process used as representative in this SPD EIS is a more efficient process than the former ammonium diurante wet conversion process for converting DUF_6 to UO_2. It is estimated that the dry conversion process generates 90 to 100 percent less waste than the wet process. Primary procedures used during the dry process include emptying cylinders, process clean-out of enriched uranium, conversion of gaseous uranium hexafluoride to uranium dioxide with hydrogen fluoride recovery, processing and blending, and final packaging.

Environmental impacts associated with the conversion of DUF_6 to UO_2 as presented in this SPD EIS are based on impacts discussed in DOE's *Final Programmatic Environmental Impact Statement for Alternative Strategies for Long-Term Management and Use of Depleted Uranium Hexafluoride* (DU PEIS) (DOE 1999e) and ROD (August 1999).

In the DU PEIS, one of several long-term management strategies analyzed is the conversion of DUF_6 to UO_2. Conversion options are based on design and construction of a new, stand-alone facility operating over a 20-year period to process the entire inventory of DUF_6. The information presented in the DU PEIS makes it possible to estimate the incremental environmental impacts associated with the uranium conversion requirements for the hybrid alternatives (Alternatives 2 through 10) presented in this SPD EIS.

Potential environmental impacts of DUF_6 to UO_2 conversion are found in Chapter 5 and Appendix F of the DU PEIS. A range of impacts are provided due to fundamental differences among the technologies within each conversion option and differences in conditions at the three sites. The potential environmental impacts associated with uranium conversion activities discussed in this SPD EIS were derived from the maximum impacts shown in the DU PEIS.

4.30.3.1 Air Quality

Air emissions of criteria pollutants would result from conversion operations. Emission sources include boilers, generators, and the conversion process. Emissions from operation of boilers, testing and operation of generators, and the conversion process are presented in the DU PEIS. The contribution to short-term concentrations would be similar, less than 5 percent of the applicable standard, for any of the criteria pollutants and hydrogen fluoride. The incremental contribution attributable to requirements for Alternatives 2 through 10 (with ceramic immobilization) versus the ambient standards for nitrogen dioxide and the other expected pollutants are shown in Table 4–233.

Table 4–233. Evaluation of Air Pollutant Concentrations Associated With the Conversion of Depleted Uranium Hexafluoride to Uranium Dioxide

Pollutant	Averaging Period	Standard or Guideline (g/m^3)[a]	SPD Increment (g/m^3)[b]
Carbon monoxide	8 hours	10,000	2.3
	1 hour	40,000	3.6
Nitrogen dioxide	Annual	100	0.00041
Hydrogen fluoride	Annual	300	0.000033
	24 hours	350	0.00027
Uranium oxide	Annual	NA	0.00000044

[a] Derived from air quality standard fractions presented in DOE 1999e.
[b] Incremental impact from conversion of DUF_6 to produce 100 t (110 tons) of UO_2 to support hybrid alternatives (Alternatives 2 through 10) with ceramic immobilization.
Key: DUF_6, depleted uranium hexafluoride; NA, not applicable; UO_2, uranium dioxide.

4.30.3.2 Waste Management

The types of waste that are expected to be generated by DUF_6 conversion include LLW, mixed LLW, hazardous waste, and nonhazardous liquid and solid waste. It is estimated that 740 m^3 (968 yd^3) of LLW, 8.8 m^3 (11.5 yd^3) of mixed LLW, 17 m^3 (22 yd^3) of hazardous waste, 30,600 m^3 (40,025 yd^3) of solid nonhazardous waste, and 518,700 m^3 (678,460 yd^3) of liquid nonhazardous waste would be generated each year by a uranium conversion

facility big enough to process DOE's inventory over a 20-year period. Of this, the annual increment associated with the conversion of UF_6 to UO_2 to support hybrid alternatives with ceramic immobilization would be approximately 3.8 m^3 (5.0 yd^3) of LLW, 0.046 m^3 (0.060 yd^3) of mixed LLW, 0.088 m^3 (0.115 yd^3) of hazardous waste, 159 m^3 (208 yd^3) of solid nonhazardous waste, and 2,695 m^3 (3,525 yd^3) of liquid nonhazardous waste.

These increments would not be expected to result in any additional requirements for treatment, storage, or disposal facilities at the conversion facility.

4.30.3.3 Human Health Risk

Radiological Impacts. The consequences to the general population of radiological emissions from normal uranium conversion activities are presented in Table 4–234.

Table 4–234. Potential Radiological Impacts on the Public From Conversion of Uranium Hexafluoride to Uranium Dioxide

Impact	Uranium Conversion [a]
Population within 80 km	
Dose (person-rem per year)	2.6×10^{-3}
10-year latent fatal cancers	1.3×10^{-5}
Maximally exposed individual	
Annual dose (mrem)	1.7×10^{-4}
10-year fatal cancer risk	8.6×10^{-10}

[a] Incremental impact from conversion of depleted uranium hexafluoride to produce 100 t (110 tons) of uranium dioxide to support hybrid alternatives (Alternatives 2 through 10) with ceramic immobilization.

Involved workers would be exposed to external radiation while handling incoming cylinders, during conversion activities and while handling uranium oxide. The annual dose received by the total involved workforce associated with SPD EIS–related activities is estimated to be 0.28 person-rem, which corresponds to 1.1×10^{-3} LCF over the 10 years of conversion activities that would be needed to support hybrid alternatives with ceramic immobilization. Doses to individual workers would be kept to minimal levels by instituting badge monitoring, administrative limits, and ALARA programs (DOE 1999e).

Hazardous Chemical Impacts. Normal operations at the conversion facility would result in low-level hazardous chemical exposures in association with trace amounts of insoluble uranium compounds and hydrogen fluoride released from process exhaust stacks. The Hazard Index associated with these exposures would be 3.1×10^{-6} for the MEI noninvolved worker, and 1.9×10^{-4} for the general population MEI. These values are substantially lower than the Hazard Index of 1, the level at which adverse health effects might be expected to occur in some exposed individuals. As such, these exposures would not be expected to result in adverse health impacts.

4.30.3.4 Facility Accidents

Possible radiological accidents associated with uranium conversion were evaluated in the DU PEIS. From this evaluation, it was determined that the bounding design basis and beyond-design-basis accidents would be an earthquake that causes a UF_6 compressor line to leak or shear and a small plane crash into full DUF_6 cylinders, respectively.

Radiological Impacts. The design basis uranium conversion accident estimated to result in the greatest potential radiological release would be an earthquake that causes a UF_6 compressor discharge pipe to become cleanly sheared and leak. This accident is considered extremely unlikely, with a frequency of occurrence of 1 in 10,000 to 1 in 1,000,000 per year. The estimated maximum radiological doses for this accident are estimated to be 2.3 rem to the noninvolved worker, 5.1 person-rem to the general population, and 0.068 rem to the MEI. Therefore, the risks in terms of an LCF resulting from this accident are 9.2×10^{-4} to the noninvolved worker, 2.6×10^{-3} to the general population, and 3.4×10^{-5} to the MEI.

For the beyond-design-basis plane crash into full DUF_6 cylinders, the frequency of occurrence is estimated to be 1 in 1 million per year or less. The estimated maximum radiological doses associated with this accident are 6.6×10^{-3} rem to the noninvolved worker, 0.27 person-rem to the general population, and 4.9×10^{-3} rem to the MEI. The maximum risks in terms of an LCF are 2.6×10^{-6} to the noninvolved worker, 1.4×10^{-4} to the general population, and 2.5×10^{-6} to the MEI.

The design basis and beyond-design-basis earthquakes could result in substantial impacts to involved workers, ranging from injuries and fatalities associated with collapsing equipment and structures to relatively high radiation exposures and uptakes of radionuclides. Immediate emergency response actions following such an accident could reduce some of the consequences to these workers.

Hazardous Chemical Impacts. Potential chemical impacts to human health from uranium conversion operations would result from exposure to trace amounts of insoluable uranium compounds (DOE 1999e). The bounding conversion accident estimated to result in the greatest potential number of adverse chemical reactions to the public would involve the rupture of an anhydrous hydrogen fluoride tank. This type of accident is considered beyond extremely unlikely, with a frequency of occurrence of 1 in 10,000 to 1 in 1,000,000 per year. Assumed to be caused by an earthquake or other major event, such an accident would release approximately 3,600 kg (8,000 lb) of anhydrous hydrogen fluoride. The occurrence of such an accident could cause approximately 41,000 members of the public to suffer adverse effects from hydrogen fluoride exposure, mostly mild and transitory effects such as respiratory irritation. Rupture of a hydrogen fluoride tank would also cause the greatest potential number of adverse effects among noninvolved workers. Such a rupture could cause up to 1,100 noninvolved workers to experience adverse effects, again, mostly mild and transitory effects such as respiratory irritation (DOE 1999e). Although involved workers could experience irreversible or fatal effects from such an accident, immediate emergency response actions could reduce some of the consequences to these workers.

4.31 POSTOPERATION SCENARIOS

4.31.1 Deactivation and Stabilization

DOE has anticipated the need for eventual deactivation of the proposed surplus plutonium disposition facilities. Process functions would be compartmentalized to allow isolation so that effective deactivation could be achieved. Protective coatings would be applied to concrete surfaces in the process areas to reduce the amount of contamination adsorbed into the concrete. Stainless steel cell and area liners would be provided to facilitate stabilization in selected areas where accumulation of radioactive contamination could increase personnel radiation exposure. Ventilation of operating and processing areas would minimize surface contamination from airborne contaminants. Process equipment would be designed to minimize areas where radioactive materials could accumulate. Operations would be conducted to minimize the spread of radioactive contamination.

When the missions have been completed and the facilities are no longer needed, deactivation and stabilization would be performed to reduce the risk of radiological exposure; reduce the need for and costs associated with long-term maintenance; and prepare the buildings for productive future use. For the purposes of this SPD EIS, it is assumed that the equipment within the building would be deactivated and the facilities stabilized to a condition suitable for reuse. It is also assumed that this level of activity would take no more than 3 years to complete.

All feed materials, including any remaining plutonium metal, plutonium oxide, uranium oxide and chemicals, and process wastes, would be removed from the facilities to leave them in a low-cost condition for surveillance and maintenance. Usable items of equipment, instruments, and machine parts would be removed for reuse in other DOE facilities. After completion of the initial deactivation effort, the facilities would be monitored to ensure that contamination present in the facilities is contained and worker and public safety maintained. Deactivation and stabilization activities would be implemented in accordance with dismantlement work packages. Finally, a formal closeout would be conducted. Closeout activities would include inspection of support systems, such as heating, ventilation, and air conditioning and water systems, to ensure that they are in condition for reuse.

4.31.2 Decontamination and Decommissioning

At the end of the useful life of the facilities, DOE would evaluate options for decontamination and decommissioning (D&D). DOE anticipates that alternatives for disposition of the facilities would include:

- D&D and demolition of the structures and release of the site for unrestricted use
- D&D and demolition of the structures and restricted use of the site
- Partial D&D and retention of the structures for unrestricted use
- Partial D&D and retention of the structures for modified or restricted use

The nature, extent, and timing of future D&D activities are not known at this time. Although some choices currently exist, both technically and under environmental regulations, for performing final D&D, DOE expects that there will be additional options available in the future. In the case of the MOX facility, D&D would be done in accordance with applicable NRC requirements. DCS would deactivate the MOX facility in accordance with applicable requirements in the potential NRC license.

No meaningful alternatives or analysis of impacts can be formulated at this time. D&D is so remote in time that neither the means to conduct D&D, nor the impacts of the actions, are foreseeable in the sense of being susceptible to meaningful analysis now. Accordingly, D&D activities are not analyzed in detail. Once proposals concerning D&D activities are developed, DOE will undertake any additional NEPA analysis that may be necessary or appropriate.

4.32 CUMULATIVE IMPACTS

The projected incremental impacts of operation of the proposed surplus plutonium disposition facilities were added to the impacts of other past, present, and reasonably foreseeable future actions at or near the candidate sites. These other site activities include baseline impacts presented in Chapter 3. A methodology for this cumulative impact assessment is presented in Appendix F.

Impacts of the following are considered in the cumulative impacts assessment:

- Current activities at or in the vicinity of the candidate sites
- Construction and operation of the proposed surplus plutonium disposition facilities
- Other onsite and offsite activities that are reasonably foreseeable

Other activities that may be implemented in the foreseeable future at one or more of the surplus plutonium disposition candidate sites and considered in the cumulative impact assessment are discussed in the following documents:

- *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (ROD issued)

- *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (ROD issued)

- *Interim Management of Nuclear Materials at the Savannah River Site Final Environmental Impact Statement* (ROD issued)

- *Waste Isolation Pilot Plant Final Environmental Impact Statement* (ROD issued)

- *Tritium Supply and Recycling Final Programmatic Environmental Impact Statement* (ROD issued)

- *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Final issued; ROD issued for TRU and hazardous wastes)

- *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (ROD issued)

- *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (ROD issued)

- *Tank Waste Remediation System Final Environmental Impact Statement* (ROD issued)

- *Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement* (Final issued)

- *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrance Livermore National Laboratory and Sandia National Laboratories*, Livermore

- *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (ROD issued)
- *Final Environmental Impact Statement for Stockpile Stewardship and Management* (ROD issued)
- *Draft Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (ROD issued)
- *Spent Nuclear Fuel Management (SRS Site)* (Draft issued)
- *Defense Waste Processing Facility Final Supplemental Environmental Impact Statement* (ROD issued)
- *Supplemental Environmental Impact Statement for Alternatives to the In-Tank Precipitation Process at Savannah River Site, Aiken, South Carolina*
- *Construction and Operation of a Tritium Extraction Facility at the Savannah River Site* (Final issued)
- *Supplement Analysis for Storing Plutonium in the Actinide Packaging and Storage Facility and Building 105–K at the Savannah River Site*
- *Los Alamos Site-Wide Environmental Impact Statement* (Final issued)
- *Hanford Remedial Action and Comprehensive Land Use Plan Environmental Impact Statement* (Revised draft issued)
- *Advanced Mixed Waste Treatment Project (INEEL)* (Final issued)
- *Final Environmental Impact Statement, Construction and Operation of the Spallation Neutron Source*
- *Final Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride*

[Text deleted.]

The related programs considered in the cumulative impact assessment and the seven candidate DOE sites potentially affected are identified in Table 4–235 (Section 4.32.8 discusses the reasonably foreseeable activities considered for the three proposed reactor sites).

Tables included in the following sections combine No Action activities with reasonably foreseeable activities at each site under the heading "Other Site Activities." The impacts associated with operation of the proposed surplus plutonium disposition facilities[53] are shown as "SPD EIS Maximum Impacts."

In addition to reasonably foreseeable site activities, other activities within the region of the candidate sites were considered in the cumulative impact analysis for selected resources. Because of the distances

[53] A bounding alternative was analyzed for each site. The bounding alternative is the alternative that involves the greatest amount of plutonium disposition construction and operation activity at the candidate site. For example, the bounding alternative for Hanford is Alternative 2—all facilities sited at Hanford.

Table 4–235. Other Past, Present, and Reasonably Foreseeable Actions Considered in the Cumulative Impact Assessment for Candidate DOE Sites

Activities	Hanford	INEEL	Pantex	SRS	LLNL	LANL	ORNL
Storage and Disposition of Weapons-Usable Fissile Materials	X	X	X	X			X
Disposition of Surplus Highly Enriched Uranium				X			X
Interim Management of Nuclear Materials at SRS				X			
[Text deleted.]							
Tritium Supply and Recycling				X			
Waste Management	X	X	X	X		X	X
Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management	X	X		X			
Foreign Research Reactor Spent Nuclear Fuel	X	X		X			
Tank Waste Remediation System	X						
Shutdown of the River Water System at SRS				X			
Radioactive releases from nuclear power plant sites, Vogtle and WNP	X			X			
Hanford Reach of the Columbia River Comprehensive River Conservation Study	X						
FEIS and Environmental Information Report for Continued Operation of LLNL and SNL					X		
Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components			X				
Stockpile Stewardship and Management			X	X	X		X
[Text deleted.]							
Management of Plutonium Residues and Scrub Alloy at Rocky Flats				X			
Spent Nuclear Fuel Management (SRS)				X			
DWPF Final Supplemental				X			
Supplemental EIS for In-Tank Precipitation Process Alternatives				X			
Construction and Operation of a Tritium Extraction Facility at SRS				X			
Supplement Analysis for Storing Plutonium in the Actinide Packaging and Storage Facility and Building 105–K at SRS				X			
Los Alamos Site-Wide EIS						X	
Hanford Remedial Action and Comprehensive Land Use Plan	X						
Advanced Mixed Waste Treatment Project		X					
Construction and Operation of the Spallation Neutron Source							X
Long-Term Management and Use of Depleted Uranium Hexafluoride							X

Key: DWPF, Defense Waste Processing Facility; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory; ORNL, Oak Ridge National Laboratory; SNL, Sandia National Laboratories; WNP, Washington Nuclear Power.

between many of the candidate DOE sites and other existing and planned non-DOE facilities, there is little opportunity for interactions of facility emissions in terms of impacts to air quality, water quality, or waste management capacity. However, whenever possible, large source contributors have been evaluated for those impacts to human health risk and socioeconomics.

4.32.1 Hanford

For Hanford, the bounding alternative for this SPD EIS would be Alternative 2. Alternative 2 calls for the siting of all three proposed disposition facilities in the 400 Area with the pit conversion and immobilization facilities in FMEF and a new MOX facility located nearby. In addition to the facilities proposed under Alternative 2, Hanford is being considered for lead assembly work.

Nuclear facilities within an 80-km (50-mi) radius of Hanford include the Energy Northwest (formerly WPPSS) WNP–2 nuclear reactor. Radiological impacts from operation of the WNP–2 are minimal, but DOE has factored them into the human health risk analysis.

4.32.1.1 Resource Requirements

Cumulative impacts on resource requirements at Hanford are presented in Table 4–236. Hanford would remain within its site capacity for its major resources, i.e., water, land, and power. If Alternative 2 were implemented, the proposed surplus plutonium disposition facilities would require about 16 percent of the annual electricity used on the site and approximately 6 percent of the water; cumulatively, about 24 percent of the site's electricity and 39 percent of the site's water would be required. The land used by these facilities would represent less than 1 percent of the developed land on the site; cumulatively, about 6 percent of the land would be used. Impacts on resource requirements were evaluated for the year 2007 (the peak year) because that would be the first full year in which all three surplus plutonium disposition facilities operate simultaneously, resulting in maximum impacts. While Hanford is also being considered for lead assembly work, lead assembly fabrication operations would be completed by 2006, and therefore would not contribute to the maximum impacts for the peak year (2007).

Table 4–236. Maximum Cumulative Resource Use and Impacts at Hanford—2007

Resource	Other Site Activities	Alternative 2 Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	14,840	1,165	16,005	NA
Electrical consumption (MWh/yr)	507,000	97,000	604,000	2,484,336
Water usage (million l/yr)	3,006	198	3,204	8,263
Developed land (ha)	8,700	22	8,722	145,000

Key: NA, not applicable.
Source: DOE 1996a, 1996f, 1997d.

4.32.1.2 Air Quality

Cumulative impacts on air quality at Hanford are presented in Table 4–237. Hanford is currently in compliance with all Federal, State, and local regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contributions to overall site concentration are extremely small. As discussed in Section 4.27.2, incremental air pollutant concentrations from lead assembly activities at Hanford would be relatively small, with lead assembly operations completed by 2006. Thus, these emissions would not contribute to the maximum cumulative concentrations for Alternative 2.

Table 4–237. Maximum Cumulative Air Pollutant Concentrations at Hanford and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (g/m^3)	Alternative 2 Increment (g/m^3)	Estimated Cumulative Concentration (g/m^3)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.65	34.7	0.35
	1 hour	40,000	4.43	52.7	0.13
Nitrogen dioxide	Annual	100	0.087	0.34	0.34
PM_{10}	Annual	50	0.0054	0.023	0.047
	24 hours	150	0.060	0.83	0.55
Sulfur dioxide	Annual	50	0.0050	1.64	3.1
	24 hours	260	0.055	8.97	3.4
	3 hours	1,300	0.375	30	2.3
	1 hour	660	1.12	34	5.2
Other regulated pollutants					
Total suspended particulates	Annual	60	0.0054	0.023	0.039
	24 hours	150	0.060	0.83	0.55
[Text deleted.]					

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Source: Derived from Table 4–25.

4.32.1.3 Waste Management

Cumulative impacts on waste management at Hanford are presented in Table 4–238. Although a few cumulative waste volumes could exceed current storage capacities if the wastes were held in storage and not disposed of, this is not likely. Current schedules for shipment of TRU waste to WIPP indicate that TRU waste generated by the surplus plutonium disposition facilities would need to be stored on the site until 2016 (DOE 1997c:17). However, because Hanford is expected to begin shipping its existing inventory of TRU waste to WIPP in 2000 (Aragon 1999), TRU waste generated by surplus plutonium disposition facilities could be stored in the space vacated by the waste shipped to WIPP. Likewise, it is unlikely that additional LLW storage capacity would be needed because this waste is routinely sent to onsite disposal. Additional mixed LLW disposal capacity could be required, but would likely be augmented by offsite commercial capacity.

4.32.1.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at Hanford are presented in Table 4–239. Over the life of the proposed activities, the number of LCFs in the general population from 15 years of Hanford operation would be expected to increase from 0.21 to 0.25 if the proposed surplus plutonium disposition facilities were located there as described in Alternative 2, including the addition of lead assembly work. Doses to the MEI are based on source location; summing the MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 1.9 mrem, which corresponds to an LCF risk from 15 years of site operation of 1.4×10^{-5}. The MEI would receive an additional 0.022 mrem/yr, for a cumulative annual dose from all activities of 1.9 mrem, when rounded, and a corresponding risk of an LCF of 1.5×10^{-5} from 15 years of operation. The regulatory dose limits for individual members of the

public are given in DOE orders and EPA and NRC regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking

Table 4–238. Cumulative Impacts on Waste Management Activities at Hanford Over 15-Year Period From 2002–2016 (m^3)

Waste Type	Other Site Activities	Alternative 2 Maximum Impacts[a]	Cumulative Total	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	39,000	1,937	40,937	1,125,975	17,216	168,500[c]
LLW	66,750	3,043	69,793	2,047,050	40,494	1,970,000
Mixed LLW	27,177	54	27,231	2,376,975	41,067	14,200
Hazardous	6,630	951	7,581	NA	NA	NA
Nonhazardous						
Liquid	3,129,075	1,214,810	4,343,885	6,450,000	NA	6,450,000
Solid	645,000	60,000	705,000	NA	NA	NA

[a] Includes waste generated during lead assembly fabrication.
[b] Total 15-year capacity derived from Table 3–5.
[c] Current disposal capacity at the Waste Isolation Pilot Plant (DOE 1997e:3-3).
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic.
Source: DOE 1997d.

Table 4–239. Maximum Cumulative Radiation Doses and Impacts at Hanford Over 15-Year Period From 2002–2016

Impact	Population Dose Within 80 km[a]		Total Site Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Other site activities	424	0.21	41,700	16.7
Alternative 2	72	0.04	4,964	2.0
Cumulative	496	0.25	46,664	18.7

[a] Values are based on the total expected duration of all proposed disposition activities (includes construction, operation, and lead assembly).
Source: DOE 1996a, 1997d.

water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways combined is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993) and NRC regulations (10 CFR 20). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of LCFs due to radiation from normal site operations over 15 years of 2.0, from about 17 to 19, if all of the proposed surplus plutonium disposition activities were sited at Hanford. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

4.32.1.5 Transportation

Transportation requirements associated with Alternative 2 and the addition of lead assembly work at Hanford would include shipments to and from all of the proposed surplus plutonium disposition facilities. It is estimated that the number of total shipments to and from Hanford associated with site activities other than surplus plutonium disposition would be 416,475 truck shipments during the same timeframe the surplus plutonium disposition facilities would be built and operated. Surplus plutonium disposition activities would add 2,474 truck shipments to this estimate for a total of 418,949. The annual dose to the MEI from these shipments would be

expected to increase from 1.68 mrem/yr to about 1.75 mrem/yr (DOE 1997d). This dose corresponds to an LCF risk from 15 years of transportation of 1.3×10^{-5}, which does not significantly increase the risk to the public.

4.32.2 INEEL

For INEEL, the bounding alternative for this SPD EIS would be Alternative 7. Alternative 7 calls for the siting of the pit conversion facility in FPF and a new MOX facility to be located nearby. In addition to the facilities proposed under Alternative 7, INEEL is also being considered for lead assembly and postirradiation examination work.

4.32.2.1 Resource Requirements

Cumulative impacts on resource requirements at INEEL are presented in Table 4–240. INEEL would remain within its site capacity for all major resources. If Alternative 7 were implemented at INEEL, the proposed surplus plutonium disposition facilities would require about 13 percent of the annual electricity used on the site and about 2 percent of the water; cumulatively, about 89 percent of the site's electricity and 14 percent of the site's water would be required. The land used by these facilities would represent less than 1 percent of the developed land on the site; cumulatively, about 2 percent of the land would be used. Impacts on resource requirements were evaluated for the year 2007 because that would be the first full year in which both surplus plutonium disposition facilities operate simultaneously, resulting in maximum impacts.

Table 4–240. Maximum Cumulative Resource Use and Impacts at INEEL—2007

Resource	Other Site Activities	Alternative 7 Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	7,250	743	7,993	NA
Electrical consumption (MWh/yr)	304,700	45,000	349,700	394,200
Water usage (million l/yr)	6,075	117	6,192	43,000
Developed land (ha)	4,600	14	4,614	230,000

Key: NA, not applicable.
Source: DOE 1995a, 1996j, 1997d, 1999f.

While ANL–W is being considered for lead assembly work, lead assembly fabrication operations would be completed by 2006, and therefore would not contribute to the maximum impacts for the peak year (2007). As a candidate for conducting postirradiation examination work, postirradiation examination activities at ANL–W would occur over the timeframe 2006–2009 and concurrently with the startup of surplus plutonium disposition activities. However, there would be no additional cumulative impacts on resource requirements (i.e., employment, electricity, water, land) associated with operation of the postirradiation examination facility at ANL–W, as these activities are routinely conducted at the site with the required infrastructure and workforce already in place.

4.32.2.2 Air Quality

Cumulative impacts on air quality at INEEL are presented in Table 4–241. INEEL is currently in compliance with all Federal, State, and local regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contributions to overall site concentrations are extremely small. As discussed in Section 4.27.1, incremental air pollutant concentrations from lead assembly activities at ANL–W would be relatively small, with lead assembly operations completed by 2006. Thus, these emissions would not contribute to the maximum cumulative concentrations for Alternative 7. In addition, should the postirradiation examination facility be located at ANL–W, there would also be no additional cumulative impact on air pollutant concentrations as these activities are routinely conducted at the site.

Table 4–241. Maximum Cumulative Air Pollutant Concentrations at INEEL and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline (g/m^3)[a]	Alternative 7 Increment (g/m^3)	Estimated Cumulative Concentration (g/m^3)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.76	303	3.0
	1 hour	40,000	3.14	1,220	3.1
Nitrogen dioxide	Annual	100	0.14	11.1	11
PM_{10}	Annual	50	0.0083	3.01	6.0
	24 hours	150	0.089	39.1	26
Sulfur dioxide	Annual	80	0.34	6.35	7.9
	24 hours	365	3.46	140	38
	3 hours	1,300	18.6	610	47
[Text deleted.]					

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.
Source: Derived from Table 4–104.

4.32.2.3 Waste Management

Cumulative impacts on waste management at INEEL are presented in Table 4–242. It is unlikely that there would be major impacts to the waste management infrastructure at INEEL because sufficient capacity should exist to manage the wastes that could be generated by planned activities. [Text deleted.]

Table 4–242. Cumulative Impacts on Waste Management Activities at INEEL Over 15-Year Period From 2002–2016 (m^3)

Waste Type	Other Site Activities	Alternative 7 Maximum Impacts[a]	Cumulative Total	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	29,730	998	30,728	716,543	190,319	168,500[c]
LLW	82,080	2,419	84,499	1,031,850	190,026	565,500
Mixed LLW	50,439	45	50,484	1,669,748	200,294	NA
Hazardous	275	158	433	NA	9,848	NA
Nonhazardous						
Liquid	30,376,890	749,154	31,126,044	48,000,000	NA	48,000,000
Solid	939,310	53,557	992,867	NA	NA	NA

[a] Includes waste generated during lead assembly fabrication and postirradiation examination.
[b] Total 15-year capacity derived from Table 3–17.
[c] Current disposal capacity at the Waste Isolation Pilot Plant (DOE 1997e:3-3).
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic.
Source: DOE 1995a, 1996j, 1997d, 1999f.

4.32.2.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at INEEL are presented in Table 4–243. Over the life of the proposed activities, the number of LCFs in the general population from 15 years of INEEL site operation would be expected to increase from 0.0040 to 0.015 if the proposed surplus plutonium disposition facilities were located there as described in Alternative 7, including the addition of lead assembly and postirradiation examination work. Doses to the MEI are based on source location; summing the

Table 4–243. Maximum Cumulative Radiation Doses and Impacts at INEEL Over 15-Year Period From 2002–2016

	Population Dose Within 80 km		Total Site Workforce	
Impact	**Dose (person-rem)**	**Number of Fatal Cancers**	**Dose (person-rem)**	**Number of Fatal Cancers**
Other site activities	8.1	0.0040	3,098	1.2
Alternative 7[a]	22	0.011	2,010	0.80
Cumulative	30	0.015	5,108	2.0

[a] Values are based on the total expected duration of all proposed disposition activities (includes construction, operation, lead assembly, and postirradiation examination).

Source: DOE 1996a, 1999f.

MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 0.23 mrem, which corresponds to an LCF risk from 15 years of site operation of 1.7×10^{-6}. The MEI would receive an additional 0.018 mrem/yr, for a cumulative annual dose from all activities of 0.25 mrem and a corresponding risk of an LCF of 1.9×10^{-6} from 15 years of operation. The regulatory dose limits for individual members of the public are given in DOE orders and EPA and NRC regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways combined is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993) and NRC regulations (10 CFR 20). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations over 15 years of 0.80, from about 1.2 to 2.0, if the pit conversion and MOX facilities were sited at INEEL, and lead assembly and postirradiation examination were also done at the site. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

4.32.2.5 Transportation

Transportation requirements associated with Alternative 7 and the addition of lead assembly and postirradiation examination work at INEEL would include shipments to and from the proposed facilities. The number of total shipments to and from INEEL associated with site activities other than surplus plutonium disposition is estimated to be 59,373 truck shipments during the approximately 15-year timeframe the proposed facilities would be built and operated. Surplus plutonium disposition activities would add 2,565 truck shipments to this estimate for a total of 61,938. The annual dose to the MEI from these shipments would be expected to increase from 1.05 mrem/yr to about 1.12 mrem/yr (DOE 1997d). This dose corresponds to an LCF risk from 15 years of transportation of 8.4×10^{-6}, which does not significantly increase the risk to the public.

4.32.3 Pantex

For Pantex, the bounding alternative for this SPD EIS would be Alternative 9. Alternative 9 calls for the siting of the new pit conversion and MOX facilities in Zone 4 West.

4.32.3.1 Resource Requirements

Cumulative impacts on resource requirements at Pantex are presented in Table 4–244. Pantex would remain within its site capacity for all major resources. If Alternative 9 were implemented, the proposed surplus

Table 4–244. Maximum Cumulative Resource Use and Impacts at Pantex—2007

Resource	Other Site Activities	Alternative 9 Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	1,750	785	2,535	NA
Electrical consumption (MWh/yr)	136,700	46,000	182,700	420,500
Water usage (million l/yr)	1,017	116	1,133	3,785
Developed land (ha)	1,489	17	1,506	6,475

Key: NA, not applicable.
Source: DOE 1996a, 1996b, 1996c, 1997d.

plutonium disposition facilities would require about 25 percent of the annual electricity used on the site and about 10 percent of the water; cumulatively, this would require about 30 percent of the site's water and 43 percent of the site's electricity. For comparison, the estimated maximum cumulative water usage of 1,133 million l/yr (299.3 million gal/yr) would be less than 5 percent of the 23.6 billion l (6.2 billion gal) of water pumped from the Carson County well fields by the city of Amarillo in 1995, and about 1 percent of the 101 billion l (26.7 billion gal) of water applied for irrigation in Carson County in 1995. The land used by these facilities would represent about 1 percent of the developed land on the site; cumulatively, about 23 percent of the land would be developed. Impacts on resource requirements were evaluated for the year 2007 because that would be the first full year in which both surplus plutonium disposition facilities operate simultaneously.

4.32.3.2 Air Quality

Cumulative impacts on air quality at Pantex are presented in Table 4–245. Pantex is currently in compliance with all Federal, State, and local regulations and guidelines, and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contributions to overall site concentrations are extremely small.

4.32.3.3 Waste Management

Cumulative impacts on waste management at Pantex are presented in Table 4–246. Because there is not any TRU waste currently stored at Pantex, space for storage would be provided within the new surplus plutonium disposition facility. It is unlikely that additional LLW or hazardous waste storage capacity would be needed at Pantex because these wastes are routinely sent to offsite disposal.

4.32.3.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at Pantex are presented in Table 4–247. Over the life of the proposed activities, the number of LCFs in the general population from 15 years of Pantex site operation would be expected to increase from 5.6×10^{-5} to 0.0031 if the proposed surplus plutonium disposition facilities were located there, as described in Alternative 9. Doses to the MEI are based on source location; summing the MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of 7.4×10^{-4} mrem which corresponds to an LCF risk from 15 years of site operation of 5.5×10^{-9}. The MEI for Alternative 9 would receive an additional 0.077 mrem/yr, for a cumulative annual dose from all activities of 0.078 mrem and a corresponding risk of an LCF would be 5.8×10^{-7} from 15 years of operation. The regulatory dose limits for individual members of the public are given in DOE orders and EPA and NRC regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways combined is 100 mrem/yr, as given in

Table 4–245. Maximum Cumulative Air Pollutant Concentrations at Pantex and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline (g/m^3)[a]	Alternative 9 Increment (g/m^3)	Estimated Cumulative Concentration (g/m^3)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.70	620	6.2
	1 hour	40,000	3.84	3,000	7.5
Nitrogen dioxide	Annual	100	0.074	2.02	2.0
PM_{10}	Annual	50	0.0053	8.8	18
	24 hours	150	0.058	89.5	60
Sulfur dioxide	Annual	80	0.0026	0.0026	0.0033
	24 hours	365	0.032	0.032	0.0086
	3 hours	1,300	0.14	0.14	0.011
	30 minutes	1,048	0.55	0.55	0.053
Other regulated pollutants					
Total suspended particulates	3 hours	200	0.24	0.24[b]	0.12
	1 hour	400	0.80	0.80[b]	0.20
[Text deleted.]					

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period.

[b] Three- and 1-hr concentrations for total suspended particulates are not listed for existing sources in the source document. Only the contribution from sources associated with the alternative are presented.

Source: Derived from Table 4–124.

Table 4–246. Cumulative Impacts on Waste Management Activities at Pantex Over 15-Year Period From 2002–2016 (m^3)

Waste Type	Other Site Activities	Alternative 9 Maximum Impacts	Cumulative Total	Site Capacity[a] Treatment	Site Capacity[a] Storage	Site Capacity[a] Disposal
TRU	12	855	867	NA	None	168,500[b]
LLW	3,810	1,543	5,353	17,745	1,953	500,000[c]
Mixed LLW	0	40	40	15,720	1,953	NA
Hazardous	3,235	258	3,493	21,795	1,953	NA
Nonhazardous						
Liquid	7,396,275	590,180	7,986,455	14,193,750	NA	14,193,750
Solid	129,660	48,446	178,106	NA	NA	NA

[a] Total 15-year capacity derived from Table 3–29.

[b] Current disposal capacity at the Waste Isolation Pilot Plant (DOE 1997e:3-3).

[c] Current disposal capacity at the Nevada Test Site (DOE 1996a:3-102).

Key: LLW, low-level waste; NA, not applicable; TRU, transuranic.

Source: DOE 1996a, 1996b, 1997d.

DOE Order 5400.5 (DOE 1993) and NRC regulations (10 CFR 20). Thus, the dose to the MEI would be expected to remain well within the regulatory limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations over 15 years of 0.86, from about 0.48 to 1.3, if the pit conversion and MOX facilities were sited at Pantex. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

Table 4–247. Maximum Cumulative Radiation Doses and Impacts at Pantex Over 15-Year Period From 2002–2016

Impact	Population Dose Within 80 km		Total Site Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Other site activities	0.11	5.6×10^{-5}	1,194	0.48
Alternative 9[a]	6.1	0.0030	2,140	0.86
Cumulative	6.2	0.0031	3,334	1.3

[a] Values are based on the total expected duration of all proposed disposition activities (includes construction and operations).

Source: DOE 1996a, 1997d.

4.32.3.5 Transportation

Transportation requirements associated with Alternative 9 at Pantex would include shipments to and from the proposed pit conversion and MOX facilities. It is estimated that the number of total shipments to and from Pantex associated with site activities other than surplus plutonium disposition would be 5,460 truck shipments during the approximately 15-year timeframe the surplus plutonium disposition facilities would be built and operated. Alternative 9 would add 2,000 truck shipments to this estimate for a total of 7,460. The annual dose to the MEI from these shipments would be expected to increase from 0.97 mrem/yr to about 1.0 mrem/yr (DOE 1997d). This dose corresponds to an LCF risk from 15 years of transportation of 7.7×10^{-6}, which does not significantly increase the risk to the public.

4.32.4 SRS

For SRS, the bounding alternative for this SPD EIS would be Alternative 3. Alternative 3 calls for the siting of new pit conversion, immobilization, and MOX facilities in F-Area near APSF, if built. [Text deleted.] SRS is also being considered as a possible lead assembly site.

Nuclear facilities within an 80-km (50-mi) radius of SRS include Georgia Power Company's Vogtle Electric Generating Plant across the river from SRS; Chem-Nuclear Services facility, a commercial LLW disposal facility just east of SRS; and Starmet CMI, Inc., located southeast of SRS, which processes uranium-contaminated metals. Radiological impacts from operation of the Vogtle Electric Generating Plant, a two-unit commercial nuclear power plant, are minimal, but DOE has factored them into the human health risk analysis. The South Carolina Department of Health and Environmental Control Annual Report (SCDHEC 1996b) indicates that operation of the Chem-Nuclear Services facility and the Starmet CMI facility does not noticeably impact radiation levels in air or liquid pathways in the vicinity of SRS. Therefore, they are not included in this assessment.

The counties surrounding SRS have numerous existing and planned industrial facilities with permitted air emissions and discharges to surface water. Because of the distances between SRS and the private industrial facilities, there is little opportunity for interactions of facility emissions, and no major cumulative impact on air or water quality.

4.32.4.1 Resource Requirements

Cumulative impacts on resource requirements at SRS are presented in Table 4–248. If Alternative 3 is implemented, the proposed surplus plutonium disposition facilities would require about 9 percent of the annual electricity used on the site and about 3 percent of the water. The land used by these facilities would represent

Table 4–248. Maximum Cumulative Resource Use and Impacts at SRS—2007

Resource	Other Site Activities	Alternative 3 Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	11,200	1,120	12,320	NA
Electrical consumption (MWh/yr)	675,000	69,000	744,000	5,200,000
Water usage (million l/yr)	7,829[a]	216	8,045	10,838[a]
Developed land (ha)	6,880	32	6,912	80,130

[Text deleted.]

[a] This value does not include the existing, separate infrastructure for withdrawals from the Savannah River or the well supply systems for process water makeup in site operating areas other than F- and S-Areas.

Key: NA, not applicable.

Source: DOE 1994b, 1995b, 1996a, 1996b, 1996e, 1997d, 1997i, 1998c, 1998d, 1998e.

less than 1 percent of the developed land on the site; cumulatively, about 14 percent of the site's electricity, 74 percent of the site's water capacity, and 9 percent of the land would be used. [Text deleted.] Impacts on resource requirements were evaluated for the year 2007 because that would be the first full year in which all three surplus plutonium disposition facilities operate simultaneously, resulting in maximum impacts. While SRS is being considered for lead assembly work, lead assembly fabrication operations would be completed by 2006, and therefore would not contribute to the maximum impacts for the peak year (2007).

4.32.4.2 Air Quality

Cumulative impacts on air quality at SRS are presented in Table 4–249. SRS is currently in compliance with all Federal, State, and local regulations and guidelines and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition facilities' contributions to overall site concentrations are extremely small. As discussed in Section 4.27.5, incremental air pollutant concentrations from lead assembly activities at SRS would be relatively small, with lead assembly operations completed by 2006. Thus, these emissions would not contribute to the maximum cumulative concentrations for Alternative 3.

4.32.4.3 Waste Management

Cumulative impacts on waste management at SRS are presented in Table 4–250. Although the cumulative waste volume for hazardous waste could exceed the storage capacity, it is unlikely that there would be major impacts to the waste management infrastructure at SRS because most hazardous waste is not held in long-term storage and is disposed of in offsite facilities. Likewise, it is unlikely that additional LLW storage capacity would be needed because this waste is routinely sent to onsite disposal.

4.32.4.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at SRS are presented in Table 4–251. Over the life of the proposed activities, the number of LCFs in the general population from 15 years of SRS operation would be expected to increase from 0.34 to 0.35 if the proposed surplus plutonium disposition facilities were located there as described in Alternative 3, including the addition of lead assembly work. [Text deleted.] Doses to the MEI are based on source location; summing the MEIs for each reasonably

Table 4–249. Maximum Cumulative Air Pollutant Concentrations at SRS and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline (g/m³)[a]	Alternative 3 Increment (g/m³)	Estimated Cumulative Concentration[b] (g/m³)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	10,000	0.37	673	6.7
	1 hour	40,000	1.4	5,100	13
Nitrogen dioxide	Annual	100	0.063	14.8	15
PM_{10}	Annual	50	0.0042	4.96	9.9
	24 hours	150	0.069	85.9	57
Sulfur dioxide	Annual	80	0.12	16.8	21
	24 hours	365	1.7	224	61
	3 hours	1,300	4.48	730	56
Other regulated pollutants					
Total suspended particulates	Annual	75	0.0042	45.4	61
[Text deleted.]					

a The more stringent of the Federal and State standards is presented if both exist for the averaging period.
b Includes contribution from proposed Tritium Extraction Facility and proposed spent nuclear fuel processing in addition to the baseline facility contributions (see Appendix G).
Source: Dervied from Table 4–38 and Table G–56.

Table 4–250. Cumulative Impacts on Waste Management Activities at SRS Over 15-Year Period From 2002–2016 (m³)

Waste Type	Other Site Activities	Alternative 3 Maximum Impacts[a]	Cumulative Total	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	13,935	1,937	15,872	25,800	34,400	168,500[c]
LLW	513,393	3,053	516,446	29,409,090	1,064	1,170,165
Mixed LLW	16,869	54	16,923	44,879,850	18,757	NA
Hazardous	4,071	1,254	5,325	313,800	5,172	NA
Nonhazardous						
Liquid	9,827,385	1,212,580	11,039,965	21,735,750	NA	21,735,750
Solid	152,705	68,824	221,529	NA	NA	NA

a Includes waste generated during lead assembly fabrication.
b Total 15-year capacity derived from Table 3–41.
c Current disposal capacity at the Waste Isolation Pilot Plant (DOE 1997e:3-3).
[Text deleted.]
Key: LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely, treated, stored, or disposed of on the site); TRU, transuranic.
Source: DOE 1994b, 1995a, 1995b, 1995c, 1996a, 1996e, 1996j, 1997d, 1997h, 1998c, 1998d, 1998e, 1998f.

foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable actions would receive an annual dose of approximately 1.06 mrem, which corresponds to an LCF risk from 15 years of site operation of 7.9×10^{-6}. The MEI would receive a maximum dose of an additional 0.0074 mrem/yr, for a cumulative annual dose from all activities of

approximately 1.07 mrem with a corresponding risk of an LCF of 8.0×10^{-6} from 15 years of operation. The regulatory dose limits for individual members of the public are given in DOE orders and EPA

Table 4–251. Maximum Cumulative Radiation Doses and Impacts at SRS Over 15-Year Period From 2002–2016

Impact	Population Dose Within 80 km		Total Site Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Other site activities	672	0.34	7,275	2.9
Alternative 3	18	9.0×10^{-3}	4,656	1.9
Cumulative	690	0.35	11,931	4.8

[a] Values are based on total expected duration of all proposed disposition activities (includes construction, operation, and lead assembly).

Source: DOE 1999g.

and NRC regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways combined is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993) and NRC regulations (10 CFR 20). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from normal site operations over 15 years of 1.9, from about 2.9 to 4.8, if all of the proposed surplus plutonium dispositions activities were sited at SRS. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

4.32.4.5 Transportation

Transportation requirements associated with Alternative 3 and the addition of lead assembly work at SRS would include shipments to and from all of the proposed surplus plutonium disposition facilities. The number of total shipments to and from SRS associated with site activities other than surplus plutonium disposition would be 115,187 truck shipments during the approximately 15-year timeframe the surplus plutonium disposition facilities would be built and operated. Surplus plutonium disposition activities would add approximately 2,557 truck shipments to this estimate for a total of 117,744. The annual dose to the MEI from these shipments would be expected to increase from 0.59 mrem/yr to about 0.66 mrem/yr (DOE 1997d). This dose corresponds to an LCF risk from 15 years of transportation of 4.9×10^{-6}, which does not significantly increase the risk to the public.

4.32.5 LLNL

For LLNL, the baseline activities include those activities connected to operation of the National Ignition Facility and the continued operation of the laboratory as detailed in the *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore* (DOE 1992). Lead assembly alternative impacts discussed in Section 4.27 of this SPD EIS provide bounding conditions for the assessment of cumulative impacts from potential surplus plutonium disposition activities at LLNL. Cumulative impacts have been assessed for the 5-year period, 2001–2005, which represents the time needed to modify facilities to conduct the proposed lead assembly work.

4.32.5.1 Resource Requirements

Cumulative impacts on resource requirements at LLNL are presented in Table 4–252. There would be no increase in site employment at LLNL due to surplus plutonium disposition activities discussed in this SPD EIS, as it is expected that existing employees would be used. If LLNL were chosen for lead assembly activities, these activities would require less than 1 percent of the annual electricity used on the site and less than 1 percent of the water used annually; cumulatively, LLNL would require 40 percent of the available electricity and 31 percent of the available water. No change in any land development at LLNL would be required as a result of the proposed lead assembly activities. Impacts on resource requirements were evaluated for the year 2003 because that would be the first full year of lead assembly activities, resulting in meximum impacts.

Table 4–252. Maximum Cumulative Resource Use and Impacts at LLNL—2003

Resource	Other Site Activities	SPD EIS Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	7,700	0	7,700	NA
Electrical consumption (MWh/yr)	346,927	720	347,647	876,000
Water usage (million l/yr)	1,224	2	1,226	4,007
Developed land (ha)	332	0	332	332

Key: LLNL, Lawrence Livermore National Laboratory; NA, not applicable.
Source: DOE 1996b:vol. I; O'Connor et al. 1998c.

4.32.5.2 Air Quality

Cumulative impacts on air quality at LLNL are presented in Table 4–253. As shown in the table, criteria pollutant concentrations are in compliance with applicable Federal and State ambient standards, with the exception of the 1-hr average nitrogen oxides concentration. The 1-hr standard for ozone may be exceeded on occasion as indicated by the ozone nonattainment designation for the San Francisco Bay Area Quality Management District. Nitrogen oxides and hydrocarbons are precursors in the formation of ozone. Reductions in nitrogen oxide emissions along with a reduction in hydrocarbon emissions can result in a reduction in peak ozone concentrations. Because the production of ozone takes place over a period of time in the presence of sunlight, it is a regional issue, and elevated localized concentrations of precursor pollutants do not necessarily correspond to elevated ozone concentrations and exceedances of the ozone standard. The surplus plutonium disposition activities' contributions to overall site concentrations are extremely small.

4.32.5.3 Waste Management

Cumulative impacts on waste management at LLNL are presented in Table 4–254. Although some of the cumulative waste volumes could exceed current storage capacities if the wastes were held in storage and not disposed of, this is not likely. Wastes are routinely shipped off the site for disposal. In the case of LLW, LLNL ships waste to NTS. Mixed waste would be treated and disposed of in accordance with the LLNL site treatment plan. Hazardous waste would be packaged and shipped off the site to Resource Conservation and Recovery Act (RCRA)–permitted treatment, storage, and disposal facilities.

4.32.5.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at LLNL are presented in Table 4–255. Over the life of the proposed activities, the number of LCFs in the general population from 5 years of LLNL operation would be expected to increase from 0.0045 from other site activities to 0.0062 from the addition of lead assembly activities. Doses to the MEI are based on source location; summing the MEIs for each

reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable activities would

Table 4–253. Maximum Cumulative Air Pollutant Concentrations at LLNL and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (g/m^3)	SPD EIS Increment (g/m^3)	Estimated Cumulative Concentration[b] (g/m^3)	Percent of Standard or Guideline
Carbon monoxide	8 hours	10,000	0.14	70.1	0.70
	1 hour	23,000	0.20	235.7	1.0
Nitrogen dioxide	Annual	100	0.046	6.1	6.1
	1 hour	470	0.93	1,207	257
PM_{10}	Annual	30	0.0033	0.83	2.8
	24 hours	50	0.026	16.2	32
Sulfur dioxide	Annual	80	0.0030	0.083	0.10
	24 hours	105	0.024	1.6	1.5
	3 hours	1,300	0.055	10.5	0.81
	1 hour	655	0.061	16.1	2.5

[a] California Standard as stated in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996b:vol. I).

[b] Based on the total pollutant concentrations presented for the Combined Program Impacts in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996b:vol. I) and the incremental concentration for lead assembly fabrication.

Key: LLNL, Lawrence Livermore National Laboratory.

Table 4–254. Cumulative Impacts on Waste Management Activities at LLNL Over 5-Year Period From 2001–2005 (m^3)

Waste Type	Other Site Activities[a]	Lead Assembly Maximum Impacts	Cumulative Total	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	392	132	524	NA	3,633	168,500[c]
LLW	5,479	700	6,179	13,915	5,239	500,000[d]
Mixed LLW	3,629	4	3,633	10,060	2,809	NA
Hazardous	5,775	0	5,775	10,060	2,825	NA
Nonhazardous						
Liquid	2,910,000	6,400	2,916,400	NA	NA	11,639,000
Solid	89,500	5,200	94,700	NA	NA	NA

[a] Derived from the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, Table 4.7.3.10–3 (DOE 1996b) and from SPD EIS Table 3–52.

[b] Total 5-year capacity derived from Table 3–53.

[c] Current disposal capacity at the Waste Isolation Pilot Plant (DOE 1997e:3-3).

[d] Current disposal capacity at the Nevada Test Site (DOE 1996a:3-102).

Key: LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely, treated, stored, or disposed of on the site); TRU, transuranic waste.

Table 4–255. Maximum Cumulative Radiation Doses and Impacts at LLNL Over 5-Year Period From 2001–2005

Impact	Population Dose Within 80 km		Total Site Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Other site activities[a]	9.0	0.0045	135	0.054
Lead assembly impacts	3.3	0.0017	84	0.034
Cumulative	12.3	0.0062	219	0.088

[a] From the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management,* Tables 4.7.3.9–1 and 4.7.3.9–3 (DOE 1996b:vol. I).

Key: LLNL, Lawrence Livermore National Laboratory.

receive an annual dose of 1.4 mrem, which corresponds to an LCF risk over 5 years of site activities of 3.5×10^{-6} (DOE 1996b:4-386). The MEI for the lead assembly alternative at LLNL would receive an additional annual dose of 0.064 mrem for a cumulative annual dose of approximately 1.5 mrem, which results in a corresponding risk of an LCF of 3.7×10^{-6}. The regulatory limits for individual members of the public are given in DOE orders, and EPA regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits. Workers on the site would be expected to see an increase in the number of expected LCFs due to radiation from lead assembly activities of 0.034, making LLNL's total expected LCFs for the period of the proposed activities 0.088. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

4.32.5.5 Transportation

Transportation requirements associated with lead assembly activities at LLNL would include shipments of uranium oxide from a uranium conversion facility to LLNL and shipments of MOX fuel assemblies from LLNL to McGuire for irradiation. The total number of offsite shipments to and from LLNL associated with site activities other than surplus plutonium disposition during the 5-year period of the lead assembly program is estimated to be 2,228 (DOE 1997d:11-47). The lead assembly work proposed for LLNL would add an additional 71 trips to this estimate for a total of 2,299. The annual dose to the MEI from these shipments would be expected to increase from 0.17 mrem/yr to about 0.20 mrem/yr. This dose corresponds to an LCF risk from 5 years of transportation of 5.1×10^{-7}, which would only slightly increase the risk to the public.

4.32.6 LANL

For LANL, the baseline activities include the extended operation of the laboratory as detailed in the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (DOE 1999b). Lead assembly alternative impacts discussed in Section 4.27 of this SPD EIS provide bounding conditions for the assessment of cumulative impacts from potential surplus plutonium disposition activities at LANL. Cumulative impacts have been assessed for the 5-year period, 2001–2005, which represents the time needed to modify facilities to conduct the proposed lead assembly work.

4.32.6.1 Resource Requirements

Cumulative impacts on resource requirements at LANL are presented in Table 4–256. There would be no increase in site employment at LANL due to surplus plutonium disposition activities discussed in this SPD EIS, as it is expected that existing employees would be used. Within the electric power pool that serves LANL, the system is near capacity and future projections on electric power use from LANL indicate that demand will exceed capacity. Consideration of options to increase system capacity is complicated because the systems for major power users in the region are also nearing capacity and demand from these users is also projected to exceed capacity. No specific proposals to rectify this situation have been fully developed. Water use is projected to remain within existing water rights, and no reduction in the discharge volume from springs in the area is foreseen. If LANL were chosen as the site for lead assembly activities, these activities would require less than 1 percent of the annual electricity used on the site and less than 1 percent of the water used annually; cumulatively, LANL would require 157 percent of the available electricity and 96 percent of the available water. Changes to the current overall land-use categories are not expected, with the possible exception of a change to the land-use designation at TA–67 if that site is chosen for the development of a new LLW disposal facility. No change in any land development at LANL would be required as a result of the proposed lead assembly activities. Impacts on resource requirements were evaluated for the year 2003 because that would be the first full year of lead assembly activities, resulting in maximum impacts.

Table 4–256. Maximum Cumulative Resource Use and Impacts at LANL—2003

Resource	Other Site Activities	SPD EIS Maximum Impacts	Cumulative Total	Total Site Capacity
Site employment	11,351	0	11,351	NA
Electrical consumption (MWh/yr)	782,000	720	782,720	500,000
Water usage (million l/yr)	6,525[a]	2	6,527	6,830
Developed land (ha)	4,586	0	4,586	11,272

[a] Includes LANL water use projected under the Expanded Operations Alternative (2,873 million l) (DOE 1999b), as well as projections of other DOE water rights users.

Key: LANL, Los Alamos National Laboratory; NA, not applicable.

Source: DOE 1996a:3-308; 1997d:4-63; 1999b:4-3, 4-182, 5-105, 5-125, 5-127.

4.32.6.2 Air Quality

Cumulative impacts on air quality at LANL are presented Table 4–257. LANL is currently in compliance with all Federal, State, and local regulations and guidelines and would continue to remain in compliance even with consideration of the cumulative effects of all activities. The surplus plutonium disposition activities' contributions to overall site concentrations are extremely small.

4.32.6.3 Waste Management

Cumulative impacts on waste management at LANL are presented in Table 4–258. Although some of the cumulative waste volumes could exceed current treatment and storage capacities, this is not likely. Wastes are routinely disposed of on the site or shipped off the site for disposal. Hazardous waste would be packaged and shipped off the site to RCRA-permitted treatment and disposal facilities. Mixed waste would be treated and disposed of in accordance with the LANL site treatment plan. Most LLW would be disposed of on the site without the need for treatment or long-term storage. The *LANL Site-Wide EIS* evaluated alternatives for expanding LLW disposal capabilities on the site or shipping LLW off the site for disposal. A decision on expansion of LLW disposal capabilities will be issued in a forthcoming ROD.

4.32.6.4 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at LANL are presented in Table 4–259. Over the life of the proposed activities, the number of LCFs in the general population from 5 years of LANL operation would not be expected to increase from 0.08 from other site activities as a result of the addition of lead assembly activities. Doses to the MEI are based on source location; summing the MEIs

Table 4–257. Maximum Cumulative Air Pollutant Concentrations at LANL and Comparison With Standards or Guidelines

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (g/m^3)	SPD EIS Increment (g/m^3)	Estimated Cumulative Concentration[b] (g/m^3)	Percent of Standard or Guideline
Criteria pollutants					
Carbon monoxide	8 hours	7,800	0.52	3,000	38
	1 hour	11,750	0.74	5,060	43
Nitrogen dioxide	Annual	74	0.17	24.2	33
	24 hours	147	1.38	120	82
PM_{10}	Annual	50	0.012	11.0	22
	24 hours	150	0.097	39.1	26
Sulfur dioxide	Annual	41	0.011	26	63
	24 hours	205	0.090	171	83
	3 hours	1,025	0.20	459	45
Other regulated pollutants					
Total suspended	Annual	60	0.012	14.0	23
particulates	24 hours	150	0.097	48.1	32

[a] New Mexico Ambient Air Quality Standard (DOE 1999b:B-54).
[b] Based on the total pollutant concentrations presented for the Expanded Operations Alternative in the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (DOE 1999b:B-54) and the incremental concentration for lead assembly fabrication.
Key: LANL, Los Alamos National Laboratory.

Table 4–258. Cumulative Impacts on Waste Management Activities at LANL Over 5-Year Period From 2001–2005 (m^3)

Waste Type	Other Site Activities[a]	Lead Assembly Maximum Impacts	Cumulative Total	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	2,735	137	2,872	10,650	24,355	168,500[c]
LLW	72,288	705	72,993	380	663	252,500
Mixed LLW	3,165	4	3,169	NA	583	NA
Hazardous	16,247	0	16,247	NA	1,864	NA
Nonhazardous						
Liquid	2,737,500	6,400	2,743,900	5,300,315	NA	2,838,750
Solid	22,000	5,200	27,200	NA	NA	NA

[a] Derived from the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, Table 5.3.9.3–1 (DOE 1999b:4-185, 4-186, 5-129) and the WM PEIS (DOE 1997d:7-3).
[b] Total 5-year capacity derived from Table 3–59.
[c] Current disposal capacity at the Waste Isolation Pilot Plant (DOE 1997e:3-3).
Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely, treated, stored, or disposed of on the site); TRU, transuranic waste.

Table 4–259. Maximum Cumulative Radiation Doses and Impacts at LANL Over 5-Year Period From 2001–2005

Impact	Population Dose Within 80 km: Dose (person-rem)	Population Dose Within 80 km: Number of Fatal Cancers	Total Site Workforce: Dose (person-rem)	Total Site Workforce: Number of Fatal Cancers
Other site activities[a]	165.5	0.08	4,165	1.7
Lead assembly impacts	0.08	3.8×10^{-5}	95	0.04
Cumulative total	165.6	0.08	4,260	1.7

[a] From the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, Tables 5.3.6.1–1 and 5.3.6.2–1 (DOE 1999b).

Key: LANL, Los Alamos National Laboratory.

for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable activities would receive an annual dose of 5.44 mrem, which corresponds to an LCF risk over 5 years of site activities of 1.4×10^{-5} (DOE 1999b:5-115). The MEI for the lead assembly alternative at LANL would receive an additional annual dose of 0.027 mrem for a cumulative annual dose of 5.47 mrem, which results in a corresponding risk of an LCF that rounds to the same 1.4×10^{-5} discussed above. The regulatory limits for individual members of the public are given in DOE orders and EPA regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required by SDWA regulations; and the dose limit from all pathways is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993). Thus, the dose to the MEI would be expected to remain well within the regulatory dose limits because only a very small portion of the dose is related to liquid pathways. Workers on the site would be expected to see little increase in the number of expected LCFs due to radiation from lead assembly activities, 0.04, leaving LANL's total expected LCFs among the workforce at 1.7 for the period of the proposed activities. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include workers rotations).

4.32.6.5 Transportation

Transportation requirements associated with lead assembly activities at LANL would include shipments of uranium oxide from a uranium conversion facility to LANL and shipments of MOX fuel assemblies from LANL to McGuire for irradiation. The total number of offsite hazardous and radioactive material shipments to and from LANL associated with site activities other than surplus plutonium disposition during the 5-year period of the lead assembly program is estimated to be 17,630 (DOE 1999b:4-197). The lead assembly work proposed for LANL would add an additional 15 trips to this estimate for a total of 17,645. The annual dose to the MEI from these shipments would be expected to increase from 0.38 mrem/yr to about 0.39 mrem/yr. This dose corresponds to an LCF risk from 5 years of transportation of 9.5×10^{-7}, which would only slightly increase the risk to the public.

4.32.7 ORNL

For ORNL, the baseline activities include those activities connected to operation of the Spallation Neutron Source as detailed in the *Final Environmental Impact Statement, Construction and Operation of the Spallation Neutron Source* (DOE 1999h) and the continued operation of the laboratory. Postirradiation examination alternative impacts discussed in Section 4.27 of this SPD EIS provide bounding conditions for the assessment of cumulative impacts from potential surplus plutonium disposition activities at ORNL. Cumulative impacts have been assessed for the 3-year period, 2006–2009, which represents the time during which proposed postirradiation examination activities would be conducted.

There would be no additional cumulative impacts on resource requirements (i.e., employment, electricity, water, land) and air quality associated with the normal operation of the postirradiation examination facility at ORNL as these activities are routinely conducted at the site.

4.32.7.1 Waste Management

Cumulative impacts on waste management at ORNL are presented in Table 4–260. Although this table indicates that some of the LLW and hazardous cumulative waste volumes could exceed current treatment and storage capacities, this is not likely. Additional LLW treatment or storage capacity should not be needed because most LLW would be disposed of off the site, as is the current practice, without the need for treatment or long-term storage. In addition, it is unlikely that further hazardous waste treatment or storage capacity would be needed because these wastes are routinely sent off the site for treatment and disposal.

Table 4–260. Cumulative Impacts on Waste Management Activities at ORNL Over 3-Year Period From 2006–2009 (m^3)

Waste Type	Other Site Activities	Postirradiation Examination Maximum Impacts[a]	Cumulative Total	Site Capacity[b]		
				Treatment	Storage	Disposal
TRU	408	11	419	1,860	1,760	168,500[c]
LLW	100,599	140	100,739	33,900	51,850	500,000d[d]
Mixed LLW	7,402	1	7,403	47,100	231,753	NA
Hazardous	44,931	1	44,932	47,100	1,051	NA
Nonhazardous						
Liquid	6,904,758	1,500	6,906,258	9,532,500	NA	NA
Solid	125,131	130	125,261	NA	NA	1,100,000

[a] Reflects total postirradiation examination waste generation (O'Connor et al. 1998a:66).
[b] Total 3-year capacity derived from Table 3–66.
[c] Current disposal capacity at the Waste Isolation Pilot Plant (DOE 1997e:3-3).
[d] Current disposal capacity at the Nevada Test Site (DOE 1996a:3-102).
Key: ORNL, Oak Ridge National Laboratory; LLW, low-level waste; NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on the site); TRU, transuranic waste.
Source: DOE 1996a, 1996b, 1996e, 1997d, 1999h.

4.32.7.2 Human Health Risk

Cumulative impacts in terms of radiation exposure on the public and workers at ORNL are presented in Table 4–261. Over the life of the proposed activities, the number of LCFs in the general population from 3 years of ORNL operation would not be expected to increase from 0.029 as a result of the addition of postirradiation examination. It is not expected that any discernable radiological impacts on the public would be incurred from postirradiation examination activities at ORNL because all the work would be accomplished in heavily shielded hot cells that are built specifically to contain radiation, thereby protecting workers and the public from potential radioactive emissions. Thus, no additional LCFs would be expected as a result of these activities. Doses to the MEI are based on source location; summing the MEIs for each reasonably foreseeable and current activity would be both misleading and technically incorrect because the hypothetical MEI cannot be in a number of different locations simultaneously. However, to provide some comparative perspective, the hypothetical MEI for all reasonably foreseeable activities would receive an annual dose of about 3.2 mrem, which corresponds to an LCF risk of 4.8×10^{-6} from 3 years of site activities. The MEI would not be expected to receive any additional dose from postirradiation examination activities. The regulatory limits for individual members of the public are given in DOE orders and EPA regulations. The dose limit from airborne emissions is 10 mrem/yr, as required by CAA regulations; the dose limit from drinking water is 4 mrem/yr, as required

Table 4–261. Maximum Cumulative Radiation Exposures and Impacts at ORNL Over 3-Year Period From 2006–2009

Impact	Population Dose Within 80 km		Total Site Workforce	
	Dose (person-rem)	Number of Fatal Cancers	Dose (person-rem)	Number of Fatal Cancers
Other site activities [a]	57.2	0.029	308	0.12
Postirradiation examination impacts	0	0	5.4	0.002
Cumulative total	57.2	0.029	313	0.13

[a] Derived from 1997 ORNL normal operations data presented in Tables 3–68 and 3–69 and the *Final Environmental Impact Statement, Construction and Operation of the Spallation Neutron Source* (DOE 1999h:5-51, 5-52).

Key: ORNL, Oak Ridge National Laboratory.

by SDWA regulations; and the dose limit from all pathways is 100 mrem/yr, as given in DOE Order 5400.5 (DOE 1993). Thus, the dose to the MEI would continue to remain well within the regulatory dose limits. Workers on the site would be expected to see a slight increase in the number of expected LCFs due to radiation from postirradiation examination activities, 0.002, making ORNL's total expected LCFs for the period of the proposed activities 0.13, when rounded. Doses to individual workers would be kept to minimal levels by instituting badged monitoring, administrative limits, and ALARA programs (which would include worker rotations).

4.32.7.3 Transportation

Transportation requirements associated with postirradiation examination activities at ORNL would include shipments of MOX spent fuel assemblies to ORNL. The total number of offsite hazardous and radioactive material shipments to and from ORNL associated with site activities other than surplus plutonium disposition during the 3-year period of the lead assembly program is estimated to be 24,385 (DOE 1997d:11-66). The lead assembly work proposed for LANL would add an additional 8 trips to this estimate for a total of 24,393. The annual dose to the MEI from these shipments would not be expected to increase from 4.4 mrem/yr, which corresponds to an LCF risk from 3 years of transportation of 6.6×10^{-6}.

4.32.8 Reactor Sites (Catawba, McGuire, North Anna)

Reasonably foreseeable future activities in the areas around Catawba, McGuire, and North Anna that could contribute to cumulative impacts include the potential for continued new home and road development. In the areas around North Anna, residential development may include a 540-home subdivision with a golf course, although this project has been on hold since the late 1980s. In addition, Old Dominion Electric is considering building a 300- to 450-MW gas-fired generating station in Louisa County, although other sites are also being considered. Activities near Catawba include the widening of the Buster Boyd Bridge on Highway 49 and the widening of a 27-km (17 mi) stretch of Interstate 77 from just south of Rock Hill north to Carowinds. In addition, the extension of water and sewer service in and around the area of the Catawba reactors is planned, along with a 4,000-home development on Highway 49 on the North Carolina side of Lake Wylie. Reasonably foreseeable future activities near McGuire include a 1,500-home development on Mountain Island Lake downstream from Lake Norman (Apter 1999).

As described in Section 4.28.1, only minor modifications would be needed to accommodate using a partial MOX fuel core in place of a 100 percent LEU fuel core at the Catawba, McGuire, and North Anna reactors. Therefore, construction is expected to produce little or no impacts that could add to cumulative effects at these sites.

As described in Section 4.28.2, normal operations using MOX fuel in place of LEU fuel at the Catawba, McGuire, and North Anna reactors are expected to produce little or no additional impacts at these sites. During normal operations with a partial MOX fuel core, air and water emissions, waste generation, employment, land use, resource requirements, and utility usage are not expected to change appreciably from those experienced when using a full LEU core. Therefore, impacts related to resource requirements, air quality, waste management, and human health risk are not expected to change from current operations.

Transportation of MOX fuel to the reactors would be in place of a portion of the LEU fuel normally transported to the reactors. As described in Section 4.28.2.6, transport of fresh MOX fuel to the reactors is likely to produce minimal additional impacts over the transport of LEU fuel.

Because the contributions to adverse effects from the proposed action would be extremely small, it is expected that activities associated with the proposed action would not exacerbate cumulative effects.

4.33 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes the major irreversible and irretrievable commitments of resources associated with the maximum number of proposed surplus plutonium disposition facilities that could be located at each site under any of the alternatives described in Chapter 2, as well as the irreversible and irretrievable commitments of resources associated with lead assembly fabrication. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources neither renewable nor recoverable for use by future generations. This section discusses three major resource categories that are committed irreversibly or irretrievably to the proposed action and alternatives: land, materials, and energy. Values for each are shown for surplus plutonium disposition facilities and lead assembly fabrication facilities in Tables 4–262 through 4–265. Because uranium conversion, postirradiation examination, and reactor operations would be conducted in existing facilities, involve the continuation of existing operations, and require relatively small amounts of additional materials and energy, no significant irreversible and irretrievable commitment of resources associated with these activities would be expected.

Table 4–262. Irreversible and Irretrievable Commitments of Construction Resources for Surplus Plutonium Disposition Facilities

Resource	Hanford (Alternative 2)	INEEL (Alternative 7)	Pantex (Alternative 9)	SRS (Alternative 3)
Electricity (MWh)	85,000	11,000	11,000	43,000
Fuel oil (l)	2,000,000	1,300,000	2,000,000	6,700,000
Concrete (m^3)	36,000	21,000	33,000	110,000
Steel (t)	9,300	6,300	8,000	33,000

Note: Calculated from the sum of the values presented in Appendix E, Tables E–5, E–12, and E–22.

Table 4–263. Irreversible and Irretrievable Commitments of Construction Resources for Lead Assembly Fabrication Facilities

Resource	ANL–W	Hanford	LLNL	LANL	SRS
Electricity (MWh)	NR	NR	NR	NR	2,800
Fuel oil (l)	NR	NR	NR	NR	45,000
Concrete (m^3)	NR	NR	NR	NR	19
Steel (t)	NR	NR	NR	NR	45

Key: ANL–W, Argonne National Laboratory–West; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory; NR, not reported.
Source: Appendix E, Table E–27.

4.33.1 Land Use

The land that might be used for plutonium disposition facilities could be returned, in the long term, to open space and other uses, if the buildings, roads, and other structures were removed, the area decontaminated, and the land revegetated. Alternatively, the land could be reused for some other industrial or DOE mission. Therefore, the commitment of the land for facilities is not necessarily irreversible.

4.33.2 Materials

The irreversible and irretrievable commitment of material resources during the entire life cycle of plutonium disposition activities using existing or new facilities includes construction materials that cannot be recovered or

recycled, materials that are rendered radioactive but cannot be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. For construction activities, a variety of common materials, such as

Table 4–264. Irreversible and Irretrievable Commitments of Operations Resources for Surplus Plutonium Disposition Facilities

Resource	Hanford (Alternative 2)	INEEL (Alternative 7)	Pantex (Alternative 9)	SRS (Alternative 3)
Land (ha)	7.5	6.7	9.2	12
Electricity (MWh)	970,000	450,000	460,000	690,000
Fuel oil (l)	2,000,000	1,000,000	1,000,000	1,700,000
Coal (t)	NA	42,000	NA	45,000
Natural gas (m^3)	NA	NA	24,000,000	NA
Hydrogen (m^3)	240,000	230,000	230,000	240,000
Nitrogen (m^3)	110,000,000	100,000,000	100,000,000	110,000,000
Oxygen (m^3)	7,500	4,000	4,000	7,500
Argon (m^3)	7,100,000	5,100,000	5,100,000	7,100,000
Chlorine (m^3)	620	630	620	620
Helium (m^3)	340,000	260,000	260,000	340,000
Sulfuric acid (kg)	5,700	1,000	4,700	4,700
Phosphoric acid (kg)	3,400	3,400	3,400	3,400
Oils and lubricants (kg)	16,000	16,000	16,000	16,000
Cleaning solvents (kg)	1,400	1,400	1,400	1,400
Polyphosphate (kg)	2,000	NA	700	1,900
Polyelectrolyte (kg)	2,400	2,400	2,400	2,400
Liquid nitrogen (kg)	11,000	11,000	11,000	11,000
Aluminum sulfate (kg)	9,400	9,700	9,600	9,600
Bentonite (kg)	4,700	4,900	4,800	4,800
Process water (l)	1,100	NA	NA	1,100
Ceramic precursor (kg)	110,000	NA	NA	110,000
Binder (kg)	3,500	NA	NA	3,500
Frit (kg)	290,000	NA	NA	290,000
Stainless steel canisters (kg)	620,000	NA	NA	620,000
Absorbents (kg)	11,000	NA	NA	11,000
Hydraulic fluid (l)	4,000	NA	NA	4,000
Oil (l)	14,000	NA	NA	14,000
Sodium hypochlorite (kg)	740	NA	NA	1,300
Corrosion inhibitor (kg)	1,300	NA	NA	2,300
Sodium nitrate (kg)	5,000	5,000	5,000	5,000
Sodium hydroxide (kg)	760	760	760	760
Ethylene glycol (kg)	3,000	3,000	3,000	3,000
Lubricant zinc stearate (kg)	3,000	3,000	3,000	3,000
Nitric acid (m^3)	1,800	1,800	1,800	1,800
Silver nitrate (kg)	1,400	1,400	1,400	1,400
Solvent (l)	150	150	150	150
Hydroxylamine nitrate (kg)	6,600	6,600	6,600	6,600
Oxalic acid dihydrate (kg)	70,000	70,000	70,000	70,000
Reillex HPG resin (wet basis) (kg)	1,600	1,600	1,600	1,600

Key: NA, not applicable.
Note: Calculated as 10-year values based on data presented in Appendix E, Tables E–7, E–15, E–17, and E–24.

Table 4–265. Irreversible and Irretrievable Commitments of Operations Resources for Lead Assembly Fabrication Facilities

Resource	ANL–W	Hanford	LLNL	LANL	SRS
Electricity (MWh)	2,160	3,600	2,160	2,160	2,160
Coal (t)	NA	NA	NA	NA	180
Natural gas (m^3)	NA	NA	165,000	165,000	NA
Fuel oil (l)	183,000	36,000	36,000	36,000	36,000
Water (l)	4,800,000	4,800,000	4,800,000	4,800,000	4,800,000
Argon (m^3)	48,000	48,000	48,000	48,000	48,000
Helium (m^3)	30	30	30	30	30
Hydrogen (m^3)	3,000	3,000	3,000	3,000	3,000
Nitrogen (m^3)	15,900	15,900	15,900	15,900	15,900
Oxygen (m^3)	15,000	15,000	15,000	15,000	15,000
Sodium nitrate (kg)	255	255	255	255	255
Alcohol (l)	690	690	690	690	690
General cleaning fluids (l)	690	690	690	690	690

Key: ANL–W, Argonne National Laboratory–West; LANL, Los Alamos National Laboratory; LLNL, Lawrence Livermore National Laboratory; NA, not applicable.
Note: Calculated as 3-year values based on data presented in Appendix E, Table E–28.

wood, sand, gravel, plastics, or aluminum, in addition to those listed below, may be required. At this time, no unusual construction material requirements have been identified. Those construction resources would be generally irretrievably lost. None of these materials are in short supply, and all are readily available in the vicinity of each candidate DOE site. For operational activities, the commitment of materials made into equipment or used as feedstock cannot be recycled at the end of the project and are considered to be irretrievable. Although the use of such materials would be irretrievable, none are in short supply, and all are readily available in the vicinity of each candidate DOE site.

4.33.3 Energy

The irretrievable commitment of resources during construction and operation of the facilities would include the consumption of fossil fuels used to generate heat and electricity for each process. Energy would also be expended in the form of diesel fuel, gasoline, and oil, for construction equipment, and transportation vehicles. The plutonium and associated uranium feedstock materials used in the disposition process can be considered as energy sources irretrievable lost, if immobilized, or after being partially burned in a reactor as MOX fuel. Reactor burnup as MOX fuel would produce some useful electricity which would be a very small percentage of total U.S. electrical capacity and demand.

4.33.4 Waste Minimization, Pollution Prevention, and Energy Conservation

4.33.4.1 Waste Minimization and Pollution Prevention

The *Pollution Prevention Act of 1990* and the *Hazardous and Solid Waste Amendments of 1984* required Federal agencies to develop and implement pollution prevention and waste minimization programs. NEPA's purpose, which is to promote efforts that will prevent or eliminate damage to the environment, is complemented by both acts. This relationship was further strengthened by Executive Order 12856 (Federal Compliance with Right to Know Laws and Pollution Prevention Requirements), 12873 (Federal Acquisition, Recycling, and Waste Prevention), and 12902 (Energy Efficiency and Water Consumption at Federal Facilities), and a 1993 memorandum from the Council on Environmental Quality (CEQ 1993). The Council on Environmental Quality

memorandum recommended that Federal agencies incorporated pollution prevention principles, techniques, and mechanisms in their NEPA planning and decisionmaking processes (DOE 1996c:G-1).

Consistent with overall national policy, DOE programs are directed to incorporate pollution prevention into their planning and implementation activities. This includes reducing the quantity and toxicity of radioactive, hazardous, mixed, and sanitary waste generated; incorporating waste recycle and reuse into program planning and implementation; and conserving resources and energy (DOE 1996f:5-286).

DOE is responding to these initiatives by reducing the use of toxic chemicals; improving emergency planning, response, and accident notification; and encouraging the development and use of clean technologies. DOE's nuclear facilities have reduced the sizes of radiological control areas in order to reduce LLW. Other facilities have scrap metal segregation programs which reduce solid waste and allow useable material to be sold and recycled. DOE facilities also are replacing solvents and cleaners containing hazardous materials with less-toxic or nontoxic materials (DOE 1997i:6-3).

Although the surplus plutonium disposition and lead assembly fabrication facilities are still in the early stages of the engineering and design, the program would integrate pollution prevention practices that include waste stream minimization, source reduction and recycling, procurement processes that preferentially procure products made from recycled materials; inventory management, and technology transfer. The facility designs would minimize the size of radiologically controlled areas, thereby minimizing the generation of TRU waste and LLW. To the extent practical, the facilities would not use solvents regulated by RCRA, thereby minimizing the amount of hazardous and mixed waste generated. Wastewater would be recycled to the extent possible to minimize effluent discharge. Equipment would be installed as modules, so when there is a breakdown, a component, rather than a large piece of equipment, would be replaced. If possible, DOE would recycle materials rather than dispose of them. DOE would store such material for future use or sell these materials to other users or salvage vendors. Additionally, DOE could burn nonrecyclable waste paper, cardboard, and oil for energy recovery rather than disposing of it as waste.

4.33.4.2 Energy Conservation

Energy conservation and efficiency are also part of waste minimization and pollution prevention in terms of incorporating efficiencies into the design process. Energy conservation for each of the alternatives would be achieved primarily in three areas: process configuration, mechanical design, and electrical design. Energy conservation would be maximized by incorporating it into the process and facility design from the outset. Where possible, the process would be configured to conserve energy by using heat exchangers so the hot exit streams could heat cool incoming streams, which would conserve heating energy. Where cooling of process streams would be required, maximum use of cooling water would be employed, which would minimize the amount of refrigeration cooling to be used. Mechanical design would employ energy efficient compressors, pumps, and fans. Ductwork would be designed for minimum pressure drop. Facilities would employ energy-efficient insulation and reflective panels where appropriate. Air conditioning systems would make efficient use of outside air. Electrical design would employ energy efficient motors, actuators, and lighting. Accurate electrical power metering of each system would indicate the major power consumers and give warning of unusually high energy consumption. This would allow corrective measures to be taken promptly.

4.34 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The use of land on any of the four DOE candidate sites under consideration for new plutonium disposition activities would be short-term uses of the environment; on completion of the disposition activities, such land could be returned to other uses, including long-term productive uses.

Losses of the natural productivity of terrestrial and aquatic habitats due to construction and operation of new plutonium disposition facilities are possible at any of the candidate DOE locations. Land clearing and construction and operational activities could disperse wildlife and eliminate habitat on a short-term basis. Although some destruction would occur during and after construction, losses would be minimized by careful siting of facilities and incorporation of mitigation measures into all construction activities. In addition, consultation and coordination with State and Federal natural resource and wildlife agencies would occur prior to any site disturbances, in order to ensure that all potential sensitive species, candidate or listed, would be protected to the maximum extent possible.

Activities at lead assembly, postirradiation examination, and reactor sites would be conducted in existing facilities with ongoing operations. Therefore, future use of these facilities would not be related to surplus plutonium disposition activities, but would be dictated by the other ongoing activities at these facilities. The short-term use of these facilities for surplus plutonium disposition activities is not expected to change their planned closure dates, and therefore should not result in an incremental change in the potential long-term productivity at these sites. There are no other activities under plutonium disposition that would affect long-term productivity of environmental resources at each site.

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Chapter 5
Environmental Regulations, Permits, and Consultations

5.1 LAWS, REGULATIONS, EXECUTIVE ORDERS, AND DOE ORDERS

The major Federal laws, regulations, Executive orders, and other compliance actions that potentially apply to surplus plutonium disposition activities, depending on the various alternatives, are identified in Table 5–1.[1] There are a number of Federal environmental statutes dealing with environmental protection, compliance, or consultation that affect compliance at every U.S. Department of Energy (DOE) location. In addition, certain environmental requirements have been delegated to State authorities for enforcement and implementation. It is DOE policy to conduct its operations in an environmentally safe manner in compliance with all applicable statutes, regulations, and standards. Although this chapter does not address pending legislation or future regulations, DOE recognizes that the regulatory environment is in transition, and subject to many changes, and that the construction, operation, and decommissioning of any surplus plutonium disposition facility must be conducted in compliance with all applicable regulations and standards.

The Atomic Energy Act of 1954 authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE's jurisdiction. Through a series of DOE orders and regulations, an extensive system of standards and requirements has been established to ensure safe operation of facilities. DOE regulations are generally found in Title 10 of the Code of Federal Regulations (CFR). For purposes of this *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), relevant regulations include 10 CFR 820, *Procedural Rules for DOE Nuclear Activities;* 10 CFR 830, *Nuclear Safety Management;* 10 CFR 834, *Radiation Protection of the Public and the Environment (Draft);* 10 CFR 835, *Occupational Radiation Protection;* 10 CFR 1021, *National Environmental Policy Act Implementing Procedures;* and 10 CFR 1022, *Compliance with Floodplains/Wetlands Environmental Review Requirements*. The DOE orders have been revised and reorganized to reduce duplication and eliminate obsolete provisions (though some older orders remain in effect during the transition). The new organization is by Series and is generally intended to include all DOE policies, orders, manuals, requirements documents, notices, and guides. Relevant DOE orders include those in the new Series 400, which deals with Work Process. Within this Series, DOE Order 420.1 addresses *Facility Safety*; 425.1A, *Startup and Restart of Nuclear Facilities*; 452.1A, *Nuclear Explosive and Weapons Surety Programs*; 452.2A, *Safety of Nuclear Explosives Operations*; 452.4, *Security and Control of Nuclear Explosives and Nuclear Weapons*; 460.1A, *Packaging and Transportation Safety*; 470.1, *Safeguards and Security Program*; and Manual 474.1, *Nuclear Materials Management and Safeguards System Reporting and Data Submission.* In addition, DOE (older number) Series 5400 addresses environmental, safety, and health programs for DOE operations.

5.2 REGULATORY ACTIVITIES

It is likely that new or modified permits would be needed before surplus plutonium disposition facilities could be constructed or operated. Permits regulate many aspects of facility construction and operations, including the quality of construction, treatment and storage of hazardous waste, and discharges of effluents to the environment. These permits would be obtained as required from appropriate Federal, State, and local agencies. Permits for constructing or operating surplus plutonium disposition facilities would not be obtained or modified before a Record of Decision was issued on this SPD EIS.

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[1] It should be noted that not all of these statutes, regulations, and orders apply to all aspects of the surplus plutonium disposition program and that the descriptions provided represent only a broad summary of each listed requirement.

5.2.1 Pit Conversion and Immobilization Facilities

The pit conversion and immobilization facilities would be designed, constructed, and operated in accordance with DOE regulations and requirements, although the facilities may, as a matter of policy, take into account any appropriate NRC standards. These facilities are categorized as nonreactor nuclear facilities. The major DOE design criteria may be found in DOE Order 6430.1A, *General Design Criteria*, and its successor Orders 420.1A, *Facility Safety*, and 430.1, *Life Cycle Asset Management*, which delineate applicable regulatory and industrial codes and standards for both conventional facilities designed to industrial standards and "special facilities" (defined as nonreactor nuclear facilities and explosive facilities). The design of the facilities would be accomplished in stages that allow for adequate review and assurance that all required standards are met. Prior to operation, the facilities would undergo cold and hot startup testing and an operational readiness review in accordance with the requirements of DOE Order 425.1. Startup of these facilities would require the approval of the Secretary of Energy.

While there are a number of areas or buildings that would be designed to conventional codes and standards, plutonium processing and storage areas, and other areas where quantities of plutonium or other special nuclear materials in excess of a minimum quantity could be present, would be required to meet the more stringent requirements for facility integrity and safeguards and security. Other applicable regulations and standards would be related to worker health and safety and environmental protection, such as DOE's radiation protection standards found in 10 CFR 835. In addition, Federal or State regulations implementing the Clean Water Act (CWA), Clean Air Act (CAA), and Resource Conservation and Recovery Act (RCRA) are applicable. These regulations are implemented through permits, and DOE would require evaluations to determine whether the pit conversion or immobilization facility emissions and activities would necessitate modification of any of these permits. Analyses in Chapter 4 have shown that there would be minimal impact from construction and operation of these facilities.

5.2.2 MOX Facility

The mixed oxide (MOX) fuel fabrication facility would be licensed to operate by the U.S. Nuclear Regulatory Commission (NRC) under its regulations in 10 CFR 70, *Domestic Licensing of Special Nuclear Material*. Because the facility would be located at a DOE site, however, certain DOE requirements affecting site interfaces and infrastructure would also be applicable. In addition, as would be the case regardless of where the facility was built, certain Federal or State regulations implementing the CWA, the CAA, and RCRA would be applicable. These regulations are implemented through permits. Evaluation would be required to determine whether MOX facility emissions and activities necessitated modification of any of these permits. Analyses in Chapter 4 have shown that there would be minimal impacts from construction and operation of the MOX facility.

MOX facility design and operating parameters would be imposed by requirements of 10 CFR 70. Facility robustness, and worker health and safety, for example, are all specified by 10 CFR 70. This regulation incorporates and refers the licensee to provisions of other NRC regulations such as those found in 10 CFR 20, *Protection Against Radiation*. Safety and environmental analyses would be required to support the license application for the MOX facility.

Integral to the National Environmental Policy Act (NEPA) process is consideration of how the proposed action might affect biotic, cultural, and Native American resources and of the need for mitigation of any potential impacts. Required consultations with agencies and recognized Native American groups have been initiated as part of the NEPA process for this SPD EIS.

5.2.3 Reactors

Nuclear power reactors undergo a lengthy licensing process under 10 CFR 50, *Domestic Licensing of Production and Utilization Facilities*, beginning before facility construction. This process includes preparation of safety analysis and environmental reports. The safety analysis report remains a living document that serves as the licensing basis for the plant and is updated throughout the life of the plant. Public hearings before a licensing board are conducted before a license is issued. Once issued, operating licenses may be amended only with proper evaluation, review, and approval as specified in 10 CFR 50.90. This prescriptive process requires demonstration that a proposed change does not involve an unreviewed environmental or safety question and provides for public notice and opportunity to comment before issuance of the license amendment. Minor license amendments can be processed fairly expeditiously, but more involved amendments can require multiple submittals before NRC is assured that the proposed action will not reduce the margin of safety of the plant. All submittals, except the portions that contain proprietary information, are available to the public.

The six reactors proposed to use MOX fuel have been operating for many years. Revisions to each of their operating licenses would be required prior to MOX fuel being brought to the reactor sites and loaded into the reactors. The regulatory process for requesting reactor license amendments to use MOX fuel would be the same as that for any 10 CFR 50 operating license amendment request. This process is initiated by the reactor licensee submitting an operating license amendment request in accordance with 10 CFR 50.90. The license amendment request would need to include a discussion of all potential impacts and changes in reactor operation that could be important to safety or the environment.

The need for modifications to site permits would be evaluated by the individual plants. The contractor team of Duke Engineering & Services, COGEMA Inc., and Stone & Webster has indicated that there would be minimal changes in effluents, emissions, and wastes (radiological or nonradiological).

5.3 CONSULTATIONS

Certain statutes and regulations require DOE to consider consultations with Federal, State, and local agencies and federally recognized Native American groups regarding the potential for alternatives for surplus plutonium disposition to disturb sensitive resources. The needed consultations must occur on a timely basis and are generally required before any land disturbance can begin. Most of these consultations are related to biotic, cultural, and Native American resources. Biotic resource consultations generally pertain to the potential for activities to disturb sensitive species or habitats. Cultural resource consultations relate to the potential for disruption of important cultural resources and archaeologic sites. Finally, Native American consultations are concerned with the potential for disturbance of ancestral Native American sites and the traditional practices of Native Americans.

DOE has initiated consultations with Federal and State agencies and federally recognized Native American groups regarding the potential for alternatives for surplus plutonium disposition to disturb sensitive resources. Table 5–2 presents a summary of the consultations initiated by DOE. Appendix O contains copies of the consultation letters sent by DOE to agencies and Native American groups, and any written responses provided by those agencies or groups. Attachments to responses are not included in Appendix O but are, nevertheless, part of the public record. All agencies and Native American groups were also sent a copy of the SPD Draft EIS. Information from the agencies and Native American group responses has been incorporated into Chapters 3 and 4 as appropriate.

5.3.1 Native American Consultations

Upon publication of the SPD Draft EIS, DOE initiated the government-to-government consultation process with federally recognized Native American groups for the proposed action and alternatives discussed herein. The consultations were conducted consistent with the direction outlined in DOE Order 1230.2, *American Indian Tribal Government Policy*. A copy of the SPD Draft EIS was presented to each federally recognized tribe that has acknowledged potential concern for resources at the Hanford Site, Idaho National Engineering and Environmental Laboratory (INEEL), Pantex Plant, and Savannah River Site (SRS) during prior consultations initiated for compliance with statutes such as the National Historic Preservation Act (16 USC 470 et seq.) and the Native American Graves Protection and Repatriation Act (NAGPRA) (25 USC 3001).

The consultation process was initiated by DOE through a formal letter identifying the potential actions at the DOE site accompanied by a copy of the SPD Draft EIS. The letter requested a response from each Native American group regarding concerns, including any concerns under the American Indian Religious Freedom Act (42 USC 1996) and NAGPRA. Among the areas of specific concern that may be identified by Native American groups are religious and sacred places and resources, Native American human remains, associated funerary objects, unassociated funerary objects, sacred objects, and cultural patrimony objects. [Text deleted.] The intent of these consultations was to identify all potential Native American concerns associated with each action discussed in the SPD Draft EIS and to consider the results of the consultation processes in this SPD Final EIS.

Consultations were requested with the Native American groups listed in Table 5–2, which included four groups related to Hanford, one to INEEL, four to Pantex and six to SRS. Consultations with the Native American groups indicate that there are no significant concerns related to the proposed action and alternatives evaluated in this SPD EIS.

In the event of inadvertent discovery of potential important materials such as human remains, associated funerary objects, unassociated funerary objects, sacred objects, and cultural patrimony during construction and operation, another consultation process will be initiated. Each DOE site considered in this SPD EIS has plans and procedures that address inadvertent discoveries of cultural material. In each case, the ground-disturbing activities would be immediately suspended upon recognition of human remains or potential cultural materials. DOE would be notified and qualified cultural resource specialists would evaluate the materials to determine potential Native American origin. If the remains or materials are determined to be of potential Native American origin and within the criteria of applicable statutes such as NAGPRA, DOE would immediately initiate consultation with Native American groups with interest in the locations, as determined during the SPD Draft EIS consultation process described above. Based on the results of the consultations, DOE would take appropriate action prior to resuming ground-disturbing activities.

5.3.2 Archaeological and Historical Resources Consultations

Each DOE site evaluated in this SPD EIS has cultural (archaeological and historical) resource management plans that prescribe consultation processes for activities that have the potential to adversely affect sites and properties eligible for nomination, or listed, on the National Register of Historic Places. The management plans have been developed consistent with archaeological and historical resource laws (see Table 5–1) as implemented under 36 CFR 800, *Protection of Historic and Cultural Properties*.

Upon publication of the SPD Draft EIS, DOE initiated consultation with the State Historic Preservation Officers (SHPOs) of Idaho, Washington, and South Carolina as appropriate under each site's programmatic agreement and management plan (see Table 5–2). Consultation with the SHPO in Texas was not required because extensive surveys of Pantex have shown that significant cultural resources are not likely to be present, and both the Texas SHPO and the Advisory Council on Historic Preservation have agreed that additional archaeological surveys are

not required. The intent of each consultation was to determine potential eligibility for nomination to the National Register of Historic Places of archaeological and historic resources that may be associated with the proposed actions and alternatives. As discussed in Section 5.3.1, DOE also initiated consultation with Native Americans. [Text deleted.] The consultation process was initiated by DOE through a formal letter to the appropriate SHPO identifying the potential actions at the DOE site accompanied by a copy of the SPD Draft EIS. In all cases, the consultation process was conducted in conformance with 36 CFR 800 requirements and programmatic agreements for the management of archaeological and historic resources and properties.

The letters sent by DOE solicited specific concerns the SHPOs may have about the DOE proposal. Consultations with the SHPOs indicate that only the South Carolina SHPO had significant concerns related to the proposed action and alternatives evaluated in this SPD EIS. The South Carolina SHPO response noted that if Alternative 3 (DOE's preferred alternative) is selected, further consultations would be required. In response to the SHPO's concerns about cultural resources present near the F-Area, additional surveys were performed. Investigations identified archaeological sites near this portion of F-Area that have been recommended to the South Carolina SHPO as eligible for nomination to the National Register. DOE currently plans to mitigate impact by avoiding these sites.

In the event that potential archaeological and historic materials are discovered during construction and operation, another consultation process will be initiated. Each DOE site considered in this SPD EIS has plans and procedures that address inadvertent discoveries of cultural material. In each case, the ground-disturbing activities would be immediately suspended upon recognition of human remains or potential archaeological and historical materials. DOE would be notified and qualified cultural resource specialists would evaluate the materials to identify and determine their potential archaeological and historical value under 36 CFR 800. If the materials are determined to be potentially eligible for nomination to the National Register of Historic places, DOE would immediately initiate an expedited formal consultation process with the appropriate SHPO, as appropriate under the programmatic agreement. Based on the results of the consultations, DOE would take appropriate action to ensure mitigation of any adverse effects to resources determined eligible for the National Register of Historic Places.

5.3.3 Endangered Species Act Consultation

Upon publication of the SPD Draft EIS, DOE conducted consultations with the appropriate regional and field offices of the U.S. Department of the Interior, Fish and Wildlife Service (USFWS) and the equivalent State agencies. The consultations were conducted to solicit input on the potential for impacts on ecological resources, especially Federal threatened, endangered, and other species of concern or their critical habitat and/or State-protected species. These consultations were conducted in accordance with Sections 7(a)-(d) of the Endangered Species Act of 1973 (16 USC Sections 1536(a)-(d)) and its implementing regulations under 50 CFR 402, *Interagency Cooperation-Endangered Species Act of 1973, As Amended*, and relevant State statutes and regulations (see Table 5–1).

The consultation process was initiated by DOE through formal letters that identified the potential actions at each DOE site and was accompanied by a copy of the SPD Draft EIS. Each letter also summarized the preliminary analysis of the potential impacts on ecological resources at each site, including any known Federal- or State-listed species with the potential for occurrence. As shown in Table 5–2, letters were sent to each respective USFWS regional or field office with primary jurisdiction over the four DOE surplus plutonium disposition candidate sites. The letters requested that the USFWS offices provide any available information on Federal threatened and endangered animal and plant species (listed or proposed) and their habitats in the vicinity of the specific project areas. Each office was also asked to identify any other issues or concerns that should be considered in this SPD EIS. A similar written request for comment was also sent to each equivalent State agency including: the Washington Department of Fish and Wildlife, Department of Ecology; Idaho Department of Fish and Game,

Conservation Data Center; Texas Parks and Wildlife Department; and the South Carolina Department of Natural Resources, Lower Coastal Wildlife Diversity.

Of the four consultations initiated with the USFWS, three of the offices provided written responses, with the resulting information considered in the preparation of this SPD Final EIS. Additional species information was provided by the USFWS Moses Lake, Washington, and Charleston, South Carolina offices. The USFWS Charleston office also indicated in its response that the proposed facilities at SRS do not appear to present a substantial risk to federally protected ecological resources and that DOE has satisfied its obligations under Section 7 of the *Endangered Species Act.* The USFWS Boise, Idaho, office indicated that the information provided in the SPD Draft EIS was accurate. In the absence of receipt of a written response, telephone communication was initiated with the USFWS office in Arlington, Texas, with officials indicating that the office had no additional information to provide or comment on the SPD Draft EIS.

Three of the four State agencies contacted also provided written responses, with one agency (i.e., South Carolina Department of Natural Resources) verbally responding that it had no additional information to provide or other comment on the SPD Draft EIS. Additional information was provided by the Washington State Department of Fish and Wildlife and the Idaho Department of Fish and Game, which was considered in development of this SPD Final EIS.

Prior to any project implementation activities at any site, additional consultations with Federal and State agencies would be conducted, as appropriate. Additionally, site-specific surveys and assessments would be conducted, as necessary, to determine the potential for impacts to protected or other sensitive animal and plant species and sensitive habitats and to identify any required mitigation measures.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders

Statute, Regulation, Executive Order	Citation	Potential Requirements
	Air Quality and Noise	
Clean Air Act of 1970 (CAA)	42 USC 7401 et seq.	Requires sources to meet standards and obtain permits to satisfy: National Ambient Air Quality Standards (NAAQS), State implementation plans, Standards of Performance for New Stationary Sources, National Emission Standards for Hazardous Air Pollutants, and Prevention of Significant Deterioration (PSD). Public radiological dose limits for DOE facilities are outlined in 40 CFR 61.92, under the authority of this act.
National Ambient Air Quality Standards	42 USC 7409; 40 CFR 50	Establishes primary and secondary ambient air quality standards governing carbon monoxide, lead, nitrogen dioxide, ozone, sodium dioxide, and particulate matter with an aerodynamic diameter less than or equal to 10 microns.
Standards of Performance for New Stationary Sources	42 USC 7411; 40 CFR 60	Establishes control/emission standards and recordkeeping requirements for new or modified sources specifically addressed by a standard.
National Emission Standards for Hazardous Air Pollutants	42 USC 7412; 40 CFR 61, 63	Establishes emission levels for carcinogenic or mutagenic pollutants or operation requirements; may require a preconstruction approval, depending on the process being considered and the level of emissions that will result from the new or modified source.
Prevention of Significant Deterioration	42 USC 7470 et seq.; 40 CFR 51.166	Establishes requirements for the State implementation plans for PSD programs. Applies to areas that are in compliance with NAAQS. Requires comprehensive preconstruction review and the application of Best Available Control Technology to major stationary sources (emissions of 100 tons per year [tons/yr]) and major modifications; requires a preconstruction review of air quality impacts and the issuance of a construction permit from the responsible State agency setting forth emission limitations to protect the PSD increment.
Determining conformity of Federal actions to State or Federal implementation plans	40 CFR 93	Requires Federal facilities to demonstrate compliance with State or Federal implementation plans for applicable actions in nonattainment areas.
Executive Order 12843, Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances	April 21, 1993	Requires Federal agencies to minimize procurement of ozone-depleting substances and conform their practices to comply with Title VI of CAA Amendments regarding stratospheric ozone protection and to recognize the increasingly limited availability of Class I substances until final phaseout.
Noise Control Act of 1972	42 USC 4901 et seq.	Requires facilities to maintain noise levels that do not jeopardize the health and safety of the public.
	Water Resources	
Clean Water Act (CWA)	33 USC 1251 et seq.	Requires U.S. Environmental Protection Agency (EPA)- or State-issued permits and compliance with provisions of permits regarding discharge of effluents to waters of the United States.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
Water Resources (Continued)		
National Pollutant Discharge Elimination System	33 USC 1342	Requires permit to discharge effluents (pollutants) and storm water to waters of the United States; permit modifications are required if discharge effluents are altered.
Wild and Scenic Rivers Act of 1968	16 USC 1271 et seq.	Requires consultation before construction of any new Federal project associated with a river designated as wild and scenic or under study in order to minimize and mitigate any adverse effects on the physical and biological properties of the river.
Safe Drinking Water Act of 1974	42 USC 300f et seq.; 40 CFR 141	Requires certification of any plant water treatment facility constructed on a site to ensure that the quality of public drinking water is protected and that maximum radioactive contaminant levels do not exceed 4 mrem dose equivalents.
Executive Order 11990, Protection of Wetlands	May 24, 1977	Requires Federal agencies to avoid the long- and short-term adverse impacts associated with the destruction or modification of wetlands.
Executive Order 11988, Floodplain Management	May 29, 1977	Directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts be avoided to the extent practical. Requires consultation if project impacts a floodplain.
Compliance with Floodplain/ Wetlands Environmental Review Requirements	10 CFR 1022	DOE's floodplain and wetlands environmental review requirements.
Civilian Use of Nuclear Materials		
Standards for Protection Against Radiation	10 CFR 20	Establishes standards for protection against ionizing radiation resulting from activities conducted by NRC licensees for both radiation workers and the public.
Domestic Licensing of Production and Utilization Facilities	10 CFR 50	Provides for the licensing of production and utilization facilities, which includes commercial nuclear power reactors. This part describes in detail the information needed to support an operational license application, a license amendment request, design criteria, enforcement actions, and other specifics of the licensing process.
Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions	10 CFR 51	Implements NRC's NEPA requirements.
Domestic Licensing of Special Nuclear Material	10 CFR 70	Establishes procedures and criteria for issuance of licenses to receive title to, own, possess, use, and initially transfer special nuclear material; and establishes and provides for the terms and conditions upon which NRC will issue such licenses.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
	Waste Management and Pollution Prevention	
Resource Conservation and Recovery Act; Hazardous and Solid Waste Amendments of 1984 (RCRA)	42 USC 6901 et seq.	Requires notification and permits for operations involving hazardous waste treatment, storage, or disposal facilities; changes to site hazardous waste operations could require amendments to RCRA hazardous waste permits involving public hearings.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA); Superfund Amendments and Reauthorization Act of 1986	42 USC 9601 et seq.	Requires cleanup and notification if there is a release or threatened release of a hazardous substance; requires DOE to enter into Interagency Agreements with EPA and State to control the cleanup of each DOE site on the National Priorities List.
Nuclear Waste Policy Act of 1982	42 USC 10101 et seq.	Establishes a schedule for the siting, construction, and operation of a geologic repository that will provide a reasonable assurance that the public and the environment will be protected from the hazards posed by disposal of high-level radioactive waste (HLW) and spent nuclear fuel; establishes Federal responsibility and a Federal policy for the disposal of HLW and spent nuclear fuel; defines the relationship between Federal and State governments with respect to the disposal of HLW and spent nuclear fuel; and establishes a Nuclear Waste Fund.
Pollution Prevention Act of 1990	42 USC 13101 et seq.	Establishes a national policy that pollution should be reduced at the source and requires a toxic chemical source reduction and recycling report for an owner or operator of a facility required to file an annual toxic chemical release form under Section 313 of the Superfund Amendments and Reauthorization Act.
Toxic Substances Control Act of 1976 (TSCA)	15 USC 2601 et seq.	Requires compliance with inventory reporting and chemical control provisions of TSCA to protect the public from the risks of exposure to chemicals; TSCA imposes strict limitations on use and disposal of equipment contaminated with polychlorinated biphenyls.
Federal Facility Compliance Act of 1992	42 USC 6961	Waives sovereign immunity for Federal facilities under RCRA and requires DOE to develop plans and enter into agreements with States as to specific management actions for specific mixed waste streams.
Executive Order 12088, Federal Compliance with Pollution Control Standards	October 13, 1978	Requires Federal agency landlords to submit to the Office of Management and Budget an annual plan for the control of environmental pollution and to consult with EPA and State agencies regarding the best techniques and methods.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
Waste Management and Pollution Prevention (Continued)		
Executive Order 12856, Federal Compliance with Right-To-Know Laws and Pollution Prevention Requirements	August 3, 1993	Requires Federal agencies to achieve 50 percent reduction of agency's total releases of toxic chemicals to the environment and offsite transfers, to prepare a written facility pollution prevention plan not later than 1995, and to publicly report toxic chemicals entering any waste stream from Federal facilities, including any releases to the environment, and to improve local emergency planning, response and accident notification.
[Text deleted.]		
Executive Order 12580, Superfund Implementation	January 23, 1987	Delegates to the heads of Executive departments and agencies the responsibility for undertaking remedial actions for releases, or threatened releases, that are not on the National Priorities List and removal actions other than emergencies where the release is from any facility under the jurisdiction or control of Executive departments and agencies.
Biotic Resources		
Fish and Wildlife Coordination Act	16 USC 661 et seq.	Requires consultation on the possible effects on wildlife of construction, modification, or control of bodies of water in excess of 10 acres in surface area.
Bald and Golden Eagle Protection Act of 1972	16 USC 668 et seq.	Requires consultations to determine if any protected birds are found to inhabit the area. If so, must obtain a permit prior to moving any nests due to construction or operation of disposition facilities.
Migratory Bird Treaty Act of 1918	16 USC 703 et seq.	Requires consultation to determine if there are any impacts on migrating bird populations due to construction or operation of disposition facilities. If so, must develop mitigation measures to avoid adverse effects.
Anadromous Fish Conservation Act of 1965	16 USC 757	Requires consultation to determine if there are any impacts on anadromous fish that spawn in fresh water or estuaries and migrate to ocean waters and on anadromous fishery resources that are subject to depletion from water resource development.
Wilderness Act of 1964	16 USC 1131 et seq.	Requires consultation with the Department of Commerce and the Department of Interior to minimize impacts.
Wild Free-Roaming Horses and Burros Act of 1971	16 USC 1331 et seq.	Requires consultation with the Department of Interior to minimize impacts.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
	Biotic Resources (Continued)	
Endangered Species Act of 1973	16 USC 1531 et seq.	Requires consultation to identify endangered or threatened species and their habitats, assess impacts thereon, obtain biological opinions and, if necessary, develop mitigation measures to reduce or eliminate adverse effects of construction or operation.
	Cultural Resources	
Antiquities Act of 1906	16 USC 431 et seq.	Requires protection of historic, prehistoric, and paleontological objects in federal lands from appropriation, excavation, injury, and destruction without permission.
DOE American Indian Tribal Government Policy	DOE Order 1230.2	Establishes government-to-government protocols for DOE interactions with tribal governments.
National Historic Preservation Act of 1966	16 USC 470 et seq.	Requires consultation with the State Historic Preservation Office prior to undertaking construction to ensure that no historical resources will be affected.
Archaeological and Historical Preservation Act of 1974	16 USC 469	Requires obtaining authorization for any disturbance of archaeological resources.
Archaeological Resources Protection Act of 1979	16 USC 470aa et seq.	Requires obtaining authorization for any excavation or removal of archaeological resources.
American Indian Religious Freedom Act of 1978	42 USC 1996 et seq.	Requires consultation with local Native American tribes to ensure that their religious customs, traditions, and freedoms are preserved.
Native American Graves Protection and Repatriation Act of 1990	25 USC 3001 et seq.	Requires repatriation of cultural items to Native Americans.
Executive Order 13007, Indian Sacred Sites	May 24, 1996	Requires the protection and preservation of Native American religious practices.
Executive Order 11593, Protection and Enhancement of the Cultural Environment	May 13, 1971	Requires the preservation of historic and archaeological data that may be lost during construction activities.
	Worker Safety and Health	
Occupational Safety and Health Act of 1970	5 USC 5108 et seq.	Requires compliance with all applicable worker safety and health regulations.
Hazard Communication	29 CFR 1910.1200	Ensures that workers are informed of, and trained to handle, all chemical hazards in the workplace.
	Transportation	
Transportation regulations	49 CFR 171, 172, 173, 174, 176, 177, 178, 397	Establishes standards for materials transportation including: packaging, marking and labeling, placarding, monitoring, routes, accident reporting, and manifesting. Includes requirements for transport by rail, air, and public highway.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
Transportation (Continued)		
Packaging and Transportation of Radioactive Materials	10 CFR 71	Establishes requirements for packaging, preparation for shipment, and transportation of licensed radioactive material, and standards for approval of packaging and shipping procedures for fissile material and for a quantity of other licensed material in excess of a Type A quantity. This part establishes the certification process, including the required documentation for and testing of shipping containers, and quality assurance program that must be in place for vendors and users of approved shipping containers.
Hazardous Materials Transportation Act of 1974	49 USC 1801 et seq.	Requires compliance with hazardous materials and waste transportation requirements.
[Text deleted.]		
Regulations of the International Atomic Energy Agency	IAEA Safety Series 6	Establishes standards for radioactive materials transportation.
International Maritime Organization Regulations	International Maritime Dangerous Goods Code, 1994	Requires segregation of radioactive materials packages from other dangerous goods and other aspects of stowage.
Other		
Atomic Energy Act of 1954	42 USC 2011 et seq.	Authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE's jurisdiction.
Price Anderson Act	42 USC 2210	Allows DOE to indemnify its contractors if the contract involves the risk of public liability from a nuclear incident.
Department of Energy Orders	Parts 100–500	Establishes standards and requirements to ensure safe operation of facilities.
National Environmental Policy Act (NEPA)	42 USC 4321 et seq.	Requires Federal agency to prepare an environmental impact statement for any major Federal action with significant environmental impact.
NEPA Implementing Procedures	10 CFR 1021	Requires DOE to follow its own implementing regulations to ensure environmental quality.
Emergency Planning and Community Right-To-Know Act of 1986	42 USC 11001 et seq.	Requires the development of emergency response plans and reporting requirements for chemical spills and other emergency releases, and imposes right-to-know reporting requirements covering storage and use of chemicals that are reported on toxic chemical release forms.
Executive Order 11514, Protection and Enhancement of Environmental Quality	March 6, 1970	Requires Federal agencies to demonstrate leadership in achieving the environmental quality goals of NEPA; provides for DOE consultation with appropriate Federal, State, and local agencies in carrying out their activities as they affect the environment.

Table 5–1. Federal Environmental Statutes, Regulations, and Executive Orders (Continued)

Statute, Regulation, Executive Order	Citation	Potential Requirements
	Other (Continued)	
Farmland Protection Policy Act of 1981	7 USC 4201 et seq.	Requires avoidance of any adverse effects to prime and unique farmlands.
Executive Order 12114, Environmental Effects Abroad of Major Federal Actions	January 4, 1979	Requires officials of Federal agencies having ultimate responsibility for authorizing and approving actions encompassed by this order to be informed of pertinent environmental considerations and to take such considerations into account, along with other pertinent considerations of national policy, in making decisions regarding such actions. While based on independent authority, this order furthers the purpose of NEPA.
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations	February 11, 1994	Requires Federal agencies to identify and address as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.
Executive Order 12656, Assignment of Emergency Preparedness Responsibilities	November 18, 1988	Assigns emergency preparedness responsibilities to Federal departments and agencies.

Table 5–2. Summary of Consultations Initiated by DOE

DOE Site	Subject	DOE Consultation Letter		Agency/Group Response	
		Addressed To (Date of Letter)	Page No.	From (Date of Response or Last Contact)	Page No.
Hanford	Cultural Resources	Mr. David Hansen State Historic Preservation Officer (October 30, 1998)	O–2	Mr. Robert Whitlam (March 2, 1999)	NA[a]
	Native American	Mr. Russell Jim Confederated Tribes and Bands of the Yakima Indian Nation (October 30, 1998)	O–4	Ms. Nancy Peters (March 5, 1999)	NA[b]
	Native American	Ms. Donna L. Powaukee Nez Perce Tribe (October 30, 1998)	O–6	Mr. Pat Sobotta (March 2, 1999)	NA[b]
	Native American	Ms. Lenora Seelatsee Wanapum Band (October 30, 1998)	O–8	Ms. Lenora Seelatsee (March 5, 1999)	NA[b]
	Native American	Mr. J.R. Wilkinson Confederated Tribes of the Umatilla Indian Reservation (October 30, 1998)	O–10	Mr. J.R. Wilkinson (March 2, 1999)	NA[b]
	EcologicalR esources	Mr. Richard Roy U.S. Fish and Wildlife Service (July 28, 1998)	O–12	Mr. Richard Roy (December 3, 1998)	O–14
	EcologicalR esources	Mr. Jay McConnaughey Washington Department of Fish and Wildlife (July 28, 1998)	O–16	Mr. Jay McConnaughey (December 7, 1998)	O–18
INEEL	Cultural Resources	Mr. Robert Yohe State Historic Preservation Officer (October 30, 1998)	O–21	Mr. Robert Yohe (March 2, 1999)	NA[a]
	Native American	Mr. Keith Tinno Fort Hall Reservation (October 30, 1998)	O–23	Mr. Jim Reed (March 2, 1999)	NA[b]
	EcologicalR esources	Ms. Susan Burch U.S. Fish and Wildlife Service (July 28, 1998)	O–25	Mr. Robert Kuesink (August 18, 1998)	O–27
	EcologicalR esources	Mr. George Stephens Idaho Department of Fish and Game (July 28, 1998)	O–29	Mr. George Stephens (August 12, 1998 and February 12, 1999)	O–31 O–32
Pantex	Native American	Mr. Virgil Franklin Sr. Cheyenne-Arapaho Tribe of Oklahoma (October 30, 1998)	O–33	Mr. Gordon Yellowman (March 2, 1999)	NA[b]
	Native American	Mr. Billy Evans Horse Kiowa Tribe of Oklahoma (October 30, 1998)	O–35	Mr. William Hensley (March 2, 1999)	NA[b]
	Native American	Mr. D.J. Mowatt Apache Tribe of Oklahoma (October 30, 1998)	O–37	Mr. D.J. Mowatt (March 2, 1999)	NA[b]
	Native American	Mr. Don Wauahdooah Comanche Tribe of Oklahoma (October 30, 1998)	O–39	Ms. Phyllis Attocknie (March 2, 1999)	NA[b]
	EcologicalR esources	Mr. Robert Short U.S. Fish and Wildlife Service (July 28, 1998)	O–41	Agency office had no comment based on personal communication with Mr. Clayton Napier (December 2, 1998)	NA[a]
	EcologicalR esources	Mr. Pat Martin Texas Parks and Wildlife Department (July 28, 1998)	O–43	Ms. Shannon Breslin (March 22, 1999)	O–45

Table 5–2. Summary of Consultations Initiated by DOE (Continued)

DOE Site	Subject	DOE Consultation Letter		Agency/Group Response	
		Addressed To (Date of Letter)	Page No.	From (Date of Response or Last Contact)	Page No.
SRS	Cultural Resources	Dr. Rodger Stroup State Historic Preservation Officer (October 30, 1998)	O–46	Ms. Nancy Brock (November 12, 1998)	O–48
	Native American	Mr. Tom Berryhill National Council of the Muskogee Creek (October 30, 1998)	O–49	Mr. Ken Childers (March 2, 1999)	NA[b]
	Native American	Ms. Nancy Carnley Ma Chis Lower Alabama Creek Indian Tribe (October 30, 1998)	O–51	Ms. Nancy Carnley (March 2, 1999)	NA[b]
	Native American	Miko Tony Hill Indian People's Muskogee Tribal Town Confederacy (October 30, 1998)	O–53	Miko Tony Hill (March 2, 1999)	NA[b]
	Native American	Ms. Virginia Montoya Pee Dee Indian Association (October 30, 1998)	O–55	Ms. Virginia Montoya (March 2, 1999)	NA[b]
	Native American	Mr. Al Rolland Yuchi Tribal Organization, Inc. (October 30, 1998)	O–57	Mr. Al Rolland (March 2, 1999)	NA[b]
	Native American	Mr. John Ross United Keetoowah Band (October 30, 1998)	O–59	Ms. Julie Moss (March 2, 1999)	NA[b]
	EcologicalR esources	Mr. Roger Banks U.S. Fish and Wildlife Service (July 28, 1998)	O–61	Mr. Edwin EuDaly (September 8, 1998)	O–63
	EcologicalR esources	Mr. Tom Murphy South Carolina Department of Natural Resources	O–67	Agency office had no comment based on personal communication with Mr. Tom Murphy (December 2, 1998)	NA[a]

[a] No written response was received. Response obtained via telephone conversation.
[b] No response was received.

Chapter 6
Glossary

acute Extremely severe or intense for a limited time.

air pollutant Any substance borne through the air that can, in high enough concentrations, harm man, other animals, vegetation, or material.

Air Quality Control Region An area designated by a State or the U.S. Environmental Protection Agency for the attainment and maintenance of National Ambient Air Quality Standards.

ALARA See *as low as is reasonably achievable.*

alternative With reference to surplus plutonium disposition, a discrete sequence of disposition actions carried out in a dedicated group of facilities.

ambient air The atmosphere around people, plants, and structures.

Ambient Air Quality Standards Regulations prescribing the levels of airborne pollutants that may not be exceeded during a specified time in a defined area.

American Indian Religious Freedom Act of 1978 An act that protects and preserves for Native Americans their traditional religious rights, including the rights of access to religious sites, use and possession of sacred objects, and worship through traditional ceremonies and rites.

anadromous Migrating from salt water to fresh water to spawn.

Anadromous Fish Conservation Act An act seeking to enhance conservation and development of the anadromous fishery resources of the United States that are subject to depletion from water resources development.

aqueous process An operation involving chemicals dissolved in water.

aquifer A saturated geologic unit through which significant quantities of water can migrate under natural hydraulic gradients.

aquitard A less-permeable geologic unit in a stratigraphic sequence. Aquitards separate aquifers.

Archaeological Resources Protection Act of 1979 An act protecting cultural resources on federally owned lands. This act requires a permit for archaeological excavations or the removal of any archaeological resources on public or Native American lands. It also prohibits interstate or foreign trafficking in cultural resources taken in violation of State or local laws, and requires Federal agencies to develop plans for surveying lands under their control.

archaeological site Any location where humans have altered the terrain or discarded artifacts during prehistoric or historic times.

artifact An object produced or shaped by human beings and of archaeological or historical interest.

as low as is reasonably achievable An approach to radiation management and control by which exposures (individual and collective) of the workforce and the general public and releases of radioactive material to the environment are kept at levels as low as reasonable, taking into account social, technical, economic, practical, and public policy considerations.

Atomic Energy Act of 1954 An act setting up "... a program for Government control of the possession, use, and production of atomic energy and special nuclear material whether owned by the Government or others, so directed as to make the maximum contribution to the common defense and security and the national welfare, and to provide continued assurance of the Government's ability to enter into and enforce agreements with nations or groups of nations for the control of special nuclear materials and atomic weapons. . . ." (Section 3(c)).

attainment area An area considered to have air quality as good as or better than the National Ambient Air Quality Standards for a given pollutant. An area may be in attainment for one pollutant and nonattaining for others. See also *nonattainment area.*

background radiation Ionizing radiation present in the environment emanating from cosmic rays and natural sources in the Earth. Such radiation varies considerably with location.

badged (worker) A worker susceptible to exposure to radiation and thus equipped with an individual dosimeter.

Bald and Golden Eagle Protection Act An act making it unlawful to take, pursue, molest, or disturb the American bald eagle and golden eagle, their nests, or their eggs, anywhere in the United States.

basalt The most common volcanic rock, dark-gray to black in color, high in iron and magnesium, and low in silica. It is typically found in lava flows.

baseline A quantitative expression of conditions, costs, schedule, or technical progress that constitutes the standard against which to measure the performance of an effort.

basin Geologically, a circular or elliptical downwarp in whose center younger beds occur; topographically, a depression into which water from the surrounding area drains.

BEIR V A designation for the fifth in a series of committee reports from the National Research Council's Committee on the Biological Effects of Ionizing Radiation.

benthic Dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

beyond-design-basis accident An accident generally with more severe impacts on onsite personnel and the public than a design basis accident, and an estimated probability of occurrence of less than 10^{-6} per year. This accident is used for estimating the impacts of a facility or process. See also *design basis accident.*

boiling water reactor A type of nuclear reactor in which fission heat is used to generate steam in the reactor to drive turbines and generate electricity.

calcareous Containing calcium carbonate (as, for example, calcite or limestone).

cancer The name given to a group of diseases characterized by uncontrolled cellular growth, with the cells having invasive characteristics such that the disease can be transferred from one organ to another.

Canadian Deuterium Uranium Reactor A Canadian nuclear reactor in which circulating heavy water (deuterium-rich water) is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions.

can-in-canister An approach to plutonium immobilization wherein cans of either ceramic or glass forms containing plutonium are encapsulated within canisters of high-level-waste glass.

canyon A remotely operated, heavily shielded plutonium- or uranium-processing facility. A deep, steep-sided valley.

capable fault As defined in 10 CFR 100, Appendix A, III (g), "a fault which has exhibited one or more of the following characteristics: (1) movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature

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Chapter 8
Distribution List

The U.S. Department of Energy is providing copies of the *Surplus Plutonium Disposition Final Environmental Impact Statement* to Federal, State, and local elected and appointed government officials and agencies; Native American groups; and other organizations and individuals listed below. Copies will be distributed in bulk to some individuals and organizations for further distribution (e.g., the State single points of contact for the National Environmental Policy Act [NEPA]). Copies will be provided to other organizations and individuals on request.

ELECTED OFFICIALS

Federal Elected Officials

- Senators and Representatives from the States of California, Georgia, Idaho, New Mexico, North Carolina, Oregon, South Carolina, Tennessee, Texas, Virginia, and Washington
- Congressional Committees:
  - Senate: Committee on Appropriations, Committee on Armed Services, and Energy and Natural Resources Committee
  - House of Representatives: Committee on Appropriations and Committee on National Security

State Elected Officials

- Governors from the States of California, Georgia, Idaho, New Mexico, North Carolina, Oregon, South Carolina, Tennessee, Texas, Virginia, and Washington
- State Senators and Representatives from the States of California, Georgia, Idaho, New Mexico, North Carolina, Oregon, South Carolina, Tennessee, Texas, Virginia, and Washington

Local Elected Officials

- Mayors, council members, etc., from areas near the Catawba Nuclear Station, Hanford Site, Idaho National Engineering and Environmental Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, McGuire Nuclear Station, North Anna Power Station, Oak Ridge National Laboratory, Pantex Plant, and Savannah

River
Site

APPOINTED OFFICIALS

Federal Appointed Officials

- Agencies that are members of the Interagency Working Group for Plutonium Disposition—Arms Control and Disarmament Agency, Central Intelligence Agency, Council on Environmental Quality, Defense Nuclear Facilities Safety Board, Department of Defense, National Security Council, Nuclear Regulatory Commission, Office of Management and Budget, State Department, and Environmental Protection Agency

- Other Federal agencies including: General Accounting Office, National Academy of Sciences, National Oceanic and Atmospheric Administration, National Science Foundation, U.S. Bureau of Indian Affairs, and U.S. National Park Service

State Appointed Officials

- NEPA single points of contact for the States of California, Georgia, Idaho, New Mexico, North Carolina, Oregon, South Carolina, Tennessee, Texas, Virginia, and Washington

- State agencies including: Commonwealth of Virginia, Office of Attorney General; Georgia Emergency Management Agency; South Carolina Nuclear Waste Program; Southern States Energy Board; State of Idaho's Idaho National Engineering and Environmental Laboratory Oversight Program; State of Texas' Division of Emergency Management; State of Texas' Office of the Attorney General; Texas Natural Resources Conservation Commission; State of Texas' Department of Health; State of Washington's Department of Ecology; State of Washington's Energy Office; Tennessee Department of Environment and Conservation/DOE

  Oversight Division; Virginia Department of Health, State Commissioner; Virginia State Corporation Commission, Division of Energy Regulation; and U.S. Nuclear Regulatory Commission, Region 2

NATIVE AMERICAN GROUPS

Federally recognized Native American tribes from the States of California, Georgia, Idaho, New Mexico, North Carolina, Oregon, South Carolina, Tennessee, Texas, Virginia, and Washington

DEPARTMENT OF ENERGY

Department of Energy Reading Rooms in the States of California, Idaho, New Mexico, North Carolina, Oregon, South Carolina, Tennessee, Texas, Virginia, Washington, and the District of Columbia

ORGANIZATIONS AND INDIVIDUALS

Organizations and individuals who have requested copies of the *Surplus Plutonium Disposition Final Environmental Impact Statement*

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